

TECHNICAL SPECIFICATIONS

Magna Regional Park

Salt Lake County Parks and Recreation



CONSTRUCTION DOCUMENT CONFORMED SET

July 22, 2019

G.B.D

G. BROWN : DESIGN INC
SITE AND LANDSCAPE ARCHITECTS

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NOTE: Contractor shall reference the APWA 2017 Manual of Standard Specifications for all specification sections denoted with (APWA) following the section name. The Contractor is responsible for obtaining the most current version of the reference specification and standard drawings and details. Plan set shall supersede any specifications if they are noted. 2017 APWA Standard Plans and Specifications are available for purchase in hard copy or electronic format at the following web address: <http://utah.apwa.net/>

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SECTION 010000 - GENERAL REQUIREMENTS

PART 1 – GENERAL

1.1 Related Documents

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Sections, shall apply to all work stated in this and subsequent sections.
- B. Separation of the specifications into divisions and sections is for convenience only and is not intended to establish limits of work.
- C. The Specifications (divisions/sections) and Drawings are complimentary, and what is called for by any one shall be as binding as if called for by all. Anything not expressly set forth in either, but which is reasonably implied, shall be furnished and performed the same as if it were both shown and mentioned. It is the intention of the documents to include all labor and materials, equipment, and transportation necessary to complete the work shown or indicated by the drawings or called for in the specifications, in accordance with the best practices prevailing for the work of the various kinds. Materials or work described in words or those which are implied and having a well known trade or technical meaning, shall be held to refer to such recognized standards.

1.2 Definitions

- A. County Representative shall be the:
Parks and Recreation Division
PLANNING/DEVELOPMENT SECTION
2001 South State St., #S4 700/ Salt Lake City, Utah 84114-4575
Contact: Dustin Wiberg
(385) 468-1817
 1. The person designated by Parks & Recreation Division to act in its behalf shall have authority to transmit instructions, receive information, interpret and define policy and decisions, with respect to materials, equipment, elements and systems pertinent to proper execution of the work and hereafter be known as the Project Manager. Any deviation from the specifications and requirements of the contract must be authorized by the County Representative. In the event the Contractor deviates without approval from County Representative, such deviation will be at the risk of the Contractor and any cost related thereto will be borne by the Contractor
- B. The County's Technical/Design Representative shall be:
Andrew Noorlander
G Brown Design, Inc.
610 East South Temple Street, Suite #50
Salt Lake City, UT 84102
(801) 575-6066
 1. The above representative or person designated by that company to act in its behalf and shall have authority to transmit instructions, receive information, interpret and define decisions to ensure compliance with contract requirements insofar as the work is concerned, and advising the County Representative of any contract issues. The Technical/Design Representative cannot authorize deviations from specifications and requirements of this contract. In the event the Contractor deviates without approval from County Representative, such deviation will be at

the risk of the Contractor and any cost related thereto will be borne by the Contractor.

1.3 Procedures

- A. This Contractor shall provide all items, materials, operations and methods including all labor, equipment and incidentals necessary for the successful completion of the project.
- B. This Contractor shall be duly licensed for the work involved and shall secure all building permits and certificates, and obtain all inspections as might be required for the proper prosecution of the work.
- C. This Contractor shall visit the site prior to submitting a bid to adequately determine the scope, intent and requirements of the project and its satisfactory completion.

1.4 Quality Assurance

- A. A Pre-Construction conference will be held before the start of any work, with the Contractor and authorized representatives of the County, to review the drawings, specifications, and applicable requirements pertaining to the work and to establish mutual understanding of procedures and precautions related to the proper prosecution of the work.
 - 1. This conference will be managed by the Salt Lake County Parks and Recreation Division; PLANNING/DEVELOPMENT SECTION
- B. The apparent low bidding contractor shall submit, using the County Sub-Contractor Form, a written list of all sub-contractors they propose to use in the work within 24 hours of request.
 - 1. The County reserves the right to reject any or all sub-contractors who have previously performed unsatisfactorily for the county or who do not meet the requirements specified in other sections of these specifications.

1.5 Notice to Proceed

- A. The County will issue the Contractor a "Notice to Proceed" for the contracted work after the pre-construction conference and when all requirements of the County with respect to contract administration, have been satisfied. The notice to proceed date will be that date agreed upon by the County and the Contractor as to when the work on the site will actually begin.

The Contractor shall then be charged in time for each successive calendar day from that date until the work is complete.

- 1. Any work done prior to the Notice to Proceed, shall be at Contractor's risk.
- B. The County will issue the Contractor a "Stop Work Order" should winter weather prohibit completion of the contracted work this year. The County will issue the Contractor a "Resume Work Order" for the remaining work to be completed next year when the weather allows the work to proceed.
 - 1. Any work done after the "Stop Work Order" is issued and before the "Resume Work Order" is issued, shall be at Contractor's risk.

1.6 Liquidated Damages

- A. Should the Contractor fail to complete the work within the time stated in the Agreement (from the date of Notice to Proceed) or within such additional time as may have been allowed by extension, there shall be deducted from any monies due, or that may become due, the Contractor shall pay the amount stipulated.

- 1.7 Payment Procedures
- A. Application for Payment shall be consistent with previous applications and payments as certified by Project Manager and paid for by County.
 - B. Payment Application Forms:
 - 1. Submit one Application for Payment provided by the County. Each application must be signed by CONTRACTOR.
 - 2. Use AIA Document G702 and AIA Document G703 continuation Sheets as form of Applications for Payment.
 - C. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of the Contractor. Project Manager will return incomplete applications without action.
 - 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 - 2. Include amounts of Change Orders issued before last day of construction period covered by the application
 - D. Submit an updated progress schedule with each Application for Payment.
 - E. When Project Manager requires substantiating information, submit data.
 - F. Schedule of Values Form: Use AIA Form G703 - Application and Certificate for Payment Continuation Sheet and AIA G723 – Project Application Summary, or EJCDC Form 1910-8-E, or CONTRACTOR's standard form, or electronic media printout following one of the above standard forms. Follow the outline presented in the Bid Form. For each item, provide a column (or row) for listing each of the following:
 - 1. Item number.
 - 2. Description of work.
 - 3. Scheduled values.
 - 4. Previous applications.
 - 5. Work in plan and stored materials under this application.
 - 6. Authorized Change Orders.
 - 7. Total completed and stored to date of application.
 - 8. Percentage of completion.
 - 9. Balance to finish.
 - 10. Retainage.
 - 11. Overhead and profit.
 - G. Submission Schedule: Comply with the time requirement of Paragraph 2.5B of the General Conditions when submitting the Schedule of Values. (Within 10 Days after the Effective Date of the Construction Contract.)
 - H. Revisions: Revise schedule of values to list approved Change Orders, with each Application for Payment.
- 1.8 Submittals
- A. Submittal Procedure
 - 1. Review submittals prior to transmittal. Determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.
 - 2. Coordinate submittals with requirements of Work and of Contract Documents.
 - 3. Sign or initial each sheet of shop drawings and product data, and each sample label to certify compliance with requirements of Contract Documents. Notify ENGINEER in writing at time of submittal, of any deviations from requirements of Contract Documents.
 - 4. Do not fabricate products or begin work that requires submittals until return of submittal with Project Manager acceptance.
 - 5. Transmit submittals to Project Manager under transmittal form. Submit the

- number of copies that Project Manager requires, plus the number of copies required by Project Manager.
 6. Comply with submittal sequences shown in the progress schedule.
 7. When required by Laws and Regulations, affix licensed professional's stamp to submittal documents.
 8. Identify pertinent Drawing sheet and detail number, and Specification section number.
 9. Identify deviations from Contract Documents.
 10. Identify the date when Project Manager must complete review of submittal.
 11. Provide space for CONTRACTOR and Project Manager review stamps.
 12. After Project Manager's review of submittal, revise and resubmit as required, identifying changes made since previous submittal.
 13. Distribute copies of reviewed submittals to concerned persons. Instruct recipients to promptly report any inability to comply with provisions.
- B. Shop Drawings
1. Present drawings in a clear and thorough manner. Title each drawing with Project name and number. Identify each element of drawings by reference to sheet number and detail or equipment schedule.
 2. Identify field dimensions. Show relation to adjacent or critical features or work or products.
 3. Provide sheet size adequate for Project Manager's review.
- C. Product Data
1. Submit only pages which are pertinent. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number. Show reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions, And required clearances.
 2. Modify product data by deleting information that is not applicable to the Work or by marking each copy to identify pertinent data.
 3. Supplement standard information, if necessary, to provide additional information applicable to the Work.
 4. Provide manufacturer's preparation, assembly and installation instructions.
- D. Samples
1. Submit 1 of each sample required by Contract Documents. Samples shall show the quality, type, range of color, finish and texture of the material.
- E. Certificates
1. Submit certificates, in duplicate, in accordance with requirements of each Specification section.

PART 2 - PRODUCTS

2.1 Products

- A. Materials used by the Contractor or any Sub-contractor shall be new, unless noted otherwise, and shall be of specified quality and furnished in sufficient quantity to facilitate proper and speedy execution of the work. Materials must be delivered to the site in original packaging with labels and trademarks intact.

2.2 Substitutions

- A. The contractor may submit for approval materials, fixtures, or equipment other than those specified. To obtain said approval, the Contractor must provide complete product data, the test results that might be required and any other information necessary to substantiate that the material or system is equal to or better than specified. Unless approval of requests is provided in writing, all materials used shall be as specified.

1. The County Parks and Recreation Division shall be the final authority in deciding the approval of any request for substitution or deviation from the plans and specifications.
 2. Any proposed product substitutions shall be in accordance with the General Conditions; shall meet or exceed specified warranty; shall be equivalent in specific features and qualities such as performance, weight, size, durability, visual effect; shall be compatible with the rest of the work; and shall not require any changes or revisions to the Construction Documents.
- B. Any material or equipment found installed on the site which is not that specified, or approved prior to bidding, shall be immediately removed and the specified item(s) installed at no additional cost to the County.

PART 3 - CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

3.1 Temporary Utilities

- A. The Contractor shall provide service required for construction operations.

3.2 Barriers and Enclosures

- A. Provide to prevent public entry to work areas and to protect existing trees and plants. Provide as required to protect existing facilities, improvements and adjacent properties from damage from construction operations. Repair damage at no cost to the County.
- B. Provide barriers around trees and plants designated to remain. Protect against vehicular traffic, stored materials, dumping, chemically injurious materials, and puddling or continuous running water.
- C. Provide protection against weather - rain, winds, storms, frost or heat so as to maintain all work free from injury or damage. New work shall be covered if necessary.

3.3 Security

- A. Provide temporary protection for installed products. Control traffic in immediate area to minimize damage.

3.4 Temporary Controls

- A. Surface Water, Erosion, and Sediment Control
1. Surface water shall be controlled so that the construction area is not allowed to become wet from runoff from adjacent areas. Surface water shall be directed away from these areas but not directed toward adjacent property, buildings, or any improvement that may be damaged by water. Surface water shall not be allowed to enter sanitary sewers.
 2. Maintain excavations free of water. Provide and operate pumping equipment as needed.
 3. Prevent erosion and sedimentation.
 4. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 5. Provide and maintain public access road around the work area.
- B. Construction Cleaning:
1. All public and private areas used as haul roads shall be continuously maintained and cleaned of all construction caused debris such as mud, sand, gravel, soils, pavement fragments, sod, etc. Care shall be taken to prevent spillage on haul routes. Any such spillage shall be removed immediately and the area cleaned.
 2. Public roads shall be maintained in accordance with applicable ordinances and regulations.
 3. Throughout all phases of construction, including suspension of work, and until

- final acceptance of the project, the Contractor shall keep the work site clean and shall remove daily all refuse, dirt, damaged materials, unusable materials, and all other trash or debris that he has created from his construction activities.
4. Materials and equipment shall be removed from the site as soon as they are no longer necessary; and upon completion of the work and before final inspection, the entire work site shall be cleared of equipment, unused materials, and rubbish so as to present a satisfactory, clean and neat appearance. All cleanup costs shall be included in the Contractor's bid.
- C. Dust Control:
1. Dust control measures shall be implemented by application of water to all work areas, storage areas, haul and access roads, or other areas affected by construction.
 2. All work shall be in compliance with the Federal, State, and local air pollution standards, and not cause a hazard or nuisance to personnel and the public in the vicinity of the work.
 3. Provide positive means to prevent air-borne dust from dispersing into atmosphere.
 4. Execute work by methods to minimize raising dust from construction operations.
- 3.5 Traffic Regulation
- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and County's operations.
 - B. Monitor parking of construction personnel's vehicles. Construction personnel will be restricted to parking in designated areas only.
 - C. Prevent parking on or adjacent to access roads or in non-designated areas.
 - D. Consult with authorities, establish public thoroughfares to be used for haul routes and site access.
 - E. Confine construction traffic to haul routes and designated construction limits.

PART 4 - METHODS

- 4.1 Installations
- A. The Contractor shall comply with all applicable safety ordinances, including required O.S.H.A. standards.
 - B. Contractor shall be responsible for all cutting, fitting, and/or patching as may be required to complete the work or to make its several parts fit together properly. During the course of construction, every care shall be taken to prevent damage to existing buildings and landscape elements not a part of the contract. Any damaged areas shall be restored to a "like new" condition at no additional cost to the County.
- 4.2 Permits
- A. The Contractor will be responsible for securing all permits that may be required to complete the work in accordance with the General Conditions.
- 4.3 Field Engineering
- A. From information provided on the drawings and provided by the County as herein specified, the contractor shall establish grades, lines, and levels required for the completion of the work in accordance with the drawings and specifications. The Contractor shall be responsible for all site engineering and layout and shall provide construction staking as necessary. The Contractor shall be responsible for the accurate placement of improvements. Any inconsistencies or problems found during this work shall be reported to the Project Manager before proceeding with the work.
 - B. The County will establish property corners and boundaries when required; and will

establish vertical and horizontal survey control points when indicated and shown on the drawings as being provided by the County.

4.4 Coordination

- A. Contractor shall at all times enforce strict discipline and good order among his employees and shall not employ on the project, any unfit person or anyone unskilled in the work assigned to him.
- B. The Contractor and Sub-contractor(s) shall coordinate their work with adjacent work of others and cooperate their efforts so as to facilitate the progress of the project. Each contractor shall afford the other contractor every reasonable opportunity for the installation and/or storage of their materials.

4.5 Utilities

- A. The locations of existing underground utilities depicted on the drawings are shown in an approximate way only. The Contractor shall determine the exact location of all existing utilities, whether or not shown on the drawings, before commencing work. He agrees to be fully responsible for any and all damages which might be occasioned by his failure to exactly locate and preserve any and all underground utilities. If damaged or removed, the existing utility shall be restored or replaced by Contractor in as nearly the original condition and location as is reasonably possible, at no cost to the Owner and/or the County.
- B. The Contractor shall notify all utility companies, including Blue Stake, whether identified on the site or not, of any required connections to, or modifications or abandonment of, existing lines and/or equipment during the execution of the work. The Contractor shall properly and timely notify each utility company involved so as to properly schedule the work and coordinate necessary inspections and acceptance.
 - 1. All such work shall be done in compliance with each utility company's requirements and standards.

4.6 Clean-up

- A. Contractor shall at all times keep premises free from accumulations of waste materials or rubbish; shall immediately remove any demolition debris; and shall, at the completion of the work, leave the area clean and habitable with no additional maintenance work required by the County upon acceptance.

4.7 Record Documents

- A. Contractor shall maintain one (1) copy of all drawings, specifications, addenda, field orders, approved shop drawings and change orders as "Record Documents".
 - 1. These documents shall be maintained in good condition and marked during construction so as to record all changes and modifications to the work and to document exact dimensions (from permanent features of the site), along with grades and elevations of all exterior and interior underground work, including conduit, piping, valves, and drains.
 - 2. At Substantial Completion of the project, documentation of changes, red-lines, and as-builts will be submitted to Landscape Architect and Project Manager for review and approval.

4.7 Substantial Completion

- A. Substantial Completion: The point in time when the Work is sufficiently complete, in accordance with the Contract Documents, that the County can occupy or use the Work for its intended purpose. Substantial Completion shall be issued in writing by the Project Manager to the Contractor.

- B. Substantial Completion procedures:
1. Before requesting substantial completion of the work from the Project Manager, Contractor shall have received approval on all building permit required inspections, as administered by the local governing municipality. The Contractor shall also supply proof of payment for all utility costs incurred during construction.
 2. Contractor shall have received written acceptance of Turf Establishment from Project Manager.
 3. The Contractor shall request in writing his intent to have the County review and accept the project as substantially complete.
 4. This request must be submitted to the Project Manager at least five (5) calendar days prior to the requested observation date in order to give those involved time to schedule attendance.
 - a. **If the work is found not substantially complete, or if the list of incomplete items is more than a few, the Contractor shall be charged for the time of those in attendance at this meeting. These monies shall be deducted from the amount due the contractor at the end of the project.**
- 4.8 Close-Out Documents and Final Payment
- A. Submit the following Close-out Documents:
1. Final Application for Payment
 2. One year warranty letter
 3. Lien Waiver
 4. Record documents
 5. Provide Operations & Maintenance manuals and instruct County's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
 6. Submit demonstration and training videotapes.
 7. Irrigation invoices, GPS locations of irrigation, etc. as required by specification section 328400.
- 4.9 One Year Warranty Period and Final Project Acceptance
- A. The Contractor warrants to the County that materials, equipment, and systems furnished under the Contract will be new and of good quality, that the work will be free from defects in quality and workmanship, and that the work will conform to the requirements of the Contract Documents. If, within one year after the date of the **Notice of Substantial Completion** any of the work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Project Manager. The Contractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.
1. At the conclusion of the one year warranty period, a final project acceptance inspection will be performed by the County.
 2. Any items needing repair or replacement will then be performed by the Contractor without additional charge or cost to the County.
 3. Once all work is complete, County will release all bonds.

END OF SECTION 010000

SECTION 011100 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 Description of Work

The work for this project shall consist of, but not be limited to preparing the site and furnishing all labor materials, and equipment to complete the following improvements with quality workmanship, in a timely manner, and in compliance with project plans and specifications:

Construction Time Schedule:

Project to Begin (N.T.P.):	Estimated August 1, 2019
Project Completion Date:	Estimated June 15, 2021

1. Review and accept existing site conditions.
2. Obtaining all required permits and approvals for construction work required by the drawings and specifications and coordinate with Salt Lake County for County to pay associated permit fees. To assist contractor and facilitate timely permitting, County has already obtained some permits and started the process for others. However, contractor shall be responsible to insure all required permits are obtained.
3. Protect all adjacent properties and steep slopes from water and erosion damage during construction.
4. Protect existing walks and other site amenities as much as possible during construction. Repair or replace any items damaged during construction.
5. Contractor shall provide survey, engineering and construction staking needed to complete the project. All surveying and construction staking shall be done under the supervision of a licensed land surveyor.
6. Perform site clearing as required in the construction documents.
7. Contractor shall be responsible for removing and disposing of existing vegetation and other materials that are required to be removed in order to properly execute this contract. All material shall be legally disposed of offsite.
8. Perform grading and earthwork as required in the construction documents.
9. Furnish and install culinary water service and meter components as required in the construction documents.
10. Furnish and install all pressurized irrigation utility components as required in the construction documents.
11. Furnish and install electrical utilities components as required in the construction documents.
12. Furnish and install all sanitary sewer components as required in the construction documents.
13. Furnish and install all drainage utilities, piping, structures, and drainage basins as required in the construction documents.
14. Furnish and install concrete walks as required in the construction documents.
15. Furnish and install retaining walls as required in the construction documents.
16. Furnish and install concrete curb and gutter and curb walls as required in the construction documents.
17. Furnish and install parking lot components as required in the construction documents.
18. Furnish and install asphalt drive and asphalt path components as required in the construction documents.
19. Coordinate delivery and install owner provided site furnishings and improvements as required in the construction documents.
20. Furnish and install signage as required in the construction documents.
21. Furnish and install all materials required for construction of Restroom/Pump House building.
22. Furnish and install all materials required for construction of Maintenance Building (if bid alternate is accepted)
23. Prepare area and coordinate with Owner's Pavilion Installer for installation of pavilions. Contractor's responsibility shall be rough grading of areas and installation of concrete

- walkways and pads at pavilions as required in the construction documents
24. Prepare playground area subgrade, drainage, and coordinate with owner's playground equipment installer for installation of owner provided Playground Equipment by Owner's Playground Equipment installer.
 25. Prepare playground area for installation of Playground Safety surfacing to include rough grading, drainage in engineered wood chip areas, and coordinate with Owner's playground safety surface installer(s) for timely installation of playground surfacing as required in the construction documents.
 26. Furnish and install custom metal feature elements, concrete columns, railings, and other site improvements as required in the construction documents.
 27. Furnish and install all materials and owners provided equipment for complete splash pad as required in the construction documents.
 28. Furnish and install all irrigation system components as required in the construction documents.
 29. Furnish and install all trees, plants, sod, seed, and native seed as required in the construction documents.
 30. Strip, stockpile, and re-place topsoil as required in the construction documents.
 31. Screen stripped and stockpiled topsoil (if alternate is accepted) as required in the construction documents.
 32. Furnish and install Planting Soil Mixes as required in the construction documents.
 33. Provide owner with As-Built Drawings as required in the construction documents
 34. Maintain and establish all trees, plants for a period specified in the construction documents. Follow specified maintenance practices during establishment period.
 35. Provide warranty on all items for one (1) year following the date of Substantial Completion.

1.2 Minimum Licensing Requirements:

Minimum Licensing requirements shall include Utah State licensed E100 - General Engineering Contractor or B100 General Building Contractor; Utah State licensed S330 - Landscape Contractor; S260 General Concrete Contractor, S380 Swimming Pool and Spa Contractor and any other classes of licenses to complete the work, as shown by the plans and specifications.

1.3 Responsibility

It is intended that the General Contractor herein after referred to as the Contractor, shall be responsible for the overall management of the construction work. This includes any work done by their employees directly or through sub-contractors. The Contractor shall properly coordinate all work done, expediting the work of various trades, as necessary, so that different elements are built and installed in proper sequence. They must function properly and, as intended, at the completion of the project.

The Contractor shall visit the site prior to submitting a bid to adequately determine the scope, intent, and requirements of the project and its satisfactory completion.

1.4 Coordination

The Contractor shall see to it that orders for manufactured items called for by the various specifications, are ordered by the various trades and are delivered at the proper time.

END OF SECTION 011100

ALTERNATES – SECTION 012300

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing Alternates.

1.3 DEFINITIONS

- A. Definitions: An alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to the Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

- 1. The cost for each alternate is the net addition to the Contract Sum to incorporate the Alternate into the Work. No other adjustments are made to the Contract sum.

1.4 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent Work as necessary to completely and fully integrate that Work into the Project.

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

- B. Notification: Immediately following the Award of the Contract, notify each party involved, in writing of the status of each Alternate. Indicate whether alternates have been accepted or rejected, or deferred for later consideration. Include complete description of negotiated modifications to alternates.

- C. Execute accepted alternates under the same conditions as other Work of this Contract.

- D. Schedule: A "Schedule of Alternates" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials necessary to achieve the Work Described under each alternate.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1 – Screening of Stockpiled Topsoil: Alternate shall include work necessary to screen stockpiled topsoil in accordance with drawings and specification and in quantities required to supply the specified depths of planting soil mix (taking into consideration that topsoil is only 50% of specified planting soil mix) and topsoil (used for seeded areas) for the project. Stripped and Stockpiled Topsoil shall be screened to meet the requirements of specification 329119 Fine Grading, Laser Grading, and Soil Preparation, which indicates that all topsoil shall be free of stone large than 1” in any dimension. Contractor shall be solely responsible to determine quantities required for screening.

- B. Alternate No. 2 – North Pavilion: Alternate shall include work necessary for Owner Provided/Owner Vendor Installed 28’ x 40’ Reservable Pavilion (located to the area north of the Playground). Contractor shall be responsible to provide associated concrete slab, electrical wiring, connections, outlets, and lighting, installation of owner provided picnic tables, two raised concrete seat wall planters, and any adjustments to planting and irrigation necessary to accommodate this addition in accordance with the drawings, details, and specifications. Owner’s vendor will be responsible for pavilion footings and pavilion assembly and installation. Mass grading for the area is included as part of base bid.

- C. Alternate No. 3 – Maintenance Building and associated site work: Alternate shall include work necessary to add the Maintenance Building, associated utilities, maintenance drives and hardscape, fencing, boulder wall, and any adjustments to planting, and irrigation necessary to accommodate this addition in accordance with the drawings, details, and specifications. Mass grading for area is included as part of base bid.

END OF SECTION 012300

SECTION 014000 - QUALITY CONTROL

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

- A. General Quality Control
- B. Workmanship
- C. Manufacturer's Instructions
- D. Manufacturer's Certificates
- E. Manufacturer's Field Services
- F. Testing Laboratory Services

1.2 RELATED DOCUMENTS

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

1.3 QUALITY CONTROL – GENERAL

- A. Maintain quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

1.4 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.5 MANUFACTURERS' INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence. Should instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

1.6 MANUFACTURERS' CERTIFICATES

- A. When required by individual Specifications Section, submit manufacturer's certificate, in duplicate, that products meet or exceed specified requirements.

1.7 MANUFACTURERS' FIELD SERVICES

- A. When specified in respective Specification Sections, require supplier to provide qualified personnel to observe field conditions, quality of workmanship, as applicable, and to make appropriate recommendations.

- B. Representative shall submit written report to Engineer listing observations and recommendations.

1.8 TESTING LABORATORY SERVICES

- A. Owner will employ and pay for services of an Independent Testing Laboratory to perform inspections, tests, and other services required by individual Specification Sections.
- B. Services will be performed in accordance with requirements of local jurisdiction having authority and with specified standards.
- C. Reports will be submitted to Owner in duplicate giving observations and results of tests, indicating compliance or non-compliance with specified standards and with Contract Documents.
- D. Contractor shall cooperate with Testing Laboratory personnel; furnish tools, samples of materials, mix design, equipment, storage and assistance as requested.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTIONS

Not Used.

END OF SECTION 014000

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 1. Inspection procedures.
 2. Project Record Documents.
 3. Final cleaning.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 2. Advise Owner of pending insurance changeover requirements.
 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 5. Prepare and submit Project Record Documents, operation and maintenance manuals, and similar final record information.
 6. Submit test records.
 7. Terminate and remove temporary facilities from Project site, along with construction tools, and similar elements.
 8. Complete final cleaning requirements
 9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, the OAR will either proceed with inspection or notify Contractor of unfulfilled requirements. The OAR will prepare the Notice of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before notice will be issued.
 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
 2. Submit copy of the OAR's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Instruct Owner's personnel in operation, adjustment, and maintenance of, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, OAR will either proceed with inspection or notify Contractor of unfulfilled requirements. OAR will inform the Contractor that a final Payment Application can be submitted after the inspection or will notify Contractor of construction that must be completed or corrected before payment application can be submitted.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit **three** copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of areas in sequential order,
 2. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Landscape Architect
 - d. Name of Contractor.
 - e. Page number.

1.6 PROJECT RECORD DOCUMENTS

- A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.
- B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

- d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.
 2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 3. Mark important additional information that was either shown schematically or omitted from original Drawings.
 4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
 5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.
- C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Note related Change Orders, Record Drawings and Product Data, where applicable.
- D. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, Record Drawings, and Record Specifications, where applicable.
- E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.7 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (115-by-280-mm) paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 – EXECUTION

3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 1. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 3. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 4. Remove tools, construction equipment, machinery, and surplus material from Project site.
 5. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

DIVISION 03 – CONCRETE

TABLE OF CONTENTS

SECTION	ITEM
033000	Cast-in-Place Concrete (architecture)
036100	Cementitious Grouting (APWA)

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 1. Cementitious materials.
 2. Admixtures.
 3. Form materials and form-release agents.
 4. Steel reinforcement and accessories.
 5. Fiber reinforcement.
 6. Curing compounds.
 7. Floor and slab treatments.
 8. Bonding agents.
 9. Adhesives.
 10. Vapor retarders.
 11. Semirigid joint filler.
 12. Joint-filler strips.
 13. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

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

- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
 - C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
 - D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
 - E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
 - F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
 - H. Preinstallation Conference: Conduct conference at **Project site**.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, **3/4 by 3/4 inch** minimum.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 , deformed.
- C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- D. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 ASTM A 706/A 706M, deformed bars, assembled with clips.
- E. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.
- F. Deformed-Steel Wire: ASTM A 496/A 496M.
- G. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- H. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 1. Portland Cement: ASTM C 150, Type II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Axim Italcementi Group, Inc.; CATEXOL CN-CI.
 - b. BASF Construction Chemicals - Building Systems; Rheocrete CNI.
 - c. Euclid Chemical Company (The), an RPM company; ARRMATECT.
 - d. Grace Construction Products, W. R. Grace & Co.; DCI.
 - e. Sika Corporation; Sika CNI.
- D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
 - b. Cortec Corporation; MCI- 2000.
 - c. Grace Construction Products, W. R. Grace & Co.; DCI-S.
 - d. Sika Corporation; FerroGard 901.
- 2.6 CURING MATERIALS Evaporation retarder in first paragraph below temporarily reduces moisture loss from concrete surfaces awaiting finishing in hot, dry, and windy conditions. Evaporation retarders are not curing compounds.
- A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
 - B. Water: Potable.
 - C. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Kure 200.
 - b. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - c. Edoco by Dayton Superior; Res X Cure WB.
 - d. L&M Construction Chemicals, Inc.; L&M Cure R.
 - e. Meadows, W. R., Inc.; 1100-CLEAR.
 - f. SpecChem, LLC; Spec Rez Clear.
- 2.7 VAPOR RETARDERS
- A. Sheet Vapor Retarder: ASTM E 1745, Class A[, except with maximum water-vapor permeance of <Insert rating>]. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Grace Construction Products; W.R. Grace & Co. -- Conn.
- b. Poly-America, L.P.
- c. Stego Industries, LLC.
- d. W.R. Meadows, Inc.
- e. Approved equal.

2.8 LIQUID FLOOR TREATMENTS; For the concrete floors in the hallways, entry, and break room of the personnel spaces.

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Curecrete Distribution Inc.; Ashford Formula.
 - b. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
 - c. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
 - d. Kaufman Products, Inc.; SureHard.
 - e. L&M Construction Chemicals, Inc.; Seal Hard.
 - f. Approved equal prior to bid.

2.9 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash: 25 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 5. Silica Fume: 10 percent.
 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06percent by weight of cement.
 - D. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 - E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 3000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.50.
 3. Slump Limit: 4 inches , plus or minus 1 inch .
- B. Foundation Walls: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 3000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.50.
 3. Slump Limit: 4 inches, plus or minus 1 inch (25 mm).
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 4500 psi at 28 days.
 2. Minimum Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches , plus or minus 1 inch .
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
 5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
 6. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 4.0 lb/cu. yd..

2.11 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.

- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

- A. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- 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 restraighening 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 waterproofing.
- C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

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

3.11 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer

according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.13 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

- a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within **24** hours of finishing.

3.14 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

DIVISION 04 – MASONRY

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042200	Concrete Masonry

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Integrally colored CMU
3. Mortar and grout.
4. Steel reinforcing bars.
5. Miscellaneous masonry accessories.

B. Related Sections:

1. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints

1.3 DEFINITIONS

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

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to IBC Section 2105.2.2.1.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
2. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
3. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainable Submittals:
 1. Product Certificates: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.
- C. Shop Drawings: For the following:
 1. Masonry Units: Show sizes, profiles, coursing, integrally colored CMU for heads and jambs and locations of special shapes and Integrally colored CMU.
 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement".
 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.7 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of the following:
 1. Masonry units.
 - a. Include data on material properties.
 - 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.
 6. Anchors, ties, and metal accessories.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units,

mortar type, and resulting net-area compressive strength of masonry determined according to ICB Section 2105.2.2.1.

- D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. 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.
- C. 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.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- 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. Build mockup of typical wall area as shown on Drawings.
 - 2. Protect accepted mockups from the elements with weather-resistant membrane.
 - 3. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. 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.
 - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site.

1.9 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 use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 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 of walls and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three 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 higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

2.2 CONCRETE MASONRY UNITS

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

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

- B. Integrally color CMU where indicated.

- C. Integral Water Repellent: Provide units made with integral water repellent.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) ACM Chemistries, Inc.; RainBloc.
- 2) BASF Aktiengesellschaft; Rheopel Plus.
- 3) Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.

- D. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2500 psi .
2. Density Classification: Medium weight.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.
6. Integrally colored CMU

- E. Integrally Colored CMU

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2500 psi.
2. Density Classification: Medium weight.
3. Size (Width): Manufactured to dimensions specified 3/8" less than nominal dimensions.
4. Colors: Match Architect's samples – close match to Terracotta color.
5. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.
6. Intended location use: Exposed CMU and exposed CMU window details.

2.3 MASONRY LINTELS

- A. General: Provide the following:
- B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs 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.

2.4 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- 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 Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Euclid Chemical Company (The); Accelguard 80.
 - b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.

- c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.
- H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ACM Chemistries, Inc.; RainBloc for Mortar.
 - b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
 - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
- I. Water: Potable.

2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).
- B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
 - 1. Interior Walls: Hot-dip galvanized, carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 3. Wire Size for Side Rods: as indicated on structural general notes.
 - 4. Wire Size for Cross Rods: as indicated on structural general notes.
 - 5. Wire Size for Veneer Ties: as indicated on structural general notes.
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: as indicated on structural general notes.
 - 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.

2.6 TIES AND ANCHORS

2.7 MISCELLANEOUS ANCHORS

- A. Anchor Bolts: Headed or L-shaped 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; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- B. Postinstalled Anchors: Torque-controlled expansion anchors.
 - 1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.
3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.8 EMBEDDED FLASHING MATERIALS (select from the following)

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and Section 076200 "Sheet Metal Flashing and Trim" and as follows:

1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
2. Copper: ASTM B 370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. weight or 0.0216 inch thick or ASTM B 370, Temper H01, high-yield copper sheet, 12-oz./sq. ft. weight or 0.0162 inch thick.
3. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
4. Fabricate through-wall metal flashing embedded in masonry with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cheney Flashing Company; [Cheney Flashing (Dovetail) or Cheney 3-Way Flashing (Sawtooth).
 - 2) Keystone Flashing Company, Inc.; Keystone 3-Way Interlocking Thruwall Flashing.
 - 3) Sandell Manufacturing Co., Inc.; Mechanically Keyed Flashing.
5. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
6. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
7. Fabricate through-wall flashing with sealant stop where indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
8. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
9. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
10. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.

B. Flexible Flashing: Use the following unless otherwise indicated:

1. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, 0.040 inch thick.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Carlisle Coatings & Waterproofing; Pre-Kleened EPDM Thru-Wall Flashing.
 - 2) Firestone Specialty Products; FlashGuard.
 - 3) Heckmann Building Products Inc.; No. 81 EPDM Thru-Wall Flashing.
 - 4) Hohmann & Barnard, Inc.; Epra-Max EPDM Thru-Wall Flashing.
 - 5) Sandell Manufacturing Co., Inc.; EPDM Flashing.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge or flexible flashing with a metal sealant stop.
4. Where flashing is fully concealed, use metal flashing or flexible flashing.

D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
3. Elastomeric Sealant: ASTM C 920, chemically curing urethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. 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.

2.9 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 or urethane.
- 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. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime mortar unless otherwise indicated.
 3. 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, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry. Refer to Structural General notes.
1. For reinforced masonry, use Type S.
 2. 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.
 3. For interior non-load-bearing partitions, Type O may be used instead of 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. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
 3. Provide grout with a slump of 10 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the 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.

3.2 INSTALLATION, GENERAL

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

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
 - 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
 - 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
 - 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
 - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 - 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
 - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 - 5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

6. 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.
7. For Faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch , with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.
5. Do not vary from a straight line more than 1/16 inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar and wet units (if required), before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout **24 inches (600 mm)** under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs 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. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 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 using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs 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.
 - 5. Provide Horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod, but not less than 3/8 inch.
 - a. Locate horizontal, pressure relieving joints beneath shelf angles supporting masonry.

3.7 LINTELS

- A. 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.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.8 FLASHING

- A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

3.9 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 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 48 inches, unless high-lift grouting procedures are followed.

3.10 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 meet specified requirements shall be done at Contractor's expense.

- B. Inspections: Level 1 special inspections according to the "International Building Code."
 - 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 Prior to Construction: One set of tests.
- D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.11 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.
 - 5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.12 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.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

DIVISION 05 – METALS

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SECTION	ITEM
051200	Structural Steel Framing
055213	Pipe and Tube Railings and Bollards
057210	Exterior Metal Railings

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fabricated building columns.
 - 2. Grout.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications".

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches (38 mm).
 - 2. Welded built-up members with plates thicker than 2 inches (50 mm).
 - 3. Column base plates thicker than 2 inches (50 mm).
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, holes, and other pertinent data.
 - 2. Include embedment Drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Identify members and connections of the Seismic-Load-Resisting System.
 - 5. Identify demand critical welds.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint qualified by testing, including the following:
 - 1. Power source (constant current or constant voltage).
 - 2. Electrode manufacturer and trade name, for demand critical welds.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, Fabricator, testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.

3. Shop primers.
4. Nonshrink grout.

- F. Survey of existing conditions.
- G. Source quality-control reports.
- H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

- A. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- C. Comply with applicable provisions of the following specifications and documents:
1. AISC 303.
 2. AISC 341 and AISC 341s1.
 3. AISC 360.
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Channels, Angles: Shapes as indicated: **ASTM A 913/A 913M, Grade 50 (345)**.
- B. Plate and Bar: Plate and Bar: **ASTM A 572/A 572M, Grade 50 (345)** .
- C. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: **ASTM A 325 (ASTM A 325M)**, Type 1, heavy-hex steel structural bolts; **ASTM A 563, Grade C, (ASTM A 563M, Class 8S)** heavy-hex carbon-steel nuts; and **ASTM F 436 (ASTM F 436M)**, Type 1, hardened carbon-steel washers; all with plain finish.
- B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- C. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- D. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.3 PRIMER

- A. Low-Emitting Materials: Paints and coatings 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. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat. To be compatible to the top paint coat that will be applied in the field.

2.4 GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
 - 1. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 - 2. Mark and match-mark materials for field assembly.
 - 3. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning," or SSPC-SP 3, "Power Tool Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. All Surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of **1.5 mils**. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than **1.5 mils**.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 REPAIRS AND PROTECTION

- A. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 051200

SECTION 055213 - PIPE AND TUBE RAILINGS AND BOLLARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel tube Railings (Guards).
 - 2. Steel pipe Bollards.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

- B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- D. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- E. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel Pipe and Tube Railings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Approved local manufacturer.
- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design railings, including attachment to building construction.

- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

- 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.

- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

- 1. Temperature Change: 120 deg F, ambient; 180 deg F material surfaces.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.4 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- B. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.5 FASTENERS

- A. General: Provide the following:
 - 1. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

- C. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 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 flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Form Changes in Direction as Follows:
 - 1. With mitered, welded joints.
- J. Close exposed ends of railing members.
- K. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

3.3 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of tubing for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post.
- C. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop primer exposed areas with the same material as used for shop primer to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

3.6 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 057210 – EXTERIOR METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Metal exterior railings and barriers
- B. Related Sections include the following:
 - 1. Division 31 – Earthwork for excavation, filling, rough grading, backfill materials, protection of existing trees and plantings, and site clearing.
 - 2. Division 32 – Concrete

1.3 DEFINITIONS

- A. Railings: Guardrails, barriers, handrails, and similar devices used for protection of occupants at retaining walls, pedestrian guidance and supports, and visual separation.

1.4 PERFORMANCE REQUIREMENTS

- A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 60 percent of minimum yield strength.
 - 2. Stainless Steel: 60 percent of minimum yield strength.
- B. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails & Barriers:
 - a. Uniform load of 50 lbf/ft (0.73kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculations on surface temperature of materials due to

both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (range): 120 deg F (67 deg C), ambient: 180 deg F (100 deg C), material surfaces.

- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

- A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components
2. Grout, anchoring cement, and paint products.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

- D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Welded connections.
4. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.

- E. Mill Certificates: Signed by manufacturers of metal products certifying that products furnished comply with requirements. Mill certificates should come directly from the Mill to Owner's Authorized Representative for verification.

- F. Welding certificates.

- G. Qualification Data: For professional engineer.

- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

- B. Product Options: Details provided in drawings indicates size and the style of railings

1. Do not modify intended aesthetic effects, as judged solely by Owner's Authorized Representative, except with Project Manager's approval. If modifications are proposed, submit comprehensive explanatory data to Project Manager for review.

C. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.6, "Structural Welding Code."

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup for each type of railing to be provided (guardrail, handrail, etc...)
2. Build mockups that show weld quality, bends, and tube thickness of each tube diameter.
3. Each mockup must include at least one seamless butt joint, one tee joint, and one corner joint or bend.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails, unless otherwise indicated.

1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
3. Provide formed-steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.
4. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.

2.2 METAL TUBING AND PIPE

- A. Tubing & Pipe: size and type indicated in drawings and details.

2.3 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 316L, 1/8" tube wall.

2.4 FASTENERS

- A. General: Provide the Following:
 - 1. Stainless-Steel Components: Type 316L stainless-steel fasteners.
 - 2. Steel Components: steel fasteners to match grade and quality of railing.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Provide concealed fasteners for attaching railings to other work, unless otherwise indicated.
 - 1. Provide tamper-resistant flat-head machine screws for exposed fasteners, unless otherwise indicated.
- D. Anchors: Provide cast-in-place chemical or torque-controlled expansion anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry 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 agency.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Nonshrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces. All field connections shall be welded.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius

of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate exposed connections to be weather tight. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Provide continuous weld at all connections and fittings.
 - 1. Use materials and methods that minimize distortion and maintain strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- H. Form changes in direction as follows:
 - 1. By bending or by inserting prefabricated elbow fittings.
- I. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- J. Close exposed ends of hollow railing members with prefabricated end fittings.
- K. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide fillers made from crush-resistant material, or other means to transfer wall loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment. All protection shall be removed and disposed by

the contractor prior to completion of project.

- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 PAINTED FINISHES

- A. Provide painted finish for railings in color as specified on the drawings.
- B. Painted finish shall include prime coat of specified primer and two topcoat applications of specified paint.
- C. Primer: Sherwin Williams Pro Industrial TM Pro-Cryl Universal Primer B66-310 Series, or approved equal. Must be designated for exterior metal applications.
- D. Paint (topcoats): Sherwin Williams Pro Industrial TM Acrylic Semi-gloss, B66-650 Series, or approved equal.
- E. Submit color samples for approval.

2.9 POWDER COAT FINISH

- A. Provide powder coat finish meeting AAMA 2605 standard specification for “High Performance Exterior Finish.”
- B. COLOR: to be as noted on the Materials Schedule on the drawings. Submit color samples for approval.

2.10 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish.
- B. Grind and polish surfaces to produce uniform finish indicated, free of cross scratches.
- C. Directional Satin Finish: No. 4.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Unless intended for field welded connection, do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5mm in 3 m).
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than 6 inches (152 mm) deep and 3 inch (76 mm) diameter for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions connected to posts and to metal supporting members as follows:
 - 1. For railings, weld flanges to posts and bolt to metal-supporting surfaces.
- C. Install removable railing sections, where indicated, in slip-fit steel sockets cast in concrete.

3.5 ANCHORING RAILING ENDS

- A. Anchor railing ends to concrete and masonry with steel sleeves concealed within railing ends and anchored to wall construction with anchors and bolts, unless otherwise detailed.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

3.6 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch (38-mm) clearance

from inside face of handrail and finished wall surface.

- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure steel wall brackets to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Payment for these services will be made by Owner.
- B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Railings will be tested according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.
- C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and will comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 CLEANING

- A. Clean steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

3.9 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in field to shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057210

DIVISION 06 – WOODS, PLASTICS, COMPOSITES

TABLE OF CONTENTS

SECTION	ITEM
061000	Rough Carpentry
061600	Sheathing
061753	Shop Fabricated Wood Trusses
066400	Fiberglass Reinforced Paneling

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Framing with dimension lumber.
- 2. Wood blocking and nailers.

- B. Related Requirements:

- 1. Section 061600 "Sheathing." For walls and roofs.
- 2. Section 313116 "Termite Control" for site application of borate treatment to wood framing.

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

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

1.4 ACTION SUBMITTALS

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

- 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

- B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Engineered wood products.
 - 4. Shear panels.
 - 5. Power-driven fasteners.
 - 6. Powder-actuated fasteners.
 - 7. Expansion anchors.
 - 8. Metal framing anchors.

1.6 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

2.1 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: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWWA 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.

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 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, 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.
- E. Non-Load-Bearing Interior Partitions: Stud, or Better grade.
1. Application: Interior partitions not indicated as load-bearing.
 2. Species:
 - a. Hem-fir (north); NLGA.
 - b. Spruce-pine-fir; NLGA.
 - c. Hem-fir; WCLIB, or WWPA.
 - d. Northern species; NLGA.
 - e. Western woods; WCLIB or WWPA.
- F. Load-Bearing Partitions: No. 2 grade or better.
1. Application: Exterior walls interior load-bearing partitions.
 2. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.
 - b. Douglas fir-larch (north); NLGA.
- G. 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.

2.3 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.
 - 4. Furring.
 - 5. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber the following species:
 - 1. Douglas fir-larch.
- C. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine; No. 2 grade; SPIB.
 - 2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
 - 3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 - 4. Northern species; No. 2 Common grade; NLGA.
 - 5. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.4 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.
- C. Power-Driven Fasteners: NES NER-272.
- 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.

2.5 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated. (or) Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
- C. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. 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 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. Install sill sealer gasket to form continuous seal between sill plates and walls.
- D. Do not splice structural members between supports.
- E. 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.
- F. 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.
- G. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- H. 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.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

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.
 - I. 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.
 - J. 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.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Where wood-preserved-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-preserved-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WALL AND PARTITION FRAMING INSTALLATION

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal 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 walls, provide 2-by-6-inch nominal- size wood studs spaced 16 inches o.c. unless otherwise indicated.
 2. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs.
- 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 depth for openings 48 inches and less in width, 6-inch nominal depth for

openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.

2. For load-bearing walls, provide jamb studs as indicated on drawings. Provide headers as indicated on drawings

3.4 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- size or 2-by-4-inch nominal- size stringers spaced 48 inches o.c. crosswise over main ceiling joists.

3.5 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 061000

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SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Roof sheathing.
- 2. Sheathing joint and penetration treatment.

- B. Related Requirements:

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

1.3 ACTION SUBMITTALS

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

- 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.

1.4 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

- A. Emissions: Products shall meet the low VOC LEED requirements.
- B. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.
- C. Oriented Strand Board: DOC PS 2.

- D. Thickness: 5/8 inch unless otherwise indicated.
- E. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE-TREATED PLYWOOD

- 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.
- 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.

2.3 ROOF SHEATHING

- A. Plywood Wall Sheathing: Exterior, Structural I sheathing.
 - 1. Span Rating: As indicated in General Structural Notes on Drawings.
 - 2. Nominal Thickness: Not less than 5/8 inch, unless otherwise indicated.
- B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.
 - 1. Span Rating: As indicated in General Structural Notes on Drawings.
 - 2. Nominal Thickness: Not less than 5/8 inch, unless otherwise indicated.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening: Length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

2.5 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 - 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

2.6 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with [APA AFG-01] [ASTM D 3498] that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
 - 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).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
 - 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."
- D. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:
 - a. Nail or staple to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
 - b. Space panels 1/8 inch apart at edges and ends.

3.3 PARTICLEBOARD UNDERLAYMENT INSTALLATION

1. Not allowed.

END OF SECTION 061600

SECTION 061753 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wood roof trusses.
2. Wood girder trusses.
3. Wood truss bracing.
4. Metal truss accessories.

B. Related Requirements:

1. Section 061600 "Sheathing" for roof sheathing and subflooring.

1.3 DEFINITIONS

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.

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 truss fabricator.
 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. Shop Drawings: Show fabrication and installation details for trusses.
1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
 2. Indicate sizes, stress grades, and species of lumber.
 3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
 4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
 5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
 6. Show splice details and bearing details.
- C. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For metal connector-plate manufacturer professional engineer and fabricator.
- B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.
- C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss fabricating firm.
- D. Evaluation Reports: For the following, from ICC-ES:
1. Wood-preservative-treated lumber.
 2. Fire-retardant-treated wood.
 3. Metal-plate connectors.
 4. Metal truss accessories.
- 1.6 QUALITY ASSURANCE
- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.

2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.
 - C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Handle and store trusses to comply with recommendations in TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
 3. Provide for air circulation around stacks and under coverings.
 - B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal-plate-connected wood trusses.
- B. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 1. Design Loads: As indicated.
 2. Maximum Deflection Under Design Loads:
 - a. Roof Trusses: Vertical deflection as indicated by structural engineer or 1/360 of span live load and 1/240 of span total load whichever is more stringent.
 - b.
- C. Comply with applicable requirements and recommendations of the following publications:

1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."
 2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."
 3. TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

- 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. Provide dressed lumber, S4S.
 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- B. Minimum Chord Size for Roof Trusses: **2 by 6 nominal** for both top and bottom chords.
- C. Minimum Specific Gravity for Top Chords: 0.50.
- D. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."

2.3 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A 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.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat all trusses unless otherwise indicated.

2.4 FIRE-RETARDANT-TREATED WOOD

- 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 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.
- D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Application: Treat all trusses unless otherwise indicated.

2.5 METAL CONNECTOR PLATES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpine Engineered Products, Inc.; an ITW company.
 - 2. CompuTrus, Inc.
 - 3. Eagle Metal Products.
 - 4. MiTek Industries, Inc.; a subsidiary of Berkshire Hathaway Inc.
 - 5. Truswal Systems Corporation; an ITW company.
 - 6. Approved Equal.
- B. Source Limitations: Obtain metal connector plates from single manufacturer.
- C. General: Fabricate connector plates to comply with TPI 1.

- D. 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.

2.6 FASTENERS

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

- 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
 - 2. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, 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.

2.7 METAL FRAMING ANCHORS AND ACCESSORIES

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

- 1. Cleveland Steel Specialty Co.
 - 2. KC Metals Products, Inc.
 - 3. Phoenix Metal Products, Inc.
 - 4. Simpson Strong-Tie Co., Inc.
 - 5. USP Structural Connectors.

- B. 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.

- C. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

- 1. Use for wood-preservative-treated lumber and where indicated.

- D. Roof Truss Bracing/Spacers: U-shaped channels, 1-1/2 inches wide by 1 inch deep by 0.040 inch thick, made to fit between two adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.

2.8 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 94 percent zinc dust by weight.

2.9 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

2.10 SOURCE QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections.
 - 1. Provide special inspector with access to fabricator's documentation of detailed fabrication and quality-control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards.
 - 2. Provide special inspector with access to places where wood trusses are being fabricated to perform inspections.
- B. Correct deficiencies in Work that special inspections indicate does not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.

- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.
- G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- H. Securely connect each truss ply required for forming built-up girder trusses.
 - 1. Anchor trusses to girder trusses as indicated.
- I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 - 1. Install bracing to comply with Section 061000 "Rough Carpentry."
 - 2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.
- J. Install wood trusses within installation tolerances in TPI 1.
- K. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- L. Replace wood trusses that are damaged or do not meet requirements.
 - 1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

3.2 REPAIRS AND 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 wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- C. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- D. Protective Coating: Clean and prepare exposed surfaces of metal connector plates. Brush apply primer, when part of coating system, and one coat of protective coating.
 - 1. Apply materials to provide minimum dry film thickness recommended by coating system manufacturer.

END OF SECTION 061753

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SECTION 066400 - FIBERGLASS REINFORCED PANELING

PART 1 - GENERAL

1.1 SCOPE

- A. Section includes plastic sheet paneling (FRP - Fiberglass Reinforced Plastic) wall panels for sanitary and/or decorative environments.

1.2 DELIVERY, STORAGE, AND HANDLING

- A. Materials are to be factory packaged on strong pallets. All materials are to be stored at or near room temperature in a dry place.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Manufacturers include but not limited to the following:
 - 1. Marlite (marlitefrp.com)
 - 2. Kemlite (kemitite.com)
 - 3. Nudo Products, Inc.
Parkland Plastics, Inc.

2.2 MATERIALS

- A. FRP wall panels shall be:
 - 1. Color: As selected by architect from manufactures standard colors.
 - 2. Textured: Pebbled
 - 3. Size: Minimize joints.
 - 4. Trim molding as required.
 - 5. Outside Corner Guards as required.
 - 6. Base Molding as required.
 - 7. Adhesive: C-551 Marlite FRP Adhesive or C-375 Marlite Construction Adhesive (or equal) as required.
 - 8. Sealant: MS-251
- B. ACCESSORIES:
 - 1. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

2. Adhesive: As recommended by plastic paneling manufacturer and with a VOC content of 50 g/L or less.
3. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 79200 "Joint Sealants."

PART 3 - EXECUTION

3.1 PREPARATION

- A. FRP Panels must be applied over a smooth, solid, flat, clean subwall such as drywall or plywood.
- B. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.

3.2 CONDITIONING

- A. Panels should be opened and allowed to acclimate for 48 prior to installation.

3.3 INSTALLATION

- A. Install all panels in strict accordance with the manufacturer's installation instructions. All Trim Molding must provide for a minimum 1/8" expansion space to insure proper installation.
- B. Install panels in a full spread of adhesive.
- C. Install trim accessories with adhesive.
- D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- E. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

3.4 MAINTENANCE

- A. Wipe down panels using a damp cloth and mild soap solution or cleaner. Refer to the manufacturer's specific cleaning recommendations. Do not use abrasive cleaners.
- B.

END OF SECTION 066400

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

TABLE OF CONTENTS

SECTION	ITEM
071326	Self-Adhering Sheet Waterproofing
072100	Thermal Insulation
072500	Weather Barriers
074113	Standing Seam Metal Roofing
074293	Soffit Panels
076200	Sheet Metal Flashing and Trim
079200	Joint Sealant

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Modified bituminous sheet waterproofing.
 - 2. Modified bituminous sheet waterproofing, fabric reinforced.

1.3 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range or ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet structure.
 - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
 - 1. Warranty Period: ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations for Waterproofing System: Obtain waterproofing materials, **protection course, and molded-sheet drainage panels** from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet: Minimum **60-mil (1.5-mm)** nominal thickness, self-adhering sheet consisting of **56 mils (1.4 mm)** of rubberized asphalt laminated on one side to a **4-mil- (0.10-mm-)** thick, polyethylene-film reinforcement, and with release liner on adhesive side; **formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction**].

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

- a. American Hydrotech, Inc.
- b. Carlisle Coatings & Waterproofing Inc.
- c. CETCO, a Minerals Technologies company.
- d. GCP Applied Technologies Inc. (formerly Grace Construction Products).
- e. Henry Company.
- f. MAPEI Corporation.
- g. Polyguard Products, Inc.
- h. Protecto Wrap Company.
- i. Soprema, Inc.
- j. Tamko Building Products, Inc.
- k. W. R. Meadows, Inc.
- l. York Manufacturing, Inc.

2. Physical Properties:

- a. Tensile Strength, Membrane: **250 psi (1.7 MPa)** minimum; ASTM D 412, Die C, modified.
- b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
- c. Low-Temperature Flexibility: Pass at **minus 20 deg F (minus 29 deg C)**; ASTM D 1970/D 1970M.
- d. Crack Cycling: Unaffected after 100 cycles of **1/8-inch (3-mm)** movement; ASTM C 836/C 836M.
- e. Puncture Resistance: **40 lbf (180 N)** minimum; ASTM E 154/E 154M.
- f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at **70 deg F (21 deg C)**; ASTM D 570.
- g. Water Vapor Permeance: **0.05 perm (2.9 ng/Pa x s x sq. m)** maximum; ASTM E 96/E 96M, Water Method.
- h. Hydrostatic-Head Resistance: [**200 feet (60 m)**] minimum; ASTM D 5385.

3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.
- B. Modified Bituminous Sheet, Fabric Reinforced: Minimum **60-mil (1.5-mm)** nominal thickness, self-adhering sheet consisting of rubberized-asphalt membrane with embedded fabric reinforcement, and with release liner on adhesive side.
1. **Manufacturers:** Subject to compliance with requirements, **[provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. Protecto Wrap Company.
 - b. Royston.
 2. Physical Properties:
 - a. Pliability: No cracks when bent 180 degrees over a **1-inch (25-mm)** mandrel at **minus 25 deg F (minus 32 deg C)**; ASTM D 146/D 146M.
 - b. Puncture Resistance: **40 lbf (180 N)** minimum; ASTM E 154/E 154M.
 - c. Water Vapor Permeance: **0.05 perm (2.9 ng/Pa x s x sq. m)** maximum; ASTM E 96/E 96M, Water Method.
 3. Sheet Strips: Self-adhering, reinforced, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid [**waterborne**] [**solvent-borne**] primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
- F. Metal Termination Bars: Aluminum bars, approximately **1 by 1/8 inch (25 by 3 mm)**, predrilled at **9-inch (229-mm)** centers.
- G.

2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Molded-Sheet Drainage Panel: Comply with Section 334600 "Subdrainage."
- B. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding **No. 70 (0.21-mm)** sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate through the core of [**9 to 21 gpm per ft. (112 to 261 L/min. per m)**] <Insert values>.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Hydrotech, Inc.
 - b. BASF Corporation; Construction Systems.
 - c. Carlisle Coatings & Waterproofing Inc.
 - d. CETCO, a Minerals Technologies company.
 - e. GCP Applied Technologies Inc. (formerly Grace Construction Products).
 - f. Insulation Solutions, Inc.
 - g. Polyguard Products, Inc.
 - h. Urethane Polymers International, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.
 - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
 - 1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of **[1/16 inch (1.6 mm)] [or] [1/8 inch (3 mm) for modified bituminous deck-paving waterproofing]**.
- F. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.
 - 1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
 - 1. Install membrane strips centered over vertical inside corners. Install **3/4-inch (19-mm)** fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
 - b. At plaza-deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and per recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform **2-1/2-inch- (64-mm-)** minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
 - 1. When ambient and substrate temperatures range between **25 and 40 deg F (minus 4 and plus 5 deg C)**, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than **60 deg F (16 deg C)**.
- D. Two-Ply Application: Install sheets to form a membrane with lap widths not less than 50 percent of sheet widths, to provide a minimum of two thicknesses of sheet membrane over areas to receive waterproofing.
- E. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.
- F. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- G. Seal edges of sheet-waterproofing terminations with mastic.
- H. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.
- I. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending **6 inches (150 mm)** beyond repaired areas in all directions.
- J. Immediately install protection course with butted joints over waterproofing membrane.
 - 1. **[Molded-sheet drainage panels] [Insulation drainage panels] [Board insulation]** may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.4 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
 - 1. For vertical applications, install **[board insulation] [protection course]** before installing drainage panels.

3.5 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.

- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071326

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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Glass-fiber blanket insulation.
 - 2. Vapor Retarder.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Reports:
 - 1. Submit Test Reports, summarized by Manufacturer of material(s), verifying qualities of thermal and air barrier] wall system components meet or exceed specified requirements.
 - a. Include results of ASTM E2357 air barrier system testing and ASTM E331 water penetration tests.
 - b. Include mill certificates indicating steel framing sheet complies with the specified requirements.
 - 2. Submit Field Inspection and Test Reports in accordance with Field Quality Control requirements.
- C. Samples: Submit following material samples:
 - 1. Insulation panel, 12" square.
 - 2. Insulation fasteners/washers and joint flashing tape, one each.
- D. Submit Material Safety Data Sheets (MSDS) for thermal [and air] barrier wall system components.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- B. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Installer Qualifications:
 - 1. Certified Installer. The Certified Installer shall carry liability insurance and bonding.
 - 2. Each worker who is installing thermal insulation must be a, or accompanied by a, Certified Installer.
 - 3. Each Certified Installer can supervise a maximum of five workers. The Certified Installer shall be thoroughly trained and experienced in the installation of thermal insulation of the types being applied.
 - 4. Certified Installers shall perform or directly supervise all work on the project.
 - 5. Certified Installers shall have their Manufacturer Certification in their possession and available on the project site, for inspection upon request.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements: Install thermal insulation work only when weather conditions are in compliance with Manufacturer's specific environmental requirements and conditions will permit work to be performed in accordance with Manufacturer's recommendations and warranty requirements.

1.7 WARRANTY

- A. Submit the following warranties:
 - 1. Exterior insulation warranty: Six month exposure and 15 year thermal warranty.
 - 2. Flashing Tape: Limited Warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION (THERMAL)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CertainTeed Corporation.
 2. Guardian Building Products, Inc.
 3. Johns Manville.
 4. Knauf Insulation.
 5. Owens Corning.
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
- C. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- D. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.2 VAPOR RETARDERS

- A. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: Two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nonwoven grid of nylon cord or polyester scrim and weighing not less than 22 lb/1000 sq. ft. (10 kg/100 sq. m), with maximum permeance rating of 0.1317 perm (7.56 ng/Pa x s x sq. m) and with flame-spread and smoke-developed indexes of not more than 5 and 60, respectively, per ASTM E 84.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Raven Industries Inc.; DURA-SKRIM 2FR.
 - b. Reef Industries, Inc.; Griffolyn T-55 FR.
 - c. Approved equal.
- B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.
- D. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.
- E. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

2.3 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
 - b. Gemco; Spindle Type.
 - c. Approved equal.
 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. AGM Industries, Inc.; RC150.
 - b. Gemco; Dome-Cap.
 - c. Approved equal.
 2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Ceiling plenums.
 - b. Attic spaces.
 - c. Where indicated.
- C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. AGM Industries, Inc.; TACTOO Adhesive.
 - b. Gemco; Tuff Bond Hanger Adhesive.
 - c. Approved equal.
- D. Baffles: Install baffles between the insulation and the roof deck that will provide a minimum of 1 inch gap. Install per Manufacture's recommendations.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, or that interfere with insulation attachment.
 - 1. Verify that substrate surfaces to receive spray polyurethane foam are free of frost, oil, grease, oxidation, dirt, loose paint, loose scale, or other deleterious material that would impair bond.
 - 2. Verify that items required to penetrate the thermal wall system are placed and penetration gaps and cracks are properly sealed before installation of spray polyurethane foam.
 - 3. Do not proceed with thermal and air barrier wall system installation until unsatisfactory conditions have been corrected.
- B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF FOUNDATION WALL INSULATION

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

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

3.4 INSTALLATION OF THERMAL INSULATION

- A. Install insulation in accordance with manufacturer's recommendations. Abut panels tightly together and around openings and penetrations.
 - 1. sheathing and lapped over the top edge of the base flashing.

3.5 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- 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. Glass-Fiber Blanket (Thermal) Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
- C. Install blanket insulation over entire ceiling area in thicknesses indicated

3.6 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

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

3.7 PROTECTION

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

END OF SECTION 072100

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SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Building paper.
 - 2. Building wrap.
 - 3. Flexible flashing.
 - 4. Drainage material.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.
- B. Shop Drawings: Show details of building wrap at terminations, openings, and penetrations. Show details of flexible flashing applications.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For water-resistive barrier, from ICC-ES.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

- A. Building Paper: ASTM D 226, Type 1 (No. 15 asphalt-saturated organic felt), unperforated.
- B. Building Paper: Water-vapor-permeable, asphalt-saturated kraft building paper that complies with ICC-ES AC38, Grade D.

- C. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
1. **Manufacturers:** Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Dow Chemical Company (The).
 - b. DuPont Building Innovations: E. I. du Pont de Nemours and Company.
 - c. Kingspan Insulation Limited.
 - d. Ludlow Coated Products.
 - e. Raven Industries, Inc.
 2. Water-Vapor Permeance: Not less than **20 perms (1150 ng/Pa x s x sq. m)** per ASTM E 96/E 96M, Desiccant Method (Procedure A).
 3. Air Permeance: Not more than **0.004 cfm/sq. ft. at 0.3-inch wg (0.02 L/s x sq. m at 75 Pa)** when tested according to ASTM E 2178.
 4. Allowable UV Exposure Time: Not less than three months.
 5. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.
- D. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 FLEXIBLE FLASHING

- A. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than **0.030 inch (0.8 mm)**.
1. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.
- B. Rubberized-Asphalt Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than **0.030 inch (0.8 mm)**.
1. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.
- C. Primer for Flexible Flashing: Product recommended in writing by flexible flashing manufacturer for substrate.
- D. Nails and Staples: Product recommended in writing by flexible flashing manufacturer and complying with ASTM F 1667.

2.3 DRAINAGE MATERIAL

- A. Drainage Material: Product shall maintain a continuous open space between water-resistive barrier and exterior cladding to create a drainage plane and shall be used under **portland cement plaster**.
 - 1. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
 - 1. Cut back barrier **1/2 inch (13 mm)** on each side of the break in supporting members at expansion- or control-joint locations.
 - 2. Apply barrier to cover vertical flashing with a minimum **4-inch (100-mm)** overlap unless otherwise indicated.
- C. Building Paper: Apply horizontally with a **2-inch (50-mm)** overlap and a **6-inch (150-mm)** end lap; fasten to sheathing with galvanized staples or roofing nails.
- D. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.
 - 1. Seal seams, edges, fasteners, and penetrations with tape.
 - 2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
 - 1. Prime substrates as recommended by flashing manufacturer.
 - 2. Lap seams and junctures with other materials at least **4 inches (100 mm)** except that at flashing flanges of other construction, laps need not exceed flange width.
 - 3. Lap flashing over water-resistive barrier at bottom and sides of openings.
 - 4. Lap water-resistive barrier over flashing at heads of openings.
 - 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

3.3 DRAINAGE MATERIAL INSTALLATION

- A. Install drainage material over building wrap and flashing to comply with manufacturer's written instructions.

END OF SECTION 072500

SECTION 074113 - STANDING-SEAM METAL ROOF ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes standing-seam metal roofing.
- B. Related Sections:
 - 1. Section 061600 "Sheathing" for insulation cover board / metal roofing and underlayment substrate.
 - 2. Section 072100 "Thermal Insulation" for preformed roof insulation boards, insulation accessories and insulation substrate board.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review structural loading limitations of deck during and after roofing.
 - 6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
 - 7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 8. Review temporary protection requirements for metal panel systems during and after installation.
 - 9. Review procedures for repair of metal panels damaged after installation.
 - 10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment, if used: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof area and eave, including fascia, as shown on Drawings; approximately 12 feet square by full thickness, including attachments, underlayment, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
2. Warranty Period: Twenty (20) years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: Twenty (20) years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
1. Warranty Period: Twenty (20) years from date of Substantial Completion.
- D. Installer's twenty (20) year warranty covering roof panel system installation and weathertightness from date of substantial completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980.
- C. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for low-slope roof products.
- D. Energy Performance: Provide roof panels with an aged Solar Reflectance Index of not less than 0.64 when tested according to CRRC-1.
- E. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: As indicated on Drawings.
 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- F. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 1680 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa)
- G. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
 1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).
- H. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- I. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 1. Uplift Rating: UL 90.
- J. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 1. Fire/Windstorm Classification: Class 1A90.
 2. Hail Resistance: MH.
- K. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 STANDING-SEAM METAL ROOFING

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
 1. Basis of Design Manufacturer: Subject to compliance with requirements, provide McELROY METAL - MEGA RIB Seam Metal Roofing, or a comparable approved equal product acceptable to Architect.
 - a. Nominal Thickness: 24 gauge.
 - b. Exterior Finish: Kynar 500 Siliconized Polyester, or equal.
 - c. Color: Patina Green or as selected by Architect from manufacturer's full range.
 2. Attachment: Exposed Fastener
 3. Joint Type: As standard with manufacturer.

4. Panel Coverage: per basis of design selection, unless otherwise indicated.
5. Rib Height: per basis of design selection, unless otherwise indicated.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; Grace Ice and Water Shield HT.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
 - e. Metal-Fab Manufacturing, LLC; MetShield.
 - f. Owens Corning; WeatherLock Metal High Temperature Underlayment.

2.4 METAL ROOFING AND UNDERLAYMENT SUBSTRATE

- A. General: Plywood Sheathing. Refer to Division 06 Section 061600 "Sheathing".

2.5 MISCELLANEOUS MATERIALS

- A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- C. Panel Fasteners: Self-tapping screws designed to withstand design loads.

- D. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
 - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.6 FABRICATION

- A. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown. Provide full length seamless panels wherever possible. Panel widths to vary as indicated on Drawings.
- B. Factory Fabrication: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

- a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.7 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine primary and secondary roof framing to verify that joists, angles and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 - 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough where indicated. Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply over the entire roof surface.
- B. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.4 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Steel Panels: Use stainless-steel fasteners, unless otherwise indicated, for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
 - 1. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - 2. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 - 3. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
 - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed 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 weather resistant.
 - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- H. Roof Curbs: Install flashing around bases where they meet metal roof panels.
- I. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113

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SECTION 074293 - SOFFIT PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes metal soffit panels.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than **1-1/2 inches per 12 inches**.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Metal Panels: **12 inches** long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.

- C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof eave, including fascia, and soffit as shown on Drawings; approximately four panels wide by full eave width, including attachments and accessories.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.
- E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.

- 2. Warranty Period: Two years from date of Substantial Completion.

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

- 2. Finish Warranty Period: **10** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

- 1. Wind Loads: 90 mph winds.
- 2. Other Design Loads: As indicated on Drawings.
- 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METAL SOFFIT PANELS

- A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. V-Groove-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with a V-groove joint between panels.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ATAS International, Inc.
 - b. Berridge Manufacturing Company.
 - c. Dimensional Metals, Inc.
 - d. Englert, Inc.
 - e. Fabral.
 - f. Innovative Metals Company, Inc.
 - g. McElroy Metal, Inc.
 - h. Petersen Aluminum Corporation.
 - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: not less than 0.034 inch.
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.

or

3. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: not less than 0.032 inch.
 - b. Surface: Smooth, flat] finish, unless otherwise indicated.
 - c. Exterior Finish: Two-coat fluoropolymer.
 - d. Color: As selected by Architect from manufacturer's full range.
4. Panel Coverage: 6 inches.
5. Panel Height: 0.375 inch as a minimum.

2.3 MISCELLANEOUS MATERIALS

- A. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- B. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- C. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch (13 mm)** wide and **1/8 inch (3 mm)** thick.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Steel Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- C. Aluminum Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.
 - a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Steel Panels: Use stainless-steel fasteners.
 - 2. Aluminum Panels: Use stainless-steel fasteners.

- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 - 1. Apply panels and associated items true to line for neat and weathertight enclosure.
 - 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 - 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 - 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

- E. Watertight Installation:
 - 1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
 - 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - 3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
 - 1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074293

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SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sheet metal flashing and trim:
 - 1. Formed low-slope roof flashing, fascia, and trim.
 - 2. Formed roof-drainage sheet metal fabrications.
 - 3. Formed wall flashing and trim.
 - 4. Formed equipment support flashing, where required.
- B. Related Sections include the following:
 - 1. Division 4 Section "Unit Masonry Assemblies" for installing flashing, reglets, copings and other sheet metal flashing and trim.
 - 2. Division 6 Section "Miscellaneous Carpentry" for wood nailers, curbs, and blocking.
 - 3. Division 7 Section "Thermoplastic Membrane Roofing" for installing sheet metal flashing and trim integral with roofing membrane.
 - 4. Division 7 Section "Formed Metal Wall Panels" for installation of sheet metal flashing and trim integral with metal wall panels.
 - 5. Division 7 Section "Roof Accessories" for roof hatches and other manufactured roof accessory units.
 - 6. Division 7 Section "Joint Sealants" for field-applied sheet metal flashing and trim sealants.
 - 7. Division 13 Section "Metal Building Systems"

1.3 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
 - 1. Wind Zone 3: For velocity pressures of 46 to 104 lbf/sq. ft. (2.20 to 4.98 kPa): 208-lbf/sq. ft. (9.96-kPa) perimeter uplift force, 312-lbf/sq. ft. (14.94-kPa) corner uplift force, and 104-lbf/sq. ft. (4.98-kPa) outward force.

- C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:
 - 1. Identify material, thickness, weight, and finish for each item and location in Project.
 - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 - 3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
 - 4. Details of expansion-joint covers, including showing direction of expansion and contraction.
- C. Samples for Initial Selection: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Sheet Metal Flashing: 12 inches (300 mm) long. Include fasteners, cleats, clips, closures, and other attachments.
 - 2. Trim: 12 inches (300 mm) long. Include fasteners and other exposed accessories.
 - 3. Accessories: Full-size Sample.

1.5 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

- B. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof coping, approximately 48 inches (1200 mm) long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
 - 2. Approval of mockups is for other material and construction qualities specifically approved by Architect in writing.
 - 3. 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.
 - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
 - 2. Review methods and procedures related to sheet metal flashing and trim.
 - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 - 4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 COORDINATION

- A. Coordinate installation of sheet metal fascia, flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SHEET METALS

- A. Aluminum Sheet, where indicated: ASTM B 209 (ASTM B 209M), Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14, finished as follows:
1. High-Performance Organic 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 manufacturers' written instructions.
 - a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2604.
 - 1) Color: As selected by Architect from manufacturer's full range.
- B. Prepainted, Metallic-Coated Steel Sheet, where indicated: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
1. Prepainted:
 - a. Flashing that is match the color of the metal panels where used with metal panels
 - b. Flashing at CMU is to match color #1760 Limestone
 2. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
 3. Exposed Finishes: Apply the following coil coating:
 - a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

- 1) Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements of AAMA 2604, except as modified below:
 - a) Humidity Resistance: 1000 hours.
 - b) Salt-Spray Resistance: 1000 hours.

2.3 UNDERLAYMENT MATERIALS

- A. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
 1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory- mitered and -welded corners and junctions.
 - 1. Available Manufacturers:
 - a. Cheney Flashing Company, Inc.
 - b. Fry Reglet Corporation.
 - c. Galv-alume
 - d. Hickman, W. P. Company.
 - e. Keystone Flashing Company, Inc.
 - 2. Material: Prefinished Aluminum, where exposed, 0.024 inch (0.6 mm) thick, Galvanized steel, where not exposed, 0.0217 inch (0.55 mm) thick].
 - 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 - 4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 - 5. Flexible Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - 6. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

2.6 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal fascia, flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal fascia, flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal fascia, flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with elastomeric butyl sealant concealed within joints.
- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured.

2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness or dimension indicated on Drawings. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
 1. Gutter Profile: as indicated on the drawings or if not indicated coordinate with architect and comply according to cited sheet metal standard.
 2. Expansion Joints: Lap type or Butt type.
 3. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen.
 4. Gutters with Girth up to: Fabricate from the following materials:
 - a. Aluminum: 0.04 inch thick. or
 - b. Galvanized Steel: 0.028 inch thick. or
 - c. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.
 1. Manufactured Hanger Style: According to SMACNA's "Architectural Sheet Metal Manual."
 2. Hanger Style: Coordinate with Architect.

3. Fabricate from the following materials:
 - a. Same as gutter.

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing and Fascia Caps, where indicated: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Furnish with Standing Seams spaced equally and as shown on Drawings.
 1. Joint Style: Standing Seam.
- B. Copings and Fascia, where indicated: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
 1. Joint Style Butt, with 12-inch- (300-mm-) wide concealed backup plate and 6-inch- (150-mm-) wide exposed cover plates.
 2. Fabricate copings from the following material:
 - a. Prepainted, Metallic-Coated Steel: 0.0396 inch (1.0 mm) thick.
- C. Base Flashing, where not furnished by roofing manufacturer or installer: Fabricate from one of the following material as required by roofing membrane manufacturer:
 1. Galvanized Steel: 0.0276 inch (0.7 mm) thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.0276 inch (0.7 mm) thick.
 3. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0276 inch (0.7 mm) thick and as shown on Drawings.
- D. Counterflashing: Fabricate from one of the following material as required by roofing membrane manufacturer:
 1. Galvanized Steel: 0.0217 inch (0.55 mm) thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.0217 inch (0.55 mm) thick.
 3. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0217 inch (0.55 mm) thick and as shown on Drawings.
- E. Flashing Receivers: Fabricate from one of the following material:
 1. Galvanized Steel: 0.0217 inch (0.55 mm) thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.0217 inch (0.55 mm) thick.
 3. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0217 inch (0.55 mm) thick.
- F. Roof-Penetration Flashing: Fabricate from one of the following material, as required by roofing manufacturer:

1. Lead-Coated Copper: 17.2 oz./sq. ft. (0.60 mm thick).
2. Galvanized Steel: 0.0276 inch (0.7 mm) thick.
3. Aluminum-Zinc Alloy-Coated Steel: 0.0276 inch (0.7 mm) thick.
4. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0276 inch (0.7 mm) thick.
5. Zinc: 0.031 inch (0.80 mm) thick.
6. PVC Roofing Membrane.

G. Roof-Drain Flashing: Fabricate from one of the following material:

1. PVC Roofing Membrane as required by roofing system manufacturer.

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing, not provided by Division 15: Fabricate from one of the following material:

1. Galvanized Steel: 0.0276 inch (0.7 mm) thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.0276 inch (0.7 mm) thick.
3. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0276 inch (0.7 mm) thick.

2.10 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
 - 1. Coat side of uncoated aluminum, stainless-steel and lead sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
 - 3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.
- C. Install exposed sheet metal flashing and trim without oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric butyl sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 1. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with elastomeric butyl sealant concealed within joints.
- G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
 - 1. Galvanized or Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.
 - 2. Aluminum: Use aluminum or stainless-steel fasteners.
 - 3. Copper Use copper or stainless-steel fasteners.
 - 4. Stainless Steel: Use stainless-steel fasteners.

- H. Seal joints with elastomeric butyl sealant as required for watertight construction.
 - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 - 2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."
- I. Soldered Joints, where required: 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 (38 mm) except where pretinned surface would show in finished Work.
 - 1. Do not solder prepainted, metallic-coated steel and aluminum sheet.
 - 2. Pretinning is not required for lead-coated copper, zinc-tin alloy-coated stainless steel and lead.
 - 3. Stainless-Steel Soldering: Pretin edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.
 - 4. Copper Soldering: Tin uncoated copper surfaces at edges of sheets using solder recommended for copper work.
 - 5. Where surfaces to be soldered are lead coated, do not tin edges, but wire brush lead coating before soldering.
 - 6. Lead-Coated Copper Soldering: Wire brush edges of sheets before soldering.
 - 7. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.
- J. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches (100 mm) in direction of water flow.
- C. Splash Pans: Install where downspouts discharge on low-sloped roofs. Set in elastomeric sealant compatible with roofing membrane.

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
 - 1. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 24-inch (600-mm) centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
 - 1. Interlock exterior bottom edge of coping with continuous cleats anchored to substrate at 24-inch (600-mm) centers.
 - 2. Anchor interior leg of coping with screw fasteners and washers at 24-inch (600-mm) centers.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for butyl sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant.
 - 1. Secure in a waterproof manner by means of snap-in installation and sealant or interlocking folded seam or blind rivets and sealant or anchor and washer at 36-inch (900-mm) centers.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other 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 with butyl sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

- B. Reglets: Installation of reglets is specified in Division 4 Section "Unit Masonry Assemblies."

3.6 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with butyl sealant to equipment support member.

3.7 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Polysulfide joint sealants.
4. Latex joint sealants.
5. Solvent-release-curing joint sealants.
6. Preformed joint sealants.
7. Acoustical joint sealants.

B. Related Sections:

1. Section 092900 "Gypsum Board" for sealing perimeter joints.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

E. Qualification Data: For qualified Installer.

F. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- H. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- I. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
 - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
- E. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Ten years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 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.
- B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

- D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.
- B. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.
- C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified in the Elastomeric Joint-Sealant Schedule to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Available Products: Subject to compliance with requirements, joint sealant schedule, and manufacturer's recommendations, provide one of the products specified in each category below where needed:

1. Elastomeric Joint Sealant Designation: ES1

- a. Base Polymer: Urethane.
- b. Type: M (multicomponent).
- c. Grade: P (pourable).
- d. Class: 25.
- e. Additional Movement Capability: 25 percent movement in extension and 25 percent in compression for a total of 50 percent movement.
- f. Use[s] Related to Exposure: T (traffic).
- g. Uses Related to Joint Substrates: M (mortar) and, as applicable to joint substrates indicated, O (other).
- h. Products:
 - 1) Sikaflex - 2c SL
 - 2) Tremco - THC-900
 - 3) Approved equal

2. Elastomeric Joint Sealant Designation: ES2

- a. Base Polymer: Neutral-curing silicone.
- b. Type: S (single component).
- c. Grade: NS (nonsag).

- d. Class: 25.
- e. Additional Movement Capability: 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement.
- f. Use[s] Related to Exposure: NT (nontraffic).
- g. Uses Related to Joint Substrates: M (mortar), A (aluminum) and, as applicable to joint substrates indicated, O (other).
- h. Products:
 - 1) Dow Corning 795
 - 2) GE Silpruf
 - 3) Tremco Spectrem 2
 - 4) Approved equal

3. Elastomeric Joint Sealant Designation: ES3

- a. Base Polymer: Urethane.
- b. Type: M (multi-component).
- c. Grade: NS (nonsag).
- d. Class: 25.
- e. Additional Movement Capability: 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement.
- f. Use[s] Related to Exposure: NT (nontraffic).
- g. Uses Related to Joint Substrates: M (mortar), A (aluminum) and, as applicable to joint substrates indicated, O (other).
- h. Products:
 - 1) Mameco Vulkem 922
 - 2) Sikaflex 2C
 - 3) Tremco Dymeric 511
 - 4) Approved equal

4. Elastomeric Joint Sealant Designation: ES4

- a. Base Polymer: Acid-curing silicone.
- b. Type: S (single component).
- c. Grade: NS (nonsag).
- d. Class: 25.
- e. Additional Movement Capability: 25 percent movement in extension and 25 percent in compression for a total of 50 percent movement.
- f. Use[s] Related to Exposure: NT (nontraffic).
- g. Uses Related to Joint Substrates: G (glass), A (aluminum) and, as applicable to joint substrates indicated, O (other).
- h. Products:
 - 1) Dow Corning 999-A
 - 2) GE Contractors 1200
 - 3) Pecora 863
 - 4) Tremco Tremsil 300
 - 5) Approved equal

5. Elastomeric Joint Sealant Designation: ES5

- a. Base Polymer: Acid-curing, mildew-resistant silicone.

- b. Type: S (single component).
- c. Grade: NS (nonsag).
- d. Class: 25.
- e. Additional Movement Capability: 25 percent movement in extension and 25 percent in compression for a total of 50 percent movement.
- f. Use[s] Related to Exposure: NT (nontraffic).
- g. Uses Related to Joint Substrates: G (glass), A (aluminum) and, as applicable to joint substrates indicated, O (other).
- h. Products:
 - 1) Dow Corning - Trademate Tile and Ceramic
 - 2) GE - Sanitary 1700
 - 3) Tremco - Tremsil 600
 - 4) Approved equal

6. Elastomeric Joint Sealant Designation: ES6

- a. Base Polymer: Acid-curing silicone.
- b. Type: S (single component).
- c. Grade: NS (nonsag).
- d. Class: 25.
- e. Additional Movement Capability: 25 percent movement in extension and 25 percent in compression for a total of 50 percent movement.
- f. Use[s] Related to Exposure: NT (nontraffic).
- g. Uses Related to Joint Substrates: G (glass), A (aluminum) and, as applicable to joint substrates indicated, O (other).
- h. Products:
 - 1) Dow Corning 999-A
 - 2) GE Contractors 1200
 - 3) Pecora 863
 - 4) Tremco Tremsil 300
 - 5) Approved equal

7. Elastomeric Joint Sealant Designation: ES7

- a. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
- b. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - 1) Sika Corporation, Construction Products Division; Sikaflex - 15LM.
 - 2) Tremco Incorporated; [Vulkem 921] [Dymonic FC].
 - 3) Approved equal.

2.3 LATEX JOINT SEALANTS

- A. General: For interior locations only and where movement capacity and weathering characteristics are not critical, provide manufacturer's standard one-part, nonsag, mildew-resistant, paintable latex sealant of either acrylic or silicone emulsion formulation indicated that is recommended for

exposed applications on interior locations and that accommodates indicated percentage change in joint width existing at time of installation without failing either adhesively or cohesively.

- B. Latex Sealant Standard: Comply with ASTM C 834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.
- C. Available Products: Subject to compliance with requirements, latex joint sealants that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Latex Joint Sealant Designation: LS1
 - a. Acrylic-Emulsion Sealant: Provide product complying with ASTM C 834 that accommodates joint movement of not more than 5 percent in both extension and compression for a total of 10 percent.
 - b. Products:
 - 1) "AC-20," Pecora Corp.
 - 2) "Sonolac," Sonneborn Building Products Div., ChemRex, Inc.
 - 3) "Tremco Acrylic Latex 834," Tremco, Inc.
 - 4) Approved equal
 - 2. Latex Joint Sealant Designation: LS2
 - a. Silicone Emulsion Sealant: Provide product complying with ASTM C 834 and, except for weight loss measured per ASTM C 792, with ASTM C 920 that accommodates joint movement of not more than 25 percent in both extension and compression for a total of 50 percent.
 - b. Products:
 - 1) "Trade Mate Paintable Glazing Sealant," Dow Corning Corp.
 - 2) Approved equal

2.4 ACOUSTICAL JOINT SEALANTS

- A. General: Use only at interior locations as indicated on drawings.
- B. Acoustical Sealant for Exposed and Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:
 - 1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- C. Acoustical Sealant for Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
- D. Available Products: Subject to compliance with requirements, provide one of the following:

1. Acoustical Joint Sealant Designation: AS1
 - a. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:
 - 1) Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E 90.
 - 2) Product has flame spread and smoke developed rating of less than 25 per ASTM E 84.
 - b. Products:
 - 1) "Sheetrock Acoustical Sealant," United States Gypsum Co.
 - 2) "AC-20 FTR Acoustical and Insulation Sealant," Pecora Corp.
 - 3) Approved equal
2. Acoustical Joint Sealant Designation: AS2
 - a. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.
 - b. Products:
 - 1) "BA-98," Pecora Corp.
 - 2) "Tremco Acoustical Sealant," Tremco, Inc.
 - 3) Approved equal

2.5 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 1. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 JOINT FILLERS FOR CONCRETE PAVING (Refer to Division 32)

- A. General: Provide joint fillers of thicknesses and widths indicated.
- B. Bituminous Fiber Joint Filler: Preformed strips of composition below, complying with ASTM D 1751:
 - 1. Asphalt saturated fiberboard.
 - 2. Sealants specified by Division 32.

2.7 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates. Confirm compatibility of cleaners with adjacent surfaces prior to application.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
 2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch (10 mm). Hold edge of sealant bead 1/4 inch (6 mm) inside masking tape.
 3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
 4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

- I. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT SEALANT SCHEDULE (Select from the following where indicated or required)

JOINT SEALANT SCHEDULE		
DESIGNATION ON DATA SHEETS	JOINT SEALERS	DESCRIPTION OF JOINT CONSTRUCTION AND LOCATION WHERE SEALANT IS TYPICALLY APPLIED
ES-1	Multi-part Pourable Urethane Sealant	Exterior and interior horizontal joints subject to traffic such as expansion joints in tile, pavers and sidewalks.
ES-2	One-Part Neutral Cure Silicone Sealant	Exterior and interior joints in vertical surfaces of concrete and masonry; between concrete masonry and stone; between metal and concrete, mortar, or stone; interior and exterior perimeter joints of metal frames in exterior walls; exterior overhead joints. Joints which

		are bordered by glass.
ES-3	Multi-component Urethane Sealant	Exterior and interior joints in vertical surfaces of concrete masonry; between concrete masonry and stone; between metal and concrete, mortar, or stone; interior and exterior perimeter joints of metal frames in exterior walls; exterior overhead joints.
ES-4	One-Part Acid Curing Silicon	Exterior and interior joints in vertical surfaces of non-porous surfaces. To be used on exterior and interior perimeter frames of walls and control and expansion and window joints. Between metal to metal, glass to glass, metal to glass, travertine to travertine, cap beads on glass.
ES-5	One-Part Mildew Resistant Silicone Sealant	Interior joints in vertical surfaces of ceramic tile in toilet rooms.
LS1/LS2	Latex Sealant	Exposed interior applications.
AS1	Acoustical Sealant	Exposed interior applications.
AS2	Acoustical Sealant	Unexposed interior applications.
Notes:	<ol style="list-style-type: none"> 1. Install sealant in joints fitting descriptions and locations listed. 2. "LS1 and LS2" are for interior use only and are to be applied only if an "ES" designation is not otherwise indicated and where movement capacity and weathering characteristics are not critical. 3. Either ES2 or ES3 may be used at contractors option where recommended by manufacturer. 4. If locations are encountered that are not described above, sealant manufacturer's recommendations are to be followed. The issue is to be brought to the attention of the Architect and General Contractor in writing. The appropriate sealant shall be submitted as part of the submittal process. 	

END OF SECTION 079200

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DIVISION 08 – OPENINGS

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SECTION 081113 – HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

- 1. Standard hollow-metal doors.
- 2. Standard hollow-metal frames for doors.

- B. Related Sections include the following:

- 1. Division 042200 Unit Masonry for embedding anchors for hollow metal work.
- 2. Division 087100 Sections for door hardware for standard steel doors.
- 3. Division 099120 painting Sections for field painting standard steel doors and frames.
- 4. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.

1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, fire-resistance and temperature-rise ratings, and finishes for each type of steel door and frame specified.
- B. Product Data: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. ANSI A250.8 indicates that manufacturer's published details are intended to suffice in place of Shop Drawings and Coordination Drawings in first two paragraphs and associated subparagraphs below; delete if not required.
- C. Shop Drawings: In addition to requirements below, provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details.

3. Frame details for each frame type, including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.
7. Details of glazing frames and stops showing glazing.

D. Qualification Data: For Installer and testing agency.

E. Sustainable Submittal: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

F. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of standard steel door and frame.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.

C. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.

D. Fire-Rated Door Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.

1. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches (1000 mm) or less above the sill.
2. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F (250 deg C) maximum in 30 minutes of fire exposure.

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.

1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.
 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating standard steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate installation of anchorages for standard steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Amweld Building Products, LLC.
 2. Ceco Door Products; an Assa Abloy Group company.
 3. Pioneer Industries, Inc.
 4. Steelcraft; an Ingersoll-Rand company.
 5. Windsor Republic Doors.
 6. Approved equal.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

- D. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching standard steel door frames of type indicated.
- E. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.
- F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD STEEL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.
 - 1. Design: Flush panel.
 - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.
 - a. Fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W) when tested according to ASTM C 1363.
 - 1) Locations: All doors.
 - 3. Vertical Edges for Single-Acting Doors: Beveled edge.
 - a. Beveled Edge: 1/8 inch in 2 inches.
 - 4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick end closures or channels of same material as face sheets.
 - 5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. All - Heavy-Duty Doors and Frames: SDI A250.8, Level 2.
 - 1. Physical Performance: Level B according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches
 - c. Face: Cold Rolled steel sheet, minimum thickness of 16 gauge, primed to be field painted.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

- 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W when tested according to ASTM C 1363.
3. Frames:
 - a. Materials: Cold Rolled steel sheet, minimum thickness of 14 gauge, primed ready for field painting.
 - b. Construction: Full profile welded.
 4. Exposed Finish: Prime.
 5. Allow for thermal expansion and contraction for the east, south and west exposures.
- C. Hardware Reinforcement: Fabricate reinforcement plates from same material as door face sheets to comply with the following minimum sizes:
1. Hinges: Continuous.
 2. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch (1.7 mm) thick.
 3. All Other Surface-Mounted Hardware: Minimum 0.067 inch (1.7 mm) thick.
- D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Exterior Frames, where indicated: Fabricated from metallic-coated steel sheet.
 1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
 2. Frames for Level 3 Steel Doors: 0.067-inch- (1.7-mm-) thick steel sheet, unless otherwise indicated.
- C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated: wet areas and exterior frame requirements.
 1. Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.042 inch for wet areas such as the pool and locker areas, changing rooms and restrooms.
 2. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
 3. Frames for Level 2 Steel Doors: 0.053-inch-thick steel sheet, unless otherwise indicated.
- D. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:
 1. Hinges: Minimum 0.123 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
 2. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch thick.
 3. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick.
- E. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.

- F. Jamb Anchors:
 - 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
- G. Floor Anchors: Formed from same material as frames, not less than 0.042 inch-thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
- H. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.
- I. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch- wide steel.
- J. Plaster Guards: Formed from same material as frames, not less than 0.016-inch thick.

2.5 STOPS AND MOLDINGS

- A. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch high, unless otherwise indicated.

2.6 FABRICATION

- A. General: Fabricate standard steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Standard Steel Doors:
 - 1. All Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Standard Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
 - 3. Plaster Guards: Weld guards to frame at back of hardware mortises in frames installed in concrete or masonry.
 - 4. Where installed in masonry, leave vertical mullions in frames open at top for grouting.
 - 5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 6. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

- 1) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.
 - 2) Two anchors per head for frames more than 42 inches (1066 mm) wide and mounted in metal-stud partitions.
- b. Compression Type: Not less than two anchors in each jamb.
 - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
- a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
1. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware.
 2. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

2.7 STEEL FINISHES, unless noted otherwise

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish standard steel door and frames after assembly.
- B. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils (0.018 mm).
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of standard steel doors and frames.
 - 1. Examine roughing-in for embedded and built-in anchors to verify actual locations of standard steel frame connections before frame installation.
 - 2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install standard steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Standard Steel Frames: Install standard steel frames for doors, and other openings, of size and profile indicated. Comply with SDI 105.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.

- d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster containing antifreezing agents.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 4 Section "Unit Masonry Assemblies."
 4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 5. Installation Tolerances: Adjust standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Standard Steel Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.
- B. Clean grout and other bonding material off standard steel doors and frames immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

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CONSTRUCTION DOCUMENT- CONFORM SET

END OF SECTION 081113

SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes electrically operated sectional doors.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Sectional doors shall meet performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Delegated Design: Design sectional doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Performance: Exterior sectional doors shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to ASCE/SE17:
 - 1. Wind Loads: Uniform pressure (velocity pressure) of 20 lbs/sf acting inward and outward.
 - a. Basic Wind Speed: 90 mph.
 - b. Exposure Category: B.
 - 2. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components. Deflection of door in horizontal position (open) shall not exceed 1/120 of the door width.
- D. Air Infiltration: Maximum rate not more than indicated when tested according ASTM E283 or DASMA 105.
 - 1. Air infiltration: Maximum rate of 0.08 cfm/sf at 15 and 25 mph.

- E. Windborne-Debris-Impact-Resistance Performance: Provide section doors that pass large missile impact and cyclic-pressure tests when tested according to ASTM E1886 and ASTM E1996.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory, include the following:
 - 1. Construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
 - 2. Rated capacities, operating characteristics, electrical characteristic, and furnished accessories.
- B. Shop Drawings: For each installations and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For sectional doors, accessories, and components, from manufacturer..
- C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sectional doors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Failure of components or operators before reaching required number of operation cycles.
 - c. Faulty operation of hardware.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
 - e. Delamination of exterior or interior facing materials.
 - 2. Warranty Period: Ten years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Basis-of-Design Product: The design is based on the product named in the basis-of-design and within the Construction Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.
 - 1. See Div. 01 Section for Substitution Procedures.

2.2 GLAZED SECTIONAL OVERHEAD DOORS

- A. Sectional Door: See Door Schedule for nominal size and floor plan for location.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
 - 1. Basis-of-Design Product: Subject to compliance with requirements provide: Overhead Door Corporation; Model 596 Series Thermacor Sectional Steel Door needed for a complete section door system.
 - 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work included in one of the following:
 - a. Amarr Garage Doors.
 - b. Arm-R-Lite.
 - c. C.H.I. Overhead Doors.
 - d. Martin Door Manufacturing.

- e. Raynor
 - f. Rite-Hite Corporation.
 - g. Wayne-Dalton Corp.
3. Door Assembly: Style and rail assembly secured with 1/4 inch (6mm) diameter through rods.
- 1. Panel Thickness: 2 inches (44mm).
 - 2. Center Stile Width: 2-11/16 inches (68mm).
 - 3. End Stile Width: 3-5/16 inches (94mm).
 - 4. Intermediate Rail Pair Width: 3-11/16 inches (94mm).
 - 5. Thermal Value = 17.4 R-value; 0.057 U-value.
 - 6. Springs: 100,000 cycles.
 - 7. Glazing: 1/4 inch (6mm) Polycarbonate glazing.
 - 8. Finish and Color: Exact color selected by architect from manufacturer's standard colors. Two-coat baked on polymer.
 - 9. Manual chain drive opener.
4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20 lbf/sq. ft. wind load, acting inward and outward.
- C. Wind Load Design: Provide to meet the Design/Performance requirements specified.
- D. Hardware: Galvanized steel hinges and fixtures. Ball bearing rollers with hardened steel races.
- E. Lock: Interior galvanized single unit.
- F. Track: Provide track as recommended by manufacturer to suit loading required and clearances available.
- G. Manual drive opener.
- H. Weatherstripping:
- 1. Flexible bulb-type strip at bottom section.
 - 2. Flexible jamb steel
 - 3. Flexible Header seal.
- I. Locking Devices: Equip door with slide bolt for padlock.
- J. Electric Door Operator:
- 1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
 - 2. Operator Type: Manufacturer's standard for door requirements.
 - 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower.
 - 4. Motor Exposure: dusty, wet, or humid.
 - 5. Emergency Manual Operation: Chain type.
 - 6. Obstruction-Detection Device: Automatic electric sensor edge on bottom section.

- a. Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range of colors.
 7. Control Station: Wall Mounted, both sides; Exterior - Key controlled, Interior – push button controlled.
 8. Other Equipment: Audible and visual signals.
- K. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
1. Electrical Characteristics (to be verified):
 - a. Phase: Single phase.
 - b. Volts: 115 V.
 - c. Hertz: 60.
 2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 5. Use adjustable motor-mounting bases for belt-driven operators.
- L. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- M. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
 - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.
 2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom section. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with door-operator control circuit to detect damage to or disconnection of sensor edge.

- N. Control Stations: Three position and Three-button control station in fixed location with momentary-contact controls labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."
 - 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 - 2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
- O. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 35 lbf.
- P. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- Q. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- R. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Tracks:
 - 1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches apart.
 - 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway

bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780/A 780M.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

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SECTION 085210 - ALUMINUM WINDOWS

PART 1 GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. Furnish and install single hung window units as described in Contract Documents.
- B. Related Sections
 - 1. Section 08 8100 - Quality of glazing and sealed units

1.2 REFERENCES

- A. American National Standards Institute / American Architectural Manufacturers Association.
 - 1. ANSI / AAMA 101-93, 'Aluminum Prime Windows and Sliding Glass Doors'
- B. American Architectural Manufacturers Association
 - 1. AAMA 1503.1-88, 'Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections'

1.3 SYSTEM DESCRIPTION

- A. Design Requirements
 - 1. Comply with minimum test requirements of ANSI / AAMA 101 for classification of specified window in following -
 - a. Air infiltration
 - b. Water Resistance
 - c. Uniform structural load
- 2. ANSI / AAMA 101 classification DH-C45 minimum for hung windows, tested at 4 feet wide by 7 feet high minimum.
 - B. Performance Requirements
 - 1. Meet following thermal performance -
 - a. Condensation Resistance Factor (CRF) of 48 minimum when tested in accordance with AAMA 1503.
 - b. Thermal Transmittance of 0.65 maximum when tested in accordance with AAMA 1503.

1.4 SUBMITTALS

- A. Product Data
 - 1. Manufacturer's literature or cut sheet
 - 2. Literature on glazing
 - 3. Color and finish selection
- B. Shop Drawings - Submit prior to framing. Show rough opening requirements.
- C. Quality Assurance / Control - Manufacturer's published installation instructions.

1.5 WARRANTY

- A. Provide written non-prorated manufacturer's warranty including
 - 1. 10 years for seal failure.

2. 2 years for failure of operating hardware
3. 2 years on stress cracks related to fabrication or installation problems.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

A. Windows

1. Factory glazed
2. Thermally broken system with poured-in-place and de-bridged structural thermal break.
3. Side load take out sash.
4. Finish And Color - clear anodized
5. Glazing Characteristics -
 - a. Clear interior pane and clear exterior panes with Low E treatment on surface 2.
 - b. Exterior pane shall be structural laminated.
 - c. See section 08 8100 - GLASS, for sealed unit configuration.
6. Glazing Beads - Manufacturer's standard.
7. Manufacturers And Models -
 - a. by Kawneer, West Valley City, UT Paul Cannon (801) 455-4184 FAX 801-974-9033
E-Mail - paulcannon@aol.com
 - b. by Vistawall, Terrell, TX Larry Garbert Phone (800) 869-4567 ex162
FAX 972-551-6264
8. Fixed unit.

2.2 ACCESSORIES

A. Anchoring Devices

1. Aluminum or stainless steel.
- 2 Other corrosion-resistant or insulated anchors as specifically approved by Architect in writing prior to use.

2.3 SOURCE QUALITY CONTROL

- A. When delivered to Project site, windows shall bear permanent label stating model of window and Manufacturer's name, or AAMA label.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Review Manufacturer's printed installation instructions prior to installing windows.
- B. Set window frame plumb, level, and in alignment. Secure window properly in opening.
- C. Apply specified sealant between window frame and building wall. Trim off excess sealant.
- D. Avoid direct contact between aluminum and adjacent steel work by insulating with materials equal to 3M's EC 1202 tape if materials are in pressure contact, or with bituminous paint if pressure between surfaces cannot be maintained.

3.2 FIELD QUALITY CONTROL

A. Notify Architect when windows are to be delivered to Project site to allow opportunity for Architect's inspection prior to installation.

3.3 CLEANING

A. After installation, clean interior and exterior metal surfaces of windows and accessories of mortar, plaster, paint, and other contaminants. Maintain protection and provide final cleaning.

END OF SECTION 085210

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SECTION 087010 - GENERAL HARDWARE REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Related Sections

1. Division 06 -
 - a. Architectural woodwork hardware
 - b. Installation

1.2 DEFINITIONS

A. Builders Hardware Manufacturer's Association (BHMA) Hardware Functions

1. F-75 Passage Latch - Latch bolt operated by knob / lever from either side at all times.
2. F-86 Utility Space Door Lock - Dead locking latch bolt operated by key in outside knob / lever or by rotating inside knob / lever. Outside knob / lever is always fixed.
3. E-2152 Deadbolt - Dead bolt operated by key from outside and turn button from inside. Bolt automatically dead locks when fully thrown.

1.3 SUBMITTALS

A. Product Data

1. Manufacturer's cut sheets
2. Two copies of Manufacturer's installation, adjustment, and maintenance instructions for each piece of hardware. Include one set in Operations And Maintenance M Manual and send one set with hardware when delivered.
3. Copy of hardware schedule
4. Written copy of keying system explanation. Keying information shall include high security keyway supplier's name, address, and phone number.
5. Copy of authorized signature card for rekeying.

B. Shop Drawings - Submit hardware schedule indicating hardware to be supplied. Schedule shall indicate details such as proper type of strikeplates, spindle lengths, hand, backset, and bevel of locks, hand and degree opening of closer, length of kickplates, length of rods and flushbolts, type of door stop, and other necessary information necessary to determine exact hardware requirements.

C. Quality Assurance / Control - Certificate or letter signed by hardware supplier and

D. Closeout - Submit keying plan and bitting schedule as record documents.

1.4 QUALITY ASSURANCE

A. Suppliers bidding this work shall have two years minimum experience in providing, detailing, scheduling, and installing builders hardware and shall employ at least one full time DHI Architectural Hardware Consultant (AHC).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Neatly and securely package hardware items by hardware group and identify for individual door with specified group number and set number used on Supplier's hardware schedule. Include fasteners and accessories necessary for installation and operation of finish hardware in same package.

1.6 SCHEDULING

A. Hardware Templates

1. Provide hardware templates within 14 days after hardware schedule is approved.
2. Supply necessary hardware installation templates to Division 06 prior to pre-installation meeting.

PART 2 PRODUCTS

2.1 FINISHES

A. Finishes for steel, brass, or bronze hardware items shall be US26D, Chromium plated, satin, except flat goods which may be US32D, stainless steel, satin. Materials other than steel, brass, or bronze shall be finished to match the appearance of US26D / 32D.

2.2 FASTENERS

A. Fasteners shall be of suitable types, sizes and quantities to properly secure hardware. Fasteners shall be of same material and finish as hardware unless otherwise specified. Fasteners exposed to weather shall be non-ferrous or corrosion resisting steel.

PART 3 EXECUTION

3.1 PREPARATION

A. Before ordering materials, examine documents to be assured that material to be ordered is appropriate for substrate to which it is to be secured and will function as intended.

3.2 HARDWARE GROUP SCHEDULE

A. See drawings for hardware callout.

END OF SECTION 08 7010

SECTION 087110 - HANGING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Products Supplied But Not Installed Under This Section
 - 1. Hinges for hollow metal doors
- B. Related Sections
 - 1. Division 06 -
 - a. Hinges for field fabricated shear wall and draft stop access doors
 - b. Hinges for Architectural Woodwork
 - 2. Section 08 7010 - General Hardware Requirements

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- A. Hinges
 - 1. Sizes -
 - a. 1-3/4 inch doors and fire-rated doors in metal frames - 4-1/2 inches by 4-1/2 inches.
 - b. 1-3/8 inch metal doors - 3-1/2 inches by 3-1/2 inches.
 - 2. Use non-removable pins on exterior opening doors.
 - 3. Hinges on exterior doors shall be solid brass, plated to achieve specified finish.
 - 4. Approved Manufacturers And Models -
 - a. Interior -
 - 1) Hager - BB 1279
 - 2) McKinney - TA 2714
 - 3) PBB - BB81
 - 4) Stanley - FBB 179
 - b. Exterior -
 - 1) Hager - BB 1191
 - 2) McKinney - TA 2314
 - 3) PBB - BB21
 - 4) Stanley - FBB 191

2.2 APPROVED MANUFACTURERS

- A. Hager Companies, St Louis, MO (314) 772-4400 www.hagerhinge.com
- B. McKinney, Scranton, PA (800) 346-7707 www.mckinneyhinge.com
- C. PBB, Ontario, CA (800) 726-3414 www.pbbinc.com
- D. Stanley, New Britain, CT (800) 337-4393 www.stanleyworks.com

END OF SECTION 08 7110

SECTION 087120 - SECURING DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section

1. Flush bolts
2. Surface bolts
3. Locksets and latchsets
4. Deadbolts
5. Cylinders
6. Interior exit devices
7. Tie down cables

B. Related Sections

1. Section 08 7010 - General Hardware Requirements

1.2 DELIVERY, STORAGE, AND HANDLING

A. Standard Key Delivery

1. Include change keys with hardware.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

A. General

1. Bolts shall have metal dust box strikes.
2. Furnish lead shields where required.
3. Backsets shall be 2-3/4 inches.
4. Electromagnetic Locks

B. Flush Bolts

1. Approved Manufacturers And Models -

a. Manual Flushbolts -	Metal Door	Wood Door
1) Glynn Johnson	FB6 F	B6W
2) Hager	282D	283D
3) Ives	458-1/2	262
4) Rockwood	555	557
5) Trimco/BBW	3917	3999

b. Manual UL Fire-Rated Flushbolts -

1) Glynn Johnson	FB6	FB6W
2) Hager	282D	283D
3) Ives	458	358
4) Rockwood	555	557
5) Trimco/BBW	3917	3913

c. Automatic Flushbolts -

1) Door Controls	845	945
2) Glynn Johnson	FB9	FB10
3) Hager	293D	294D
4) Ives	357	356
5) Rockwood	1845	1945
6) Trimco/BBW	3820	3825

C. Surface Bolts

1. Acceptable Manufacturers And Models -
 - a. Hager 276D
 - b. Ives 253B 26D, 12 inch.
 - c. Equal as approved by Architect before installation.

D. Locksets And Latchsets

1. Lever Operated -
 - a. Approved Models And Manufacturers -
 - 1) AL Series by Schlage (preferred)
 - 2) 170 Series by Marks
 - 3) 5400LN by Yale
2. Knob Operated -
 - a. Approved Models And Manufacturers -
 - 1) 120 by Marks
 - 2) A Series by Schlage
 - 3) 5300 Series by Yale

E. Deadbolts

1. Approved Manufacturers - Match manufacturer of locksets.

F. Standard Cylinders

1. Approved Manufacturers - Match Manufacturer of locksets

G. Electromagnetic Locks -

1. Electromagnetic Locks: BHMA A156.23; electrically powered; with electromagnetic attached to frame and armature plate attached to door; full-exterior type, as required by application indicated. Approved Manufacturers - Match Manufacturer of locksets
2. Function: Fail Safe
3. Exterior Function: Proximity reader.
4. Interior Function: Push button release

2.2 MANUFACTURERS

- A. DCI - Door Controls Inc, Dexter, MI (800) 443-4324
- B. Glynn-Johnson, Indianapolis, IN (800) 525-0336 www.vonduprin.com
- C. Hager, St Louis, MO (314) 772-4400 www.hagerhinge.com
- D. Ives, New Haven, CT (203) 772-0310
- E. Knappe & Vogt, Grand Rapids, MI (800) 253-1561 www.kv.com
- F. Marks USA, Amityville, NY (800) 526-0233
- G. Precision, Romulus, MI (313) 326-7500
- H. Rockwood, Manufacturing Co, Rockwood, PA (800) 458-2424
www.rockwoodmfg.com

- I. Sargent, New Haven, CT (203) 562-2151
- J. Schlage, Colorado Springs, CO (800) 847-1864 www.schlage.com
- K. Trimco / BBW, Los Angeles, CA (213) 262-4191 www.qualityhdwe.com
- L. Von Duprin, Indianapolis, IN (800) 999-0408 www.vonduprin.com
- M. Yale, Charlotte, NC (800) 438-1951 www.yalesecurity.com
- N. Maglock: Allegion PLC
- O. Maglock: Dorma USA
- P. Maglock: Assa Abloy
- Q. Maglock: Hager Companies
- R. Maglock: Securitron Magnalock Corp.

END OF SECTION 08 7120

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SECTION 087150 - CLOSING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Products Supplied But Not Installed Under This Section
 - 1. Closers for hollow metal doors.
- B. Related Sections
 - 1. Section 08 4110 - Closers for aluminum-framed storefront doors
 - 2. Section 08 7010 - General Hardware Requirements

1.2 WARRANTY

- A. Provide Manufacturer's standard warranty, 5 years minimum.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- A. Surface-Mounted Overhead Door Closers
 - 1. Closers provided under this Section shall be from same Manufacturer.
 - 2. Provide parallel arms on closers unless door position in relation to adjacent wall requires otherwise. Provide covers.
 - 3. Closers shall allow for 180 degree opening and not be used as a stop.
 - 4. Closers shall have following features -
 - a. Adjustable sweep speed
 - b. Adjustable backcheck
 - c. Non-handed, non-sized
 - 5. Approved Models And Manufacturers -
 - a. 7900 Series by Dorma, Reamstown, PA (800) 523-8483 www.dorma-usa.com
 - b. 1461 Series by LCN, Princeton, IL (800) 526-2400 www.lcnclosers.com
 - c. 8501 Series by Norton, Charlotte, NC (800) 438-1951 www.yalesecurity.com
 - d. 1431 Series by Sargent, New Haven, CT (203) 562-2151

2.2 SUMMARY OF DESIGN

- A. Where door closers are required for functional or safety reasons, they shall be from an acceptable manufacturer's heavy-duty, overhead, surface-mounted type.
- B. Closer must be made of cast iron, providing superior burst and yield strength, and must be tested to over 10 million cycles, demonstrating durability, elimination of internal leaks, and minimum porosity, additionally minimizing expansion and contraction.
- C. Closers shall have forged steel arms, providing maximum strength, including tensile and side loading.
- D. Closers must have a minimum 1 1/2" piston bore diameter to minimize abusive pressure spikes and achieve less psi of hydraulic pressure.
- E. Closers must have a double heat-treated pinion 11/16" with large teeth, and use full compliment bearings.
- F. All-weather hydraulic fluid must be provided in closers where temperature differential spans -30 degrees Fahrenheit to 120 degrees Fahrenheit, thus eliminating seasonal adjustments.

G. Powder-coated finish to be provided, passing a 100 hour salt spray test 4-times the standard.

H. High use doors shall have closers with a 20 year warranty. Moderate use doors shall have closers with a 10 year warranty.

I. Attaching screws shall bolt through doors; wood screws pull out and are, therefore, not acceptable.

J. Floor-mounted closers are not acceptable.

K. Pressure relief valves in closers are not acceptable.

L. Door closers shall not have hold-open devices, unless otherwise considered by the County Project Manager.

M. Closers shall be located on the inside of doors.

PART 3 EXECUTION

3.1 INSTALLATION

A. Mount closers on stop side of door wherever conditions permit.

B. Through-bolt hardware-to-door connections.

3.2 ADJUSTING

A. Adjust closers to provide maximum opening force as required by governing code authority and proper back check and sweep speed.

END OF SECTION 08 7150

SECTION 087160 - PROTECTIVE PLATES AND TRIM

PART 1 GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section

1. Kick plates

B. Related Sections

1. Section 08 7010 - General Hardware Requirements and VMR Suppliers

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

A. Kick Plates

1. Size - 10 inches high by width of door less 3/4 inch on each side.
2. Material - 0.050 inch thick Stainless Steel

2.2 APPROVED MANUFACTURERS

A. Baldwin, Reading, PA (215) 777-7811

B. Glynn-Johnson, Indianapolis, IN (800) 525-0336 www.vonduprin.com

C. Hager, St Louis, MO (314) 772-4400 www.hagerhinge.com

D. H B Ives, Wallingford, CT (203) 294-4837

E. Rockwood Manufacturing Co, Rockwood, PA (800) 458-2424 www.rockwoodmfg.com

F. Trimco / BBW / Quality, Los Angeles, CA (213) 262-4191 www.qualityhdwe.com

END OF SECTION 08 7160

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SECTION 087170 - STOPS AND HOLDERS

PART 1 GENERAL

1.1 SUMMARY

- A. Products Supplied But Not Installed Under This Section
 - 1. Door stops
 - 2. Door stops and holders
- B. Related Sections
 - 1. Section 08 7010 - General Hardware Requirements and VMR Suppliers

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- A. Stops
 - 1. Use wall type stops unless indicated otherwise on Door Schedule.
 - 2. Provide model appropriate for substrate. Wall stops may be either cast or wrought.
 - 3. Interior Wall, Approved Manufacturers And Models -
 - a. Baldwin - 4275
 - b. Glynn Johnson - 60W
 - c. Hager - 236W
 - d. Ives - 407-1/2
 - e. Quality - 302 Series
 - f. Rockwood - 409
 - g. Trimco / BBW - W1274CCS
 - 4. Exterior Wall, Approved Manufacturers And Models -
 - a. Baldwin - 4081
 - b. Glynn Johnson - WB11
 - c. Hager - 255W
 - d. Ives - 447
 - e. Quality - 138-38
 - f. Rockwood - 474/475
 - g. Trimco / BBW - 1204
 - 5. Floor Mount, Approved Manufacturers And Models -
 - a. Baldwin - 4001
 - b. Glynn Johnson - FB13 or FB13X
 - c. Hager - 242F
 - d. Ives - 436
 - e. Quality - 431ES
 - f. Rockwood - 440/441
 - g. Trimco / BBW - 1210
 - 6. Overhead, Approved Manufacturers And Models -
 - a. Corbin Russwin - DH5203 Series
 - b. Glynn-Johnson - 90S Series
 - c. Sargent - 590S Series

B. Door Stops And Holders

1. Approved Models And Manufacturers -
 - a. Baldwin - 4090-491 or 4095-4096
 - b. Glynn-Johnson - F20X, F20 or W20X, W20
 - c. Hager - 268F, 268S or 256S, 256W
 - d. Ives - 444, 445, 446, 450
 - e. Quality - 39, 139 or 47, 147
 - f. Rockwood - 472, 473, 476, 477
 - g. Trimco / BBW - 1223, 1224 or 1206, 1207

2.2 MANUFACTURERS

- A. Baldwin, Reading, PA (215) 777-7811
- B. Corbin Russwin, Berlin, CT (203) 225-7411 www.yalesecurity.com
- C. Glynn-Johnson, Indianapolis, IN (800) 525-0336 www.vonduprin.com
- D. Hager, St Louis, MO (314) 772-4400 www.hagerhinge.com
- E. H B Ives, Wallingford, CT (203) 294-4837
- F. Rockwood Manufacturing Co, Rockwood, PA (800) 458-2424 www.rockfordmfg.com
- G. Sargent, New Haven, CT (203) 562-2151
- H. Trimco / BBW / Quality, Los Angeles, CA (213) 262-4191 www.qualityhdwe.com

PART 3 EXECUTION

3.1 INSTALLATION

A. Interface With Other Work - When using overhead stops, coordinate installation with door closer and other door hardware.

B. All exterior and interior doors that do not swing open to at least 108 shall have door stops installed, preferably on a wall.

C. Handles, pulls, latches, locks, and other operating devices on accessible doors shall have a shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist to operate.

D. Lever-operated mechanisms, push-type mechanisms, and U-shaped handles are acceptable designs. When sliding doors are fully open, operating hardware shall be exposed and usable from both sides. Hardware required for accessible door passage shall be mounted no higher than 48 in (1220 mm) above finished floor.

END OF SECTION 08 7170

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SECTION 087180 - ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section

1. Metal thresholds where required for hollow metal doors
2. Weatherstripping for exterior hollow metal doors
3. Smoke gaskets
4. Silencers

B. Related Sections

1. Section 08 7010 - General Hardware Requirements and VMR Suppliers

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

A. Thresholds Approved Manufactures are: Pemko, Hager and NGP.

1. Interior Doors at Acoustic Seals, Approved Model And Manufacturer -
 - a. 151A by Pemko (ADA Compliant)
2. Outswinging Exterior Doors, Approved Model and Manufacturer bases for design -
 - a. 2005_T by Pemko (ADA Compliant)

B. Weatherstripping

1. Approved Models And Manufacturers -
 - a. 800S by Hager
 - b. A625A by NGP
 - c. 35041CP by Pemko

C. Smoke Gaskets

1. Color: Black
2. Approved Models And Manufacturers -
 - a. 726S by Hager
 - b. 5050 by NGP
 - c. S88D by Pemko

D. Door Silencers

1. Acceptable Models And Manufacturers -
 - a. For Wood Frames -
 - 1) GJ 65 by Glynn Johnson
 - 2) 308D by Hager
 - 3) 21 by Ives
 - 4) 1337 B by Quality
 - 5) 1229 B by Trimco / BBW
 - b. For Metal Frames -
 - 1) GJ 64 by Glynn Johnson
 - 2) 307D by Hager

- 3) 20 by Ives
 - 4) 1337 A by Quality
 - 5) 1229 A by Trimco / BBW
- c. Equal as approved by Architect before installation.

2.2 MANUFACTURERS

- A. Glynn Johnson, Indianapolis, IN (800) 525-0336 www.vonduprin.com
- B. Hager, St Louis, MO (314) 772-4400 www.hagerhinge.com
- C. H B Ives, Wallingford, CT (203) 294-4837
- D. National Guard Products - NGP, Memphis, TN (800) 647-7874 www.ngpinc.com
- E. Pemko, Ventura, CA (800) 283-9988 www.pemko.com
- F. Trimco / BBW / Quality, Los Angeles, CA (213) 262-4191 www.qualityhdwe.com

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install smoke gaskets and acoustical seals in manner to give continuous air-tight fit.
 1. Install smoke gaskets in 'wipe seal' configuration.
 2. Install acoustical seal with seal under door.

END OF SECTION 08 7180

SECTION 088050 - ACRYLIC GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. 3form glazing for window as indicated on the drawings.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated (including frame).
- B. Glass Samples: For each type of the following products, where indicated; 12 inches square.
- C. Qualification Data: For installers.
- D. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who have a minimum of 5 years experience with this type of work.
- B. Source Limitations for lite panels: From single source from single manufacturer for each type.

- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- D. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where thickness is indicated, it is a minimum. Provide thicknesses as indicated on the drawings or as needed to comply with application indicated.

2.2 GLASS PRODUCTS

- A. Manufacturer
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. 3form, Koda XT
 - b. Color as selected by Architect from manufacturer's full range of colors.

2.3 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including lite panel products, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and lite panel manufacturers' written instructions for selecting sealants suitable for applications indicated and for conditions existing at time of installation.
 3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
 4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant (unless otherwise indicated): Neutral-curing, non-migrating type silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; Bondaflex Sil 290.
 - d. Pecora Corporation; 890.
 - e. Sika Corporation, Construction Products Division; SikaSil-C990.
 - f. Tremco Incorporated; Spectrem 1.
- 2.4 GLAZING TAPES (if required select from the following)
- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
- 2.5 MISCELLANEOUS GLAZING MATERIALS
- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- 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).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.6 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of 3form, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect lite panel edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by lite panel manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
- H. 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.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by lite panels, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.

- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

- A. Comply with manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.8 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Remove and replace lite panels that are broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- D. Wash on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088050

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SECTION 088100 - GLASS

PART 1 GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. Quality of glazing used in windows and safety laminated windows.
- B. Related Sections
 - 1. 08 5000 Sections - Furnishing and installing of glazing in windows.

1.2 REFERENCES

- A. American Society For Testing And Materials
 - 1. ASTM C 1036-91, 'Standard Specification For Flat Glass'.
 - 2. ASTM C 1048-92, 'Standard Specification For Heat-Treated Flat Glass - Kind H, Kind FT Coated and Uncoated Glass'.
 - 3. ASTM E 774-92, 'Standard Specification for Sealed Insulating Glass Units'.
 - 4. ASTM E 1996 and ASTM C 1172 'Standard Specification for Extreme Wind and Impact - Glass Construction' and 'Standard Specification for Laminated Architectural Float Glass' respectively.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements - Glazing shall meet applicable requirements of Federal Consumer Product Safety Standard 16CFR1201.
- B. Manufacturer's Labels - Labels showing strength, grade, thickness, type, and quality are required on each piece of glass.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Exterior Window Glazing
 - 1. Thickness -
 - a. Glass Panes - 1/4 Inch, Double Strength
 - b. Sealed Units - 1 1/4 inch
 - 2. Double pane, sealed insulating glass units meeting requirements of ASTM E 774 and ASTM E 1996 for impact strength. Class A.
 - 3. Glazing shall have following characteristics -
 - a. Clear - ASTM C 1036, Type I, Class I, Quality q3.
 - b. Pyrolytic Low E -
 - 1) Energy Advantage Clear by LOF
 - 2) Equal by AFG, PPG, or Ford.
 - 3) Other low E glazing system standard with window manufacturer which meets or exceeds performance characteristics of specified glazing is approved.
 - c. Sealed units to be 1 1/4 inch as follows, exterior face to be 1/4 inch heat strengthened glass with PVB laminated interlayer coating applied to surface 2 over 1/4 inch heat strengthened glass. 1/2 inch air space. Glazing in window units interior face to be 1/4 inch heat strengthened glass. Exterior exposed glaze surface shall be structural laminated.
 - d. Glazing to be quality q3.

2.2 MANUFACTURERS

A. Approved Manufacturers for Low E and Gray Tinted Glazing

1. AFG Industries, Kingsport, TN (800) 251-0441
2. PPG Industries, Pittsburgh, PA (800) 377-5267
3. Saflex Architectural Glazing Solutions, 575 Maryville Centre Drive, St. Louis, MO 63141,
(314) 674-1000.
4. Guardian Architectural Glass Products, 14600 Romine Road, Carleton, MI48117,
(734) 654-6264.

END OF SECTION 08 8100

DIVISION 09 – FINISHES

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092200	Western 1-Kote Stucco System
092216	Non-Structural Metal Framing
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099123	Interior Painting
099650	Graffiti-Resistant Coatings
099726	Concrete Floor Sealant

SECTION 092200 - WESTERN 1-KOTE STUCCO SYSTEM

PART I – GENERAL

1.1 SCOPE:

- A. This specification describes the minimum requirements for the application of the Western 1-Kote Exterior System consisting of weather barrier, lath & fasteners, and Western 1-Kote.
- B. OR EQUAL

1.2 REFERENCE SECTION / SCOPES OF WORK:

- A. Section 03300 – Concrete
- B. Section 04220 – Unit Masonry
- C. Section 05410 – Load Bearing Steel Studs
- D. Section 06110 – Wood Framing
- E. Section 07250 - Vapor Retarders
- F. Section 07600 – Flashing and Sheet Metal
- G. Section 07900 – Joint Sealants
- H. Section 09250 – Sheathing Boards
- I. Section 09900 - Painting

1.3 REFERENCES:

- A. Western 1-Kote ICC Evaluation Report #1607
- B. Northwest Walls and Ceilings Bureau: Portland Cement Plaster Resource Guide - Latest Revision
- C. Federal Specification FS UUB 790-A Building Paper
- D. American Society for Testing and Materials (ASTM)
- E. International Building Code: Current Adopted Edition
 - 1. C 847 – Metal Lath
 - 2. C 897 – Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters.
 - 3. C 926 – Specification for Application of Portland Cement-Based Plaster.
 - 4. C 1063 – Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster.
 - 5. C 834 / C 920 Sealants
 - 6. E 119 – Test Method for Fire Tests of Building Construction Materials.

1.4 SYSTEM DESCRIPTION:

- A. Weather barrier, woven, welded or expanded metal lath reinforcement, Western 1-Kote Concentrate or sanded basecoat, and Western Exterior Stucco or Western Premium Acrylic Finish-Elastomeric (PAF-E).
- B. OR EQUAL

1.5 QUALITY ASSURANCE:

- A. Obtain cement plaster, stucco/synthetic finish, lath, fasteners and trim that comply with the requirements of the Western 1-Kote Exterior Stucco System
- B. Manufacturer: Sacramento Stucco or approved blenders of Western Blended Products.
- C. Contractor shall provide trained personnel qualified to install weather barrier, lath, plaster and finishes per the scope of work described in this specification.

1.6 DELIVERY, STORAGE AND HANDLING:

- A. Deliver, store, handle, and protect products for use on the project.
- B. Deliver product to job site:
 - 1. Without exposure to weather or other sources of moisture.
 - 2. In manufacturer's unopened container, packages or bundles; clearly identified.
- C. Store in dry, ventilated space off of the ground.
- D. Protect materials from soiling, rusting and damage.

1.7 SITE CONDITIONS:

- A. Contractor shall have reasonable and safe access to the jobsite for delivery, staging, storing, mixing and application of materials required for the described scope of work.

1.8 ENVIRONMENTAL CONDITIONS:

- A. Cold Weather Requirements: Provide heat and protection, temporary or permanent, as required to protect each coat of plaster from freezing – during and at least 24 hours after application or longer – to insure curing of the base and finish coats without freezing. Distribute heat uniformly to prevent concentration of heat on plaster near heat sources; provide deflection or protective screens. (Use of Xccelerate Cold Weather NON-Chloride additive is permissible.)
- B. Warm Weather Requirements: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and moist cure plaster to prevent dry out during the first forty-eight (48) hours or longer as required by climatic conditions. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these as required.
- C. Application Requirements: Apply plaster when substrate or ambient air temperature is 40 degrees F and rising (unless sand and mixing water are heated to 70 degrees F and temporary protection is provided to keep minimum 40 degrees F or above in plastered areas for 24 hours minimum after set has occurred in accordance with

PCA Portland Cement Plaster Stucco Manual. Do not use frozen materials in mixes and do not apply materials to frozen bases.

- D. Protection: Protect finished surface installed prior to plastering by covering with suitable drop cloths. When application of cement plaster is to interior spaces, screen openings with plastic film when building is subject to hot, dry winds, or when temperature differentials between interior and exterior spaces of more than 20 degrees F are present.

1.9 SEQUENCING:

- A. The General Contractor shall coordinate communications between the trades and scheduling of the work prior to project commencement and while the work is in progress.
- B. Consult other trades in advance and make provisions for their work to avoid cutting and patching.
- C. Applicator of the Cement Plaster System shall schedule all inspections required by local authorities or product manufacturers, at each required stage, before continuing with the next stage of the system.
- D. All wall penetrations shall be installed with proper flashing details by the appropriate trades before lathing shall begin. Flashing materials shall be compatible with sealant, building paper and flashings installed for the lath.
- E. Attachment of drywall or other products to the interior sides of walls receiving Western 1-Kote shall be complete before the installation of the exterior cement plaster.
- F. Tile, Stone or other roofing materials of significant weight shall be loaded onto roof before application of exterior cement plaster.
- G. Adequately moist cure Western 1-Kote.
- H. (Apply required leveling coats and primers.) **Attach specification 09220-BPS**
- I. (Apply acrylic finish coat.) **Attach specification 09220-PAF**

PART II – PRODUCTS

2.1 MANUFACTURERS:

- A. Sacramento Stucco Company, West Sacramento, CA.
- B. Western Stucco Company, Glendale, AZ.
- C. Rio Grande Stucco Company, El Paso, TX
- D. Ash Grove Packaging, Precision Packaging, Materials Packaging
- E. Fortifiber
- F. Clark Western, Cemco or equal
- G. Davis, K-lath, Structalath or equal
- H. Stockton Wire Products or equal

2.2 WEATHER BARRIER, LATH AND TRIM MATERIALS:

- A. All products used for the system shall be approved for exterior application.
- B. All weather barriers, flashings, metal reinforcing, trims, woven and welded wire, fasteners and other lath accessories for vertical and horizontal applications, shall be sized, spaced and installed per the listed reference standards and the latest adopted building codes.
- C. Expanded Metal Lath: Meeting requirements of ASTM C 847.
 - 1. Self-furring where attached directly to substrate.
 - 2. Flat or High-Rib where required.
- D. Strip Mesh: Expanded metal lath, minimum 2.5 pounds per square foot; 2 inch wide by 24 inches long.
- E. Sheathing Paper: Breather type asphalt saturated paper, water vapor permeable. Barrier to meet the following standards: FS UU-B-790a, Type 1, Style 2, Grade D 60 minute 2 ply UBC 1707a / 4706d. Sealant meeting ASTM C 834 or ASTM C920. Building paper, flashing and sealant shall be Fortifiber High Performance Window Flashing System.
- F. Trim:
 - 1. Casing Bead: Galvanized roll-formed sheet steel minimum 26 gauge, depth governed by plaster thickness. Maximum lengths.
 - 2. Corner Bead: Galvanized roll-formed sheet steel minimum 26 gauge. Maximum lengths; 2-5/8 inch expanded metal flanges (3-1/4 inch reinforced flanges).
 - 3. Control Joint: Galvanized formed sheet steel minimum 26 gauge, V or J profile, protected with plastic tape for removal after plastering, depth governed by plaster thickness; maximum lengths.
 - 4. Plastic Nose corner aid where specifically called out meeting ASTM D 1784

2.3 PLASTER MATERIALS:

Choose 1 or 2

- A. (Premium Sanded Western 1-Kote)
- C. (Western 1-Kote Concentrate)
- D. Aggregate: Natural sand in accordance with ASTM C 897.
- E. Water - Clean, fresh, potable and free of mineral or organic matter, which can affect plaster.

PART III – EXECUTION

3.1 EXAMINATION:

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

3.2 PREPARATION:

- A. Protect surfaces near the work of this Section from damage or disfiguration. Protect fixtures, frames, inserts and other adjacent work from rusting, soiling or clogging due to plastering.

3.3 Lathing – Walls:

- A. Install weep screeds where required.
- B. Install Fortifiber weather resistive barrier in accordance with section 2.2 of this specification.
- C. Install Casing Beads where required.
- D. Install Fortifiber High Performance Window Flashing System with Moistop neXT in place of Moistop PF for sill and jamb flashing.
- E. Install metal head flashing with end dams over all wall penetrations per NWCB Resource Guide detail FWB9
- F. Apply metal lath or woven wire per manufacturers' instructions. Fasten per ASTM C 1063, UBC Sections 25B, and 25-C
- G. Control joints should be utilized at all areas where movement may be anticipated such as: Wall penetrations, structural plate lines, or between dissimilar materials, columns and cantilevered areas.
- H. Stucco panel shall be designed to be no longer than twenty (20) feet without the use of a control joint and entire panel should not exceed a three to one ratio.
- I. As a general rule, stucco panels should be as square as possible and not in excess of 144 sq ft.
- J. Install 3/8" horizontal and vertical control joints where specified on drawings. Install over continuous lath. Vertical joints shall be continuous. Abut horizontal joints to vertical joints. Intersections and end-to-end terminations shall be embedded in sealant. Install level, plumb and true to line; secure firmly in place.
- K. Fasten all trims to wood or steel framing or wire tie. Attachment to sheathing is not permissible.
- L. Install casing beads where indicated on drawings or where plaster terminations are exposed. Butt and align ends. Install level, plumb and true to line; secure firmly in place.

3.4 APPLICATION – PLASTER APPLICATION:

- A. Mix and apply Western 1-Kote in accordance with ICC Report #1607 instructions. ICC report available at www.westernblended.com or www.icc-es.org
- B. Apply 3/8" to 1/2" base coat without cold joints.
 - 1. The brown coat shall be hard floated to promote densification.
 - 2. Cut brown coat through full depth with trowel or use applicable trims at intersection of plastered walls and plastered soffit.

3.5 CURING:

- A. Western 1-Kote must be hydrated for the first forty-eight (48) hours after application to ensure proper curing. Environmental conditions will determine the schedule and volume of hydration. Hot, windy or dry conditions may dictate curing for an extended period.

- B. Portland cement is a high pH surface. Follow instructions of finish coat manufacturer for proper application over Western 1-Kote.

END OF SECTION 092200

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes non-load-bearing steel framing members for the following applications:

1. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

1.2 SUBMITTALS

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

B. Provide information sufficient to show compliance for the suspended ceiling:

1. Comply with requirements of seismic design category 'D'.
2. Provide submittal showing compliance with ASTM C636, CISA guidelines and ASCE7 section 13.5.6

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. Sound Transmission Characteristics: For STC-rated assemblies that incorporate nonload-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Coordination of Trades: It is the responsibility of both the General Contractor and/or the Finish-Subcontractor to verify that the framing is straight, plumb, and square, if that is the intent of the design of the surface of each space, prior to the installation of the wall and ceiling materials.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
2. Protective Coating: manufacturer's standard corrosion-resistant zinc coating, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.

C. Flat Hangers: Steel sheet.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.

1. Depth: 2-1/2 inches or as per manufacturers recommendation for this layout.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch bare-steel thickness, with minimum 1/2 inchwide flanges, 3/4 inch deep.

2. Steel Studs: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.0179 inch

b. Depth: As indicated on Drawings

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

a. Minimum Base Metal Thickness: 0.0179 inch

F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

a. Armstrong World Industries, Inc.; Drywall Grid Systems.

b. Chicago Metallic Corporation; 640-C Drywall Furring System.

c. USG Corporation; Drywall Suspension System.

d. Or equal

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: Meet or exceeds ASTM C645 & C754. AISI-NASPEC 2001. ASTM E119, E72 & E90. ICC_ES1977. Architectural Testing, Inc. ATI CCRR-0109. NYC MEA 300-05-M. UL Listed V450- Unless noted otherwise on the Construction Drawings provide as follows:

1. 362 UDS-20EQ:

a. Web depth 3.625 in.

b. Thickness 25 mils (20 gauge) EQ

2. 250 UDS-20EQ:

a. Web depth 2.500 in.

b. Thickness 25 mils (20 gauge) EQ

3. 162 UDS-25EQ:

a. Web depth 1.625 in.

b. Thickness 15 mils (25 gauge) EQ

B. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.

2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1) Steel Network Inc. (The); VertiClip SLD Series.

2) Superior Metal Trim; Superior Flex Track System (SFT).

3) Or equal

C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0179 inch Retain first paragraph and subparagraphs below for channel bridging for fixture attachment or lateral bracing. Indicate locations and details of installation on Drawings.

D. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2 inch wide flanges.

1. Depth: As indicated on Drawings or inches
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0179 inch
2. Depth: 7/8 inch

F. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

G. Cold-Rolled Furring Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inchwide flanges.

1. Depth: As indicated on Drawings.
 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch.
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inchdiameter wire, or double strand of 0.0475-inch- diameter wire.
- H. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.4 AUXILIARY MATERIALS

A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

3.2 INSTALLING SUSPENSION SYSTEMS

A. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

B. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within as defined in the differed submittal requirements.

3. Do not attach hangers to steel roof deck.

4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.

5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.

6. Do not connect or suspend steel framing from ducts, pipes, or conduit.

C. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

D. Seismic Bracing: Sway-brace suspension systems with hangers used for support for seismic category 'D'. Grid suspension systems are suitable for use with gypsum board. They might not be acceptable for gypsum veneer plaster; consult gypsum veneer plaster and grid suspension system manufacturers before specifying them.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.3 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Where studs are installed directly against new or existing walls assuming the design of the exterior masonry walls are not intentionally sloped and corners are not angled, apply studs against the exterior masonry wall, only if, masonry wall will allow studs to be plumb and corners square otherwise shim and/or layout furring as needed to provide plumb and straight walls and square corners.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb, unless otherwise indicated.

b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.

c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

D. Direct Furring:

1. Screw to wood framing.

2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c. E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 09 2216

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Gypsum board.
 - 2. Tile backing panels.
 - 3. Backing Panel for shower wall panels.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry".
 - 2. Section 061600 "Sheathing".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:

1.4 QUALITY ASSURANCE

- A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Install mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - b. Each texture finish indicated.
 - 2. Apply or install final decoration indicated, including painting and wall coverings, on exposed surfaces for review of mockups.
 - 3. Simulate finished lighting conditions for review of mockups.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent unless otherwise indicated.
- B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- C. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Gypsum.
 2. CertainTeed Corp.
 3. Georgia-Pacific Gypsum LLC.
 4. JamesHardie.
 5. National Gypsum Company.
 6. USG Corporation.

2.3 GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
1. Thickness: 5/8 inch. and 1/2 inch.
 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- B. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
1. Core: **5/8 inch**, Type X.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 SPECIALTY GYPSUM BOARD

- A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.
1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
 2. Long Edges: Tapered.
- B. Mold Resistant Acoustically Enhanced Gypsum Board: ASTM C 1396/C 1396M. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. National Gypsum Company; Sound Break.
 - b. Quiet Solution, Quiet Rock.
 - c. Approved equal.
 2. Core: 1/2 inch, Type X, where indicated
 3. Core: 5/8 inch, Type X, where indicated.
 4. Long Edges: Tapered.

2.5 GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Glass-Mat Gypsum Sheathing Board, where indicated: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; GlasRoc Sheathing.
 - b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
 - c. National Gypsum Company; Gold Bond, e(2)XP.
 - d. USG Corporation; Securock Glass Mat Sheathing.
 2. Core: 5/8 inch, Type X, and 1/2 inch.

2.6 TILE BACKING PANELS (Select from the Following)

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; GlasRoc Tile Backer.
 - b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
 - c. Approved equal.
 2. Core: 5/8 inch (15.9 mm), Type X.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges, unless otherwise indicated.
1. Thickness: 5/8 inch, unless otherwise indicated.
 - a. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274. American Gypsum.
 2. Core: 5/8 inch (15.9 mm), Type X.

2.7 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 2. Shapes, select from the following where indicated:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - d. Expansion (control) joint.
 - e. Curved-Edge Cornerbead: With notched or flexible flanges.

- B. Exterior Trim: ASTM C 1047.
 - 1. Material: Hot-dip galvanized steel sheet, or rolled zinc.
 - 2. Shapes:
 - a. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - b. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.8 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
 - 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 - 5. Skim Coat: For final coat of Level 5 finish where indicated, use setting-type, sandable topping compound.
- D. Joint Compound for Exterior Applications:
 - 1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
 - 2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.
- E. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
 - 2. Cementitious Backer Units: As recommended by backer unit manufacturer.
 - 3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.9 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Laminating adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
 - b. Grabber Construction Products; Acoustical Sealant GSC.
 - c. Pecora Corporation; AC-20 FTR.
 - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - e. USG Corporation; SHEETROCK Acoustical Sealant.
 - 2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- F. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:

1. Type X: As indicated on Drawings at vertical and horizontal surfaces.
2. Flexible Type: As indicated on Drawings. Apply in double layer at curved assemblies.
3. Moisture- and Mold-Resistant Type X: As indicated on Drawings at wet areas and exterior stud walls.
4. Mold Resistant Acoustically Enhanced Type: As indicated on Drawings to meet required STC ratings.

- 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 (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

- C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- E. Curved Surfaces:
 - 1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
 - 2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.
 - 3. Refer to Wall Types on Drawings for additional information.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

- A. Where indicated, apply panels perpendicular to supports, with end joints staggered and located over supports.
 - 1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
 - 2. Fasten with corrosion-resistant screws.
 - 3. Skim Coat Surface.

3.5 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
- B. Cementitious Backer Units: ANSI A108.11, at locations indicated.
- C. Water-Resistant Backing Board: Install where indicated with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
- D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.
4. U-Bead: Use at exposed panel edges where indicated.
5. Curved-Edge Cornerbead: Use at curved openings.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

E. Aluminum Trim: Install in locations indicated on Drawings.

3.7 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile, panels that are substrate for acoustical tile and where indicated on Drawings.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

a. Primer and its application to surfaces are specified in other Section 099123 "Interior Painting." Level 5 is suitable for surfaces receiving gloss and semigloss enamels and other surfaces subject to severe lighting. It is considered a high-quality gypsum board finish.

5. Level 5: Where indicated on Drawings.

a. Primer and its application to surfaces are specified in other Section 099123 "Interior Painting."

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.8 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

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SECTION 096623 - RESINOUS MATRIX TERRAZZO FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Thin-set, epoxy-resin terrazzo flooring.

- B. Related Requirements:

- 1. Section 079200 "Joint Sealants" for sealants installed with terrazzo.
- 2. Section 096723 "Resinous Flooring" for decorative resinous flooring systems applied as self-leveling slurries or as troweled or screeded mortars.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]**.

- 1. Review methods and procedures related to terrazzo including, but not limited to, the following:
 - a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
 - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - c. Review special terrazzo designs and patterns.

1.4 ACTION SUBMITTALS

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

- B. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work. Show layout of the following:

- 1. Divider strips.
- 2. Control-joint strips.
- 3. Accessory strips.
- 4. Abrasive strips.

5. Stair treads, risers, and landings.
 6. Precast terrazzo jointing and edge configurations.
 7. Terrazzo patterns.
- C. Samples: For each exposed product and for each color and texture specified, **6 inches (150 mm)** in size.
- D. Samples for Initial Selection: NTMA's "Terrazzo Color Palette" showing the full range of colors and patterns available for each terrazzo type.
- E. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo Sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in sizes indicated below:
1. Terrazzo: [**6-inch- (150-mm-)**] square Samples.
 2. Precast Terrazzo: [**6-inch- (150-mm-)**] square Samples.
 3. Accessories: [**6-inch- (150-mm-)**] long Samples of each exposed strip item required.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each type of terrazzo material or product.
- C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- D. Preinstallation moisture-testing reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For terrazzo to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Engage an installer who is a contractor member of NTMA.
 2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 1. Build mockups for terrazzo including accessories.

- a. Size: Minimum 100 sq. ft. (9 sq. m) of typical poured-in-place flooring and base condition for each color and pattern
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
- B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
- C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
- B. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.

2.3 EPOXY-RESIN TERRAZZO

- A. Epoxy-Resin Terrazzo **<Insert designation>**: Comply with manufacturer's written instructions for matrix and aggregate proportions and mixing.

1. Sherwin-Williams Company
2. Key Resin Company
3. Sika Sarnifil.
4. Similar qualified product company.

- B. Mix Color and Pattern: **[As selected by Architect from manufacturer's full range]** **[As selected by Architect from NTMA's "Terrazzo Color Palette" EI Series]** **[As selected by Architect from NTMA's "Terrazzo Color Palette" EII Series]** **[As selected by Architect from NTMA's "Terrazzo Color Palette" EIII Series]** **[As selected by Architect from NTMA's "Terrazzo Color Palette" EIV Series]** **[Match Architect's sample]** **[Match existing]** **<Insert NTMA designation or custom mix>..**

- C. Materials:

1. Moisture-Vapor-Emission-Control Membrane: Two-component, high-solids, high-density, low-odor, epoxy-based membrane-forming product produced by epoxy terrazzo manufacturer that reduces moisture emission from concrete substrate to not more than **3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)** in 24 hours.
2. Substrate-Crack-Suppression Membrane: Product of terrazzo-resin manufacturer, having minimum 120 percent elongation potential according to ASTM D 412.
 - a. Reinforcement: Fiberglass scrim.
3. Primer: **[Manufacturer's product recommended for substrate and use indicated]** **<Insert requirements>**.
4. Epoxy-Resin Matrix: **[Manufacturer's standard recommended for use indicated]** **<Insert requirements>** and in color required for mix indicated.
 - a. Physical Properties without Aggregates:
 - 1) Hardness: 60 to 85 per ASTM D 2240, Shore D.
 - 2) Minimum Tensile Strength: **3000 psi (20.7 MPa)** per ASTM D 638 for a **2-inch (51-mm)** specimen made using a "C" die per ASTM D 412.
 - 3) Minimum Compressive Strength: **10,000 psi (6.9 MPa)** per ASTM D 695, Specimen B cylinder.
 - 4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.

- a) Distilled water.
 - b) Mineral water.
 - c) Isopropanol.
 - d) Ethanol.
 - e) 0.025 percent detergent solution.
 - f) 1.0 percent soap solution.
 - g) 5 percent acetic acid.
 - h) 10 percent sodium hydroxide.
 - i) 10 percent hydrochloric acid.
 - j) 30 percent sulfuric acid.
- b. Physical Properties with Aggregates: For terrazzo blended according to manufacturer's recommendations with one part epoxy resin with three parts marble aggregate consisting of 60 percent No. 1 chips and 40 percent No. 0 chips that is ground and grouted to a **1/4-inch (6.35-mm)** nominal thickness, and cured for 7 days at **75 deg F (24 deg C)** plus or minus **2 deg F (1 deg C)** and at 50 percent plus or minus 2 percent relative humidity.
- 1) Flammability: Self-extinguishing, maximum extent of burning **1/4 inch (6.35 mm)** according to ASTM D 635.
 - 2) Thermal Coefficient of Linear Expansion: **0.0025 inch/inch per deg F (0.0025 mm/mm per 0.5556 deg C)** according to ASTM C 531.
5. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
- a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131/C 131M.
 - b. 24-Hour Absorption Rate: Less than 0.75 percent.
 - c. Dust Content: Less than 1.0 percent by weight.
6. [<Double click to insert sustainable design text for recycled content.>](#)
7. Finishing Grout: Resin based.

2.4 STRIP MATERIALS

- A. Thin-Set Divider Strips: L-type angle in depth required for topping thickness indicated.
1. Material: **[As indicated] [White-zinc alloy] [Brass] [Aluminum] [Plastic, in color selected from full range of industry colors] <Insert requirements>**.
 2. Top Width: **[As indicated] [1/8 inch (3.2 mm)] [1/4 inch (6.4 mm)] <Insert dimension>**.
- B. Heavy-Top Divider Strips: L-type angle in depth required for topping thickness indicated.
1. Bottom-Section Material: **[As indicated] [Galvanized steel] [Matching top-section material] <Insert requirements>**.
 2. Top-Section Material: **[As indicated] [White-zinc alloy] [Brass] [Aluminum] [Plastic, in color selected from full range of industry colors] <Insert requirements>**.

3. Top-Section Width: [As indicated] [1/8 inch (3.2 mm)] [1/4 inch (6.4 mm)] [3/8 inch (9.5 mm)] [1/2 inch (12.7 mm)] <Insert dimension>.
- C. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.
- D. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
 1. Base-bead strips for exposed top edge of terrazzo base.
 2. Edge-bead strips for exposed edges of terrazzo.
 3. Nosings for terrazzo stair treads and landings.
 4. <Insert requirements>.
- E. Abrasive Strips: [Three-line] [Two-line] [One-line] [Abrasive nosing strip and two-line] <Insert requirements> abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
 1. Width: [1/2 inch (12.7 mm)] <Insert dimension>.
 2. Depth: As required by terrazzo thickness.
 3. Length: [4 inches (100 mm) less than stair width] [As indicated] <Insert dimension>.
 4. Color: [As selected by Architect from full range of industry colors] <Insert requirements>.

2.5 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.
- B. Anchoring Devices:
 1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
 2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.
- C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.
- F. Sealer: [Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; and is recommended by sealer manufacturer] [Acrylic] [Urethane] [Chemical-resistant epoxy] [Water based] <Insert requirements>.

1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
2. Acid-Base Properties: With pH factor between 7 and 10.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
- B. Concrete Slabs:
 1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written instructions.
 - c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.
- C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
- D. Preinstallation Moisture Testing:
 1. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests.
 2. Moisture Testing: Perform tests so that each test area does not exceed [**200 sq. ft. (18.6 sq. m)**] <Insert area>, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Moisture-Vapor-Emission Test: Maximum moisture-vapor-emission rate of [**3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)**] <Insert rate> in 24 hours when tested according to ASTM F 1869 using anhydrous calcium chloride.
 - b. Relative Humidity Test: Maximum [**75**] <Insert number> percent relative humidity measurement when tested according to ASTM F 2170 using in-situ probes.

3. Proceed with terrazzo installation only after concrete substrates pass moisture testing[**or after installation of moisture-vapor-emission-control membrane on substrate areas that fail testing**].
- E. Moisture-Vapor-Emission-Control Membrane: Install according to manufacturer's written instructions.
 1. Install on concrete substrates that incorporate lightweight aggregates.
 2. Install concrete substrates that fail preinstallation moisture testing.
- F. Substrate-Crack-Suppression Membrane: Install to isolate and suppress substrate cracks according to manufacturer's written instructions.
 1. Prepare and prefill substrate cracks with membrane material.
 2. Install membrane [**at substrate cracks**] [**to produce full substrate coverage**] in areas to receive terrazzo.
 3. Reinforce membrane with fiberglass scrim.
- G. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
 1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

3.3 EPOXY-RESIN TERRAZZO INSTALLATION

- A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- B. Strip Materials:
 1. Divider and Control-Joint Strips:
 - a. Locate divider strips [**in locations indicated**].
 - b. Install control-joint strips: **back to back and directly above concrete-slab control joints**] [**in locations indicated**].
 - c. Install control-joint strips with [**1/4-inch (6.4-mm)**] gap between strips, and install sealant in gap.
 - d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
 2. Accessory Strips: Install [**as required to provide a complete installation**] [**in locations indicated**] <Insert requirements>.
 3. Abrasive Strips: Install with surface of abrasive strip positioned [**1/16 inch (1.6 mm)**] <Insert dimension> higher than terrazzo surface.
- C. Apply primer to terrazzo substrates according to manufacturer's written instructions.

- D. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions.
 - 1. Installed Thickness: **1/4 inch (6.4 mm)** nominal.
 - 2. Terrazzo Finishing: Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
 - a. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond abrasives. Follow initial grind with 60/80-grit stones or with comparable diamond abrasives.
 - b. Grouting: Before grouting, clean terrazzo with water, rinse, and allow to dry. Apply and cure epoxy grout.
 - c. Fine Grinding/Polishing: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted. Grind with **[80] [120]**-grit stones or with comparable diamond abrasives until grout is removed from surface.
 - 3. Installation Tolerance: Limit variation in terrazzo surface from level to **1/4 inch in 10 feet (6.4 mm in 3 m)**; noncumulative.
- E. Install and finish poured-in-place terrazzo stairs at the same time the adjacent terrazzo flooring is installed.
- F. Install and finish poured-in-place terrazzo base at the same time the adjacent terrazzo flooring is installed.

3.4 PRECAST TERRAZZO INSTALLATION

- A. Install precast terrazzo units using method recommended in writing by NTMA and manufacturer unless otherwise indicated.
- B. Do not install units that are chipped, cracked, discolored, or improperly finished.
- C. Seal joints between units with **joint compound matching precast terrazzo matrix**.

3.5 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.6 CLEANING AND PROTECTION

- A. Cleaning:
 - 1. Remove grinding dust from installation and adjacent areas.
 - 2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

- B. Sealing:
 - 1. Seal surfaces according to NTMA's written recommendations.
 - 2. Apply sealer according to sealer manufacturer's written instructions.

- C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 096623

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Concrete.
2. Clay masonry.
3. Steel.
4. Galvanized metal.
5. Aluminum (not anodized or otherwise coated).
6. Exposed dimension lumber (rough carpentry).
7. Plastic trim fabrications.
8. Exterior portland cement (stucco).
9. Exterior gypsum board.

B. Related Sections include the following:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 06 Sections for shop priming carpentry with primers specified in this Section.
3. Division 09 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 SUBMITTALS

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

B. Samples for Verification: For each type of paint system and each color and gloss of top-coat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).

b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on benchmark samples.

a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish 1 gal. (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.

2. Products: Subject to compliance with requirements, provide one of the products specified.

3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

5. Basis-of-Design Product: The design of each product type is based on the product named in the legend(s) found at the end of this section and within the Construction Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.

6. See Div 01 Section 012500 for "Substitution Procedures".

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

2.3 MANUFACTURERS

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

1. Benjamin Moore & Co.
2. Bennette Paint Mfg. Co., Inc.
3. Cabot Incorporated, Samuel
4. Columbia Paint & Coatings.
5. ICI Paints.
6. Kwal-Howells Paint.
7. Porter Paints.
8. PPG Architectural Finishes, Inc.
9. Sherwin-Williams Company (The).

B. PAINT PRODUCTS

1. (PT-X):
 - a. Basis-of Design Product: See 'Paint Finish Legend' at the end of this section and in the Construction Documents as the product listed as the basis-of-design.

2.4 BLOCK FILLERS

A. Interior/Exterior Latex Block Filler: MPI #4.

1. VOC Content: E Range of E2 maximum.

2.5 WOOD FILLERS

A. Wood Filler Paste: MPI #91.

1. VOC Content: E Range of E2 maximum.

2.6 PRIMERS/SEALERS

A. Alkali-Resistant Primer: MPI #3.

1. VOC Content: E Range of E2 maximum.

B. Bonding Primer (Water Based): MPI #17.

1. VOC Content: E Range of E2 maximum.

2.7 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

1. VOC Content: E Range of E2 maximum.

B. Quick-Drying Alkyd Metal Primer: MPI #76.

1. VOC Content: E Range of E2 maximum.

C. Cementitious Galvanized-Metal Primer: MPI #26.

1. VOC Content: E Range of E2 maximum.

D. Waterborne Galvanized-Metal Primer: MPI #134.

1. VOC Content: E Range of E2 maximum.
- E. Quick-Drying Primer for Aluminum: MPI #95.
 1. VOC Content: E Range of E2 maximum.

2.8 STAINS

- A. Exterior Semitransparent Stain (Solvent Based): MPI #13.
 1. VOC Content: E Range E2 maximum.

2.9 EXTERIOR LATEX PAINTS

- A. Exterior Latex (Flat): MPI #10 (Gloss Level 1).
 1. VOC Content: E Range of E2 maximum.
- B. Exterior Latex (Semigloss): MPI #11 (Gloss Level 5).
 1. VOC Content: E Range of E2 maximum.

2.10 QUICK-DRYING ENAMELS

- A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
 1. VOC Content: E Range of E2 maximum.
- B. Quick-Drying Enamel (High Gloss): MPI #96 (Gloss Level 7).
 1. VOC Content: E Range of E2 maximum.

2.11 ALUMINUM PAINT

- A. Aluminum Paint: MPI #1.
 1. VOC Content: E Range of E2 maximum.

2.12 FLOOR COATINGS

- A. Interior/Exterior Clear Concrete Floor Sealer (Water Based): MPI #99.
 1. VOC Content: E Range of E2 maximum.
- B. Interior/Exterior Latex Floor and Porch Paint (Low Gloss): MPI #60 (maximum Gloss Level 3).
 1. VOC Content: E Range of E2 maximum.
 2. Environmental Performance Rating: EPR 2.
- C. Exterior/Interior Alkyd Floor Enamel (Gloss): MPI #27 (Gloss Level 6).
 1. VOC Content: E Range of E2 maximum.
 2. Additives: Manufacturer's standard additive to increase skid resistance of painted surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Masonry (Clay and CMU): 12 percent.
2. Plaster: 12 percent.
3. Gypsum Board: 12 percent.
4. Wood: 15 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.

C. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

D. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

E. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Aluminum Substrates: Remove surface oxidation.

I. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

J. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.

K. Exterior Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. General:

B. Concrete Substrates, Traffic Surfaces:

1. Latex Floor Paint System: MPI EXT 3.2A.

a. Prime Coat: Interior/exterior latex floor and porch paint (low gloss).

b. Intermediate Coat: Interior/exterior latex floor and porch paint (low gloss).

c. Topcoat: Interior/exterior latex floor and porch paint (low gloss).

C. CMU Substrates:

1. Latex System: MPI EXT 4.2A.

a. Prime Coat: Interior/exterior latex block filler.

b. Intermediate Coat: Exterior latex matching topcoat.

c. Topcoat: Exterior latex [(flat)] [(semigloss)] [(gloss)].

D. Exposed Rough Carpentry Substrates:

1. Basis-of-Design Product: Cabot, Semi-transparent Acrylic Stain- #1300 Series or by substitution:

a. Semitransparent Stain System: MPI EXT 6.2L.

1. Two Stain Coats: Exterior semitransparent stain (solvent based).

E. Steel Substrates:

1. Quick-Drying Enamel System: MPI EXT 5.1A.

a. Prime Coat: Quick-drying alkyd metal primer.

b. Intermediate Coat: Quick-drying enamel matching topcoat.

c. Topcoat: Quick-drying enamel [(semigloss)] [(high gloss)].

F. Galvanized-Metal Substrates:

1. Latex Over Water-Based Primer System: MPI EXT 5.3H.

a. Prime Coat: Waterborne galvanized-metal primer.

b. Intermediate Coat: Exterior latex matching topcoat.

c. Topcoat: Exterior latex semigloss.

G. Aluminum Substrates:

1. Latex System: MPI EXT 5.4H.

a. Prime Coat: Quick-drying primer for aluminum.

b. Intermediate Coat: Exterior latex matching topcoat.

c. Topcoat: Exterior latex semigloss.

H. Glue-Laminated Beam and Column Substrates:

1. Latex System: MPI EXT 6.1L.

a. Prime Coat: Exterior latex wood primer.

b. Intermediate Coat: Exterior latex matching topcoat.

c. Topcoat: Exterior latex [(flat)] [(semigloss)] [(gloss)].

I. Plastic Trim Fabrication Substrates:

1. Latex System: MPI EXT 6.8A.

a. Prime Coat: Bonding primer (water based).

- b. Intermediate Coat: Exterior latex matching topcoat.
- c. Topcoat: Exterior latex (semigloss).
- 2. Alkyd System: MPI EXT 6.8B.
 - a. Prime Coat: Bonding primer (water based).
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (semigloss).
- J. Exterior Gypsum Board Substrates:
 - 1. Latex System: MPI EXT 9.2A.
 - a. Prime Coat: Exterior latex matching topcoat.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex as indicated on paint schedule on drawings.

END OF SECTION 099113

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SECTION 099123 - INTERIOR PAINTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on typical building interior substrates- see Paragraph 3.3 Interior Painting Schedule, at the end of this section, for an indication of items to be painted. Note: This Schedule, while trying to be complete, may not include all surfaces and needs to be augmented with painting noted throughout the Construction Drawings, including but not limited to the Room Finish Schedule and the Project Manual.

B. Related Sections include the following:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 06 Sections for shop priming carpentry with primers specified in this Section.
3. Division 08 Sections for factory priming windows and doors with primers specified in this Section.
4. Division 09 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.3 SUBMITTALS

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

B. Samples: For each finish and for each color and texture required provide an 8-1/2" x 11" sample for approval by Owner. Note: Allow for sufficient time in the submittal process for this review by Architect and Owner to occur without hindering the schedule.

C. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products, preparation and workmanship: Complying with MPI standards indicated and listed in "MPI Approved Products List."

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional (five) 5% percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
5. Basis-of-Design Product: The design of each product type is based on the product named in the legend(s) found at the end of this section and within the Construction Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.
6. See Div 01 Section 012500 for "Substitution Procedures".

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Flat Topcoat Paints: VOC content of not more than 50 g/L.
4. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.
 - j. 1,2-dichlorobenzene.
 - k. Diethyl phthalate.

- l. Dimethyl phthalate.
- m. Ethylbenzene.
- n. Formaldehyde.
- o. Hexavalent chromium.
- p. Isophorone.
- q. Lead.
- r. Mercury.
- s. Methyl ethyl ketone.
- t. Methyl isobutyl ketone.
- u. Methylene chloride.
- v. Naphthalene.
- w. Toluene (methylbenzene).
- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

2.3 PAINT PRODUCTS

A. Available Manufacturers: The following are approved manufacturers that may be considered for a comparable product as part of the request for substitution:

1. Benjamin Moore & Co.
2. Bennette Paint Mfg. Co., Inc.
3. Columbia Paint & Coatings.
4. ICI Paints.
5. Kwal-Howells Paint.
6. Porter Paints.
7. PPG Architectural Finishes, Inc.
8. Sherwin-Williams Company (The).

B. PAINT PRODUCTS

1. (PT-X):

a. Basis-of Design Product: See 'Paint Finish Legend' at the end of this section and in the Construction Documents as the product listed as the basis-of design.

C. PRIMERS/SEALERS

1. Interior Latex Primer/Sealer: MPI #50.
2. Interior Alkyd Primer/Sealer: MPI #45.

D. METAL PRIMERS

1. Quick-Drying Alkyd Metal Primer: MPI #76.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

C. Percentages in five subparagraphs below are based on "MPI Architectural Painting Specification Manual."

1. Gypsum Board: 12 percent.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

D. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:

1. Mechanical Work:

a. Uninsulated metal piping.

b. Uninsulated plastic piping.

c. Pipe hangers and supports.

d. Tanks that do not have factory-applied final finishes.

e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.

f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

h. Do not paint new elevator hoist machine and related equipment

2. Electrical Work:

a. Do not paint existing switchgear.

b. Do not paint existing panelboards.

c. Do paint electrical equipment that is indicated to have a factory-primed finish for field painting.

E. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

F. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.3 INTERIOR PAINTING SCHEDULE

A. The following items may or may not be specifically called out in the Room Finish Schedule or noted throughout the Construction Drawings & Project Manual but should be included as part of the painting scope of work when exposed to view:

1. Floors:

a. Concrete.

b. Wood.

B. Paint in living units, Clubhouse and Pool Restrooms. These areas shall receive a three tone paint finish as indicated.

1. Walls: (Paint Tone 1)

a. Gypsum wallboard.

- b. Wood.
- 2. Ceilings & Soffits: (Paint Tone 2)
 - a. Gypsum board.
 - b. Wood.
- 3. Trim, Doors, Door Casing and Window Casing: (Paint Tone 3)
 - a. Wood
- 4. Miscellaneous Items:
 - a. Handrails whether metal or wood if not factory finished.
 - b. Guardrails whether metal or wood if not factory finished.
 - c. Hollow metal doors and frames.
 - d. Exposed metals, when not covered by other materials, to include but not limited to:

ited to:

- 1) HSS columns
- 2) Metal brackets

5. Mechanical/Electrical/ - see 3.2 D.1 & D.2. Paint systems in this Article are based on "MPI Architectural Painting Specification Manual" (hereafter, "MPI Manual"). For renovation projects, consult "MPI Maintenance Repainting Manual" and revise paint systems accordingly.

C. Concrete Substrates, Nontraffic Surfaces:

- 1. Latex System: MPI INT 3.1E.
 - a. Prime Coat: Interior latex matching topcoat.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex: flat
- 2. Latex Over Sealer System: MPI INT 3.1A.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex flat

D. Steel Substrates:

- 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex: flat

E. Gypsum Board Substrates:

- 1. Latex System: MPI INT 9.2A.
 - a. Prime Coat: Interior latex matching topcoat.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex: flat

END OF SECTION 099123

SECTION 099650 - GRAFFITI-RESISTANT COATINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. Furnish and apply anti-graffiti coating as described in Contract Documents.
- B. Related Sections
 - 1. Section [04 2000](#) - Concrete Masonry Unit

1.2 SUBMITTALS

- A. [Product Data](#)
 - 1. Manufacturer's product data and MSDS sheets.
 - 2. Published instructions on care and maintenance procedures including graffiti removal using both hot and cold water methods and re-application.
- B. [Quality Assurance / Control](#) - Published graffiti removal and product application instructions on lining substrate preparation requirements, application methods, and equipment necessary for each substrate to be protected.

1.3 QUALITY ASSURANCE

- A. Qualifications
 - 1. Applicators shall have been trained by and acceptable to Coating Manufacturer.
 - 2. Applicator shall have experience in application of specified products for five years minimum and be acceptable to Architect.
- B. Regulatory Requirements - Comply with applicable hazardous material and VOC regulations.
- C. Field Samples - Demonstrate application of anti-graffiti coating on masonry mock-up panels provided under Division 04 following specified application procedures and coverage rates.
- D. [Pre-Installation Conference](#) - Schedule pre-installation conference to occur during application of field samples.

1.4 [DELIVERY, STORAGE, AND HANDLING](#)

- A. Deliver specified products in original containers with Coating Manufacturer's labels intact on each container.

1.5 PROJECT CONDITIONS

- A. Project Environmental Conditions - Perform application when ambient and surface temperatures are 40 deg. F minimum and rising.

1.6 MAINTENANCE

- A. Provide maintenance kit for cold water removal process consisting of following
 - 1. Two suitable brushes
 - 2. Two paint rollers with a roller pan
 - 3. Two stiff bristle scrub brushes
 - 4. Two marked Hudson type sprayers filled with appropriate product, one for anti-graffiti coating and one for cleaning agent.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Anti-Graffiti Coating

1. Transparent, non-perceptible finish which will not alter natural texture and appearance of substrate.
2. UV stable, vapor permeable, and pH neutral.
3. Sacrificial type coating system.
4. System which does not create hazardous waste containment and recapture problem during graffiti removal.

B. Approved Products

1. Anti-Graffiti Coating -
 - a. Graffiti Protector (J-44) by Dayton / Richmond
 - b. Deface Eraser SC-1 by Prosoco
2. Cleaning Agent -
 - a. Graffiti Klean (J-45) by Dayton / Richmond
 - b. Graffiti Wipe by Prosoco

2.2 MANUFACTURERS

- A. Dayton / Richmond Concrete Accessories, Oregon, IL (800) 745-3707 or (937) 866-0711
www.daytonrichmond.com
- B. Prosoco, Kansas City, KS (800) 255-4255 or (913) 281-2700 www.prosoco.com

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive coating to make certain that jointing, tooling, and cleaning operations specified in other Sections have been completed and that no conditions are present that would prevent proper application of system.

3.2 PREPARATION

- A. Protection
 1. Protect adjacent surfaces and landscaping as recommended by Coating Manufacturer.
 2. Allow surfaces to properly cure and dry before application of coating. Allow new masonry to cure seven days minimum before application of coating.
- B. Surface Preparation
 1. Clean surfaces of dust, dirt, and other foreign material that will interfere with proper coating application.
 2. Allow surfaces to dry to within limits recommended by Coating Manufacturer.

3.3 APPLICATION

A. Carefully follow Specifications and Coating Manufacturer's written application program. Do not exceed Coating Manufacturer's recommended coverage rate.

3.4 CLEANING

A. Upon completion of work of this Section, remove excess coating material from surrounding surfaces and leave work clean, orderly, and in acceptable condition.

3.5 DEMONSTRATION

A. Demonstrate graffiti removal and re-application procedures by applying graffiti to masonry mock-up panel provided under Division 04, removing graffiti, and re-applying protective coating. Use specified maintenance kit for demonstration of cold water method and discuss requirements for hot water method.

END OF SECTION 099650

SECTION 099726 - CONCRETE FLOOR SEALANT

PART 1 GENERAL

1.1 Summary

- A. Includes But Not Limited To
 - a. Preparing and sealing of new concrete apparatus floor and other service areas indicated to be left exposed in finished building, as described in Contract Documents.
- B. Related Sections
 - a. Section 09901 – General Painting Requirements.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittal:
 - a. Product Data for Credit IEQ 4.2: For interior paints and coatings, documentation including printed statement of VOC content.
 - b. Laboratory Test Reports for Credit IEQ 4: For interior paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - c. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
- C. Samples for Initial Selection: For each finish coat indicated.

PART 2 – PRODUCTS

2.1 Materials

- A. Florock
 - a. First Coat - Florock System 3700 – Solvent Based Epoxy Primer.

2.2 Approved Manufacturers

- A. Florock Coatings, Chicago, Illinois (800)356-7625 (www.florck.net)
- B. Equal Approved Prior to Bidding

PART 3 – EXECUTION

3.1 Application

- A. Twenty eight day cure on new concrete.
- B. Follow Manufacturer's directions carefully, making sure that concrete is clean and properly prepared before sealing.

END OF SECTION 099726

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DIVISION 10 – SPECIALTIES

TABLE OF CONTENTS

SECTION	ITEM
104413	Fire Extinguisher Cabinets
104416	Fire Extinguishers
108110	Toilet Accessories

SECTION 104413 - FIRE EXTINGUISHER CABINET

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes fire protection cabinets for fire extinguishers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- C. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 FIRE PROTECTION CABINET (FE#, see Schedule at the end of this section):

- A. Cabinet Type: Suitable for fire extinguisher.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide J. L. Industries, Inc., a division of Activar Construction Products Group;
 - 1) Type: Ambassador Series
 - 2) Cabinet Material: Cold-rolled Steel with Powder-coat Finish
 - 3) Tub Material: Cold-rolled Steel with Powder-coat Finish
 - 4) Mounting: Semi-recessed and Surface Mount
 - 5) Glazing: Full Tempered Glass
 - 6) Fire Rated Option: Yes
 - 2. or a comparable product by one of the following:
 - a. Fire End & Croker Corporation;
 - b. Kidde Residential and Commercial Division, Subsidiary of Kidde plc;
 - c. Larsen's Manufacturing Company;
 - d. Modern Metal Products, Division of Technico Inc.;
 - e. Potter Roemer LLC.

- B. Cabinet Construction: Nonrated and Fire Rated.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch thick, cold-rolled steel sheet lined with minimum 5/8-inch thick, fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Steel sheet.

D. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

E. Cabinet Trim Material: Steel sheet, same material and finish as door.

F. Door Material: Steel sheet.

G. Door Style: Fully glazed panel with frame.

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.

3. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.

4. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door glazing.

2) Application Process: Decals or Pressure-sensitive vinyl letters.

3) Lettering Color: Black.

4) Orientation: Vertical.

K. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:
a. Exterior of cabinet door, and trim, except for those surfaces indicated to receive another finish.

b. Interior of cabinet and door.

2. Steel: Baked enamel or powder coat.

a. Color and Gloss: White or Red.

2.3 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Miter and weld joints and grind smooth.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed and prepare recesses as required by type and size of cabinet and trim style.

B. Install fire protection cabinets in locations and at mounting heights indicated and at heights acceptable to authorities having jurisdiction.

C. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

D. Identification: Apply decals or vinyl lettering at locations indicated.

E. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

F. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

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SECTION 104416 - FIRE EXTINGUISHER

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.
- C. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.4 WARRANTY

A. Fire Extinguishers warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: 6 (Six) years from date of shipment.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers:

1. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

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

- a. Ansul Incorporated; Tyco International Ltd.
- b. J. L. Industries, Inc.; a division of Activar Construction Products Group.
- c. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
- d. Larsen's Manufacturing Company.

1. If not noted otherwise provide the following fire extinguisher type and capacity: Multipurpose dry-chemical type in steel container UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with red or black baked-enamel finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 108110 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Products Supplied But Not Installed Under This Section
 - 1. Accessories for Rest Rooms, Grab Bars
- B. Related Sections
 - 1. Division 06 -
 - a. Blocking
 - b. Installation

1.2 SUBMITTALS

- A. Product Data - Manufacturer's literature or cut sheets
- B. Shop Drawings - Schedule showing items used, location where installed, and proper attaching device

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- A. Approved Products And Manufacturer - equals from list of approved manufactures part 2.2 of this section.

- 1. Rest Rooms - listed manufactures product is bases of design.
 - a. Grab Bars - Concealed mount, 18 ga, type 304 stainless steel, 1- 1/2 inch diameter, and non-slip finish in configuration as shown on Drawings.
 - b. Soap Dispensers: Model number B-5050, by Bobrick.
 - c. Robe Hook: Model number B233, by Bobrick.
 - d. Mirror: Model number B-298 2436, by Bobrick.
 - e. Toilet Paper Dispensers: Model number B-5288, by Bobrick.
 - f. Semi-Recessed Paper Towel Dispenser/Waste Receptacle: Model number B-4369, by Bobrick.
 - g. Shower Rod, Hooks and Curtain: B-207x60, 204-1 and 204-3 (respectively), by Bobrick.
 - h. Phenolic Folding shower seat: B-5191, by Bobrick.

2.2 APPROVED MANUFACTURERS

- A. A & J Washroom Accessories, New Windsor, NY (914) 562-3332.
- B. ASI - American Specialties Inc, Yonkers, NY (914) 476-9000.
- C. Bobrick Washroom Equipment Inc, North Hollywood, CA (818) 764-1000.
- D. Bradley Corp, Menomonee Falls, WI (414) 251-6000.
- E. GAMCO - General Accessory Manufacturing Co, Dallas, TX (800) 451-5766.
- F. World Dryer, 5700 McDermott Drive, Berkeley, IL 60163. (708) 449-6950.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install items in accordance with Manufacturer's instructions. Provide mounting devices proper for base structure.

B. Install sealant around perimeter of all toilet accessories.

C. Provide required block for all toilet accessories as required to install and secure product in place. Reference GENERAL NOTES on Construction Document drawings for concentrated load requirement for Grab Bars and Shower Seat.

END OF SECTION 10 8110

DIVISION 13 – SPECIAL CONSTRUCTION

TABLE OF CONTENTS

SECTION	ITEM
131213	Interactive Water Feature

SECTION 131213 - INTERACTIVE WATER FEATURE

PART 1 - GENERAL REQUIREMENTS:

1.01 RELATED SECTIONS AND DOCUMENTS:

The General provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to the work specified in this section.

Other related sections include the following:

Division 3 – Concrete (for additional concrete and finishing requirements.)

Division 22 – Plumbing

Division 23 – Heating Ventilating and Air Conditioning

Division 26 – Electrical

Division 31 –Earthwork (for additional sub-grade preparation for interactive water feature and interactive water feature system backfilling requirements.)

Division 00 – Procurement and Contracting Requirements and Division 1 – General Requirements, as indexed, apply to this section. Comply with the provisions of the codes, specifications and standards of the Department of Health for the public interactive water features and other applicable codes and regulations and as shown on the drawings and/or hereinafter specified. The interactive water feature contractor is responsible to submit plans to the local Health Department for approval. Plans shall be reviewed, approved and stamped by the Health Officer and Building Department before the contractor may begin construction. See Division 1 – General Requirements for additional information.

1.02 SCOPE:

“Interactive Water Feature” or “Splash Pad” or “River” or “Pool” or “Feature” means any Interactive Feature / River etc. shown as part of this project. Herein the feature shall be designated as Interactive Water Feature. The Interactive Water Feature Contractor shall furnish and install the Interactive Water Feature including but not limited to the reinforced concrete feature / river, structures, finishes, piping, fittings, circulation and filtration equipment, sanitizing systems, deck tiles, grating, waterproofing, sealants & caulking, water play features, etc. shown on the Interactive Water Feature drawings and as specified herein (unless otherwise determined by the General Contractor as part of scope delineation).

1.03 INTERACTIVE WATER FEATURE CONTRACTOR'S RESPONSIBILITY:

The Interactive Water Feature Contractor shall provide the following services:

Provide and pay all costs relative to start up and or training of owner's designated operator in the correct use of equipment required for the Interactive Water Feature function and operation as recommended by the product manufacturers. Interactive Water Feature Contractor shall supply a qualified field technician for this purpose.

Provide chemicals for interactive water feature operation at time of start-up. Provide liquid chlorine, hydrochloric acid, and cyanuric acid as aids in maintaining chemical balance. The interactive water feature contractor is responsible to maintain proper balancing tank water chemistry and keep the interactive water feature, pump vault and balancing tank swept and vacuumed clean until the project substantial completion and the interactive water feature is turned over to the owner.

1.04 MEASUREMENTS:

During bidding, the contractor shall examine the site and compare it with the drawings and specifications. Verify all dimensions shown on Drawings by taking field measurements; proper fit and attachment of all parts is required. Before commencing work, check all lines and levels indicated and such other work as has been completed. Should there be any discrepancies, immediately report in writing to the Architect.

1.05 COORDINATION:

Coordinate work with other trades (Electrical, Mechanical, Plumbing, General, etc.). Coordinate with the soils engineer, soils testing contractor and General Contractor to assure proper grading, soil properties, compaction requirements, membranes, and sub drain locations and installation before commencing work.

1.06 DELIVERY AND STORAGE:

Deliver materials undamaged to the job site in each manufacturer's unopened containers. Inspect for damage and remove damaged items from job site. Store and adequately protect undamaged materials against damage while temporarily stored at the site. Store materials off the ground under protective covers.

1.07 SUBMITTALS:

Submit five (5) copies of manufacturer's performance data, specifications and installation instructions for each accessory and/or equipment specified. Submittal shall be, as a minimum, bound in a three ring binder with labels and tabs for each submittal category. As an alternate means of submittal, the submittals may be provided as one joined pdf format with the information as described above – with each cut-sheet identified for its intended use (individual pdfs are not acceptable and will be required to be resubmitted). Also see requirements of Division 1. Submittal shall be made to the Architect for approval prior to beginning any work on the pool.

Submit for the following:

1. Pipe & Pipe Fittings
2. Valves, each type
3. Balancing Tank Fittings
4. Interactive water feature Frame & Grates
5. Interactive water feature Features / Fittings
6. Feature Controller
7. Variable Frequency Drive
8. High Rate Sand Filter
9. Pumps with and without integral hair and lint strainers
10. Hair and Lint Strainers
11. Basket Strainer
12. Chemical Controller w/ sensors (complete with water level control)
13. Chemical Feeders
14. Chemical Storage Vessels
15. Chemicals (MSDS Sheets)
16. Ultra Violet (UV) Disinfection System
17. Flow Meter Sensor
18. Gauges, Meters and Instrumentation
19. Pre-Fabricated Concrete Balancing Tank (with access hatch and grated vent)
20. Pre-Fabricated Concrete Pump Vault (with access hatch)
21. Pipe Penetration Seals and Sleeves
22. Waterproofing Materials

23. Sealants and Caulking
24. Expansion Joint Materials
25. Waterstops
26. No Running Tiles
27. Interactive Water Feature Area Safety Signs
28. Chemical Room Safety Signs
29. Cleaning Equipment including Portable Vacuum
30. Water Test Sets
31. Concrete Experience Data
32. Quality Assurance Information
33. Non-structural Components
 - a. Provide the details and engineering calculations (wet stamped and signed) for all non-structural components permanently attached to structures and their supports and attachments, designed to resist the effects of earthquake motions in accordance with ASCE 7-05.
 - b. Submit to building department as a deferred submittal (if required by building inspector).

Product Sample Submittals:

1. Interactive water feature Finish: Concrete Mock-Up
Submit one 24" x 24" mock-up with a finish as called for in the project document. Submittal of sample shall be made to the Landscape Architect for approval prior to beginning any work on the interactive water feature.

Shop Drawings Required:

1. Animation Control Panel
 - Submit panel design and components.
 - Submit sequence choreography, including simulation.
 - See section 7 for additional requirements.

1.08 SUBSTITUTIONS:

If any contractor wishes to submit a substitution / equivalent / or an alternate recirculation system, filter, and/or water feature item, the contractor shall submit plans and specifications to the Architect for approval at least ten (10) days prior to the bid date. Said plans and specifications shall be for this specific project, and show the installation of the proposed equipment. All changes required in the interactive water feature structure and in the building construction shall be listed in order to determine the extra costs or savings thereof. Substitutions, equivalents, and alternates submitted for the interactive water feature system shall also include all of the submittal information required in Section 13 1213, Paragraph 1.07 (with the exception of the full shop drawings) to the Architect for approval at least ten (10) days prior to the bid date.

Whenever the words "or equal," "or approved equal" appear in the specification or plans, they shall be interpreted to mean material or an item of equipment equal in quality to that named. The burden of proof of quality or service shall be on the supplying contractor. Proof of inequality is not implied by the specifications and is not a burden of the owner or his representatives. The Architect shall be sole judge as to whether or not an item submitted as an equal is acceptable. If the Interactive water feature Contractor submits a substitution on an "equal" basis, he shall assume all risks involved should the architect find it not acceptable. The Interactive water feature Contractor shall assume all costs for charges in drawings and specifications affected by the substitution, and the cost increase, if any, on adjoining work.

1.09 PATENTED MATERIALS:

The Interactive Water Feature Supplier/Contractor shall pay all royalties and license fees. The Interactive Water Feature Contractor shall defend all suits or claims for infringement of any patent

rights and shall save the Owner, the General Contractor, the Interactive water feature Engineer, and the Architect harmless from the loss on account thereof, except that the Interactive water feature Contractor shall not be responsible for all such loss when a particular manufacturer or manufacturers is specified. But, if the Interactive water feature Contractor has reason to believe that the design, process, or product specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the General Contractor, Interactive water feature Engineer, Owner, and Architect. Also see General Conditions and Division 1.

1.10 GUARANTEE:

Provide Guarantee / Warranty per GENERAL CONDITIONS, and per each individual piece of equipment and/or accessory as listed by manufacturer.

1.11 INSPECTION:

Examine all sub surfaces to receive work and report in writing to the Architect any conditions detrimental to work. Failure to observe this injunction constitutes a waiver to any subsequent claims to the contrary and will make this Contractor responsible for any corrections the Architect may require. Continuation of work will be construed as acceptance of all sub surfaces.

1.12 QUALIFICATION OF INTERACTIVE WATER FEATURE CONTRACTOR:

The apparent low bidder shall deliver to the Architect, Owner, & Interactive water feature Engineer for approval the following experience data in writing within 24 hours after the bid opening, for verification of experience of the Interactive water feature Contractor:

1. That the interactive water feature contractor shall be a state-licensed commercial swimming pool contractor.
2. That the prospective bidder has demonstrated suitable technical experience by having successfully installed at least two (2) interactive water features of the material, design, complexity, and extent to that indicated for this project within the past five years. List the principals to contact regarding said interactive water features so that proper inquiries can be made as to their completion, interactive water feature technology used, operation, etc., relative to such construction.
3. Only interactive water features constructed by the firm submitting the bid will be considered. Interactive water features by another company or individual in the employ of another concern shall not be considered.
4. A list of the major public pool and interactive water feature jobs he currently has under contract, the amount of the contracts and the current percentage of completion.

The interactive water feature contractor shall provide a qualified project manager throughout the contract period with experience managing projects with the construction type, size and scope similar to this project. The project manager shall be on site as required to assure proper coordination, scheduling, and performance of work.

The interactive water feature contractor shall be bondable and shall furnish a letter of intent to furnish 100% Performance and Payment Bond from their bonding agency. The interactive water feature contractor shall furnish proof of all liability insurance, etc. and also that of any subcontractor. Also see General Conditions and Division 1.

1.13 CODES AND STANDARDS:

Comply with the provision of the codes, specifications, and standards of the ANSI/NSPI standard, the current International Building Code standards, International Fire Code Standards, Local Building Department standards, and County Department of Health standards for public swimming pools, and other applicable codes and regulations and as shown on the drawings and/or hereinafter specified.

- All Local Pool-Related Codes
- County Codes
- Utah Pool-Related Health Codes, including R392-302
- ANSI, MAHC, and other industry standards
- NEC section 680

In addition to those standards referenced above, work in this section shall conform to requirements of the following reference standards, as applicable, unless otherwise required herein or on the drawings. Unless otherwise indicated on the drawings, or specified, furnish the highest or best grade of material specified in referenced standards.

1. American National Standards Institute (ANSI):
 - a. A13.1-81 Scheme for the identification of Piping Systems
2. American Society for Testing and Materials (ASTM):
 - a. A36-81A Structural Steel
 - b. A120-83 Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless, for Ordinary Uses
 - c. A123-78 Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes
 - d. A153-82 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - e. A386-78 Zinc Coating (Hot-Dip) on Assembled Steel Products
 - f. D1785-81 Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
 - g. D1785-83 Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - h. D2464-76 Threaded Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
 - i. D2467-76 A Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
 - j. D2564-80 Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings
 - k. D2774-04 Underground Installation of Thermoplastic Pressure Piping
 - l. F1668-96 Construction Procedures for Buried Plastic Pipe
 - m. F2376-08 Classification, Design, Manufacture, Construction, and Operation of Water Slide Systems.
 - n. F2461-09 Manufacture, Construction, Operation, and Maintenance of Aquatic Play Equipment.
 - o. C94 Standard Specification for Ready-Mix Concrete
3. Manufacturers Standardization Society of Valves and Fittings Industry (MSS):
 - a. SP-58-1983 Pipe Hangers and Supports - Materials and Design
 - b. SP-69-1983 Pipe Hangers and Supports - Selection and Application
4. National Fire Protection Association (NFPA):
 - a. National Electric Code (NEC) (applicable adopted year of publication)
 - b. National Fire Protection Association (NFPA) - Standard No. 704
5. Other Codes and Standards:
 - a. Utah R392-302 Design, Construction and Operation of Public Pools
 - b. Not Used
 - c. NSF - Standard 50 & Standard 61
 - d. U.S. EPA - Clean Water Act
 - e. UFC - Article 80
 - f. American Public Health Association Public Swimming Pools: Recommended Regulations for Design and Construction, Operation and Maintenance”
 - g. WWA - Construction for Operating Safely
 - h. IAPMO Standard IAPMO / ANSI Z 124.7-1997 for a fiberglass reinforced plastic spa pool

- i. OSHA 29 CRF - Hazard Communication Standard
- j. National Spa and Pool Institute (NSPI) Standards: ANSI/NSPI-1 2003: American National Standard for Public Swimming Pools.
- k. US EPA - SARA Title III
- l. UFC - Standard No. 79-3
- m. National Sanitation Foundation - Standard Number 50: Circulation System Components for Swimming Pools, Spas, or Hot Tubs: NSF Listings: Swimming Pools, Spas, and Hot tubs
- n. FIFRA - Worker Safety Regulations
- o. National Electrical Code (NEC) (applicable adopted year of publication) Article 680: Swimming Pools, Fountains, and Similar Installations
- p. US EPA - 40 CFR 122.26
- q. OSHA - CFR 1910.146
- r. APHA - Model Swimming Pool Code
- w. CDC - Proper Swimming Pool Design
- t. CDC - Water Slide Flumes
- u. CDC - Public Spas and Hot tubs
- v. UL - Green Book
- w. UL - Yellow Book
- x. The Chlorine Institute - Safety at Nonresidential Pools
- y. International Building Code (IBC) applicable adopted year of publication
- z. International Fire Code (IFC) applicable adopted year of publication
- 1. Chapters on Hazardous Materials, Corrosive Materials, Oxidizers and any other applicable chapters
- aa. ANSI - Standard 14.3 for Ladders and Safety Equipment
- bb. ASME - Standard A13.1 for pipe labeling and marking code

1.14 RELATED WORK AND RESPONSIBILITIES OF THE GENERAL CONTRACTOR:

General responsibilities of the General Contractor shall be as follows:

Harmful Chemicals: No contractor or his workmen shall place any acid or alkaline chemicals or oil in contact with interactive water feature which will be injurious to the interactive water feature or interactive water feature materials.

Contact with Other Systems: General Contractor shall not hang or connect pipe, electrical conduit, or any other materials to the interactive water feature system.

The General Contractor shall furnish labor, material, services, equipment, and appliances necessary to perform the following work in connection with installation of the interactive water feature, as required by the approved drawings and specified herein:

Locations: General Contractor shall be responsible for horizontal dimensions and grade elevations accurately from established lines and bench marks, as required by the drawings, and be responsible for those grades.

Safeguards: Provide, erect and maintain all necessary barricades, signs, lights and flares to protect workmen and the public.

The general contractor is responsible for implementing and enforcing a confined-space entry safety plan per OSHA prior to performing any work in the balancing tank or the pump vault.

Provide temporary light, heat, water, and power service to installation area, as may be needed for construction. Provide water to fill the interactive water feature balancing tank.

Precaution: Do not bring in or operate compaction equipment, trucks or other heavy equipment within five feet of the interactive water feature, its components, the balancing tank or pump vault.

Responsibility for Damage: The General Contractor shall protect the interactive water feature from damage during surrounding construction, back-filling and deck installation and shall be responsible for the cost of repairs for damage to the interactive water feature caused by his construction equipment and/or workmen.

Sub-Drain: General Contractor shall provide and install permanent sub-drain system underneath the interactive water feature, balancing tank and / or pump vault in areas where there is a potential for groundwater.

Site Preparation: The General Contractor shall provide all site preparation per the recommendations of an owner provided site specific project soils report to ready the site for the interactive water feature excavation and interactive water feature installation requirements. Also see Section 2300 –Earthwork.

Site Preparation Structural Backfill: Also see Section 2300 –Earthwork. General Contractor shall thoroughly compact any backfill that is around or supports any interactive water feature piping equipment or components to 95% Modified Proctor. It shall be compacted in 8" loose layers to 95% of maximum dry density based on ASTM D1557. All fill shall be tested. Contractor will be responsible for any damage to the work as a result of that compaction. The General Contractor shall provide all site preparation backfill per the recommendations of an owner provided site specific project soils report to ready the site for the interactive water feature excavation and interactive water feature installation requirements.

Disposal: Remove excess and unsuitable soil and materials. Dispose of said materials on or off the site as directed by the Architect or Owner. This includes excess soil as a result of the interactive water feature, pump vault and balancing tank excavation. Interactive water feature contractor is responsible to stockpile excess soil on site at General Contractor's direction.

Concrete Work: General Contractor shall construct backwash pit of reinforced concrete as per Architectural drawings, interactive water feature drawings and structural drawings. Coordinate between all drawings and notify architect immediately if a discrepancy is found.

Balancing Tank: General Contractor shall provide and install continuous Ribbed Centerbulb water stops at all joints of the tank. The waterstops shall be compatible with the concrete system, the liquids and/or chemicals to be contained or controlled, and be able to be subjected to the hydrostatic pressures created within. The General Contractor shall fill any holes created by form ties with neat cement. Concrete finish of backwash pit shall be as smooth as possible as to receive two coats of waterproofing in accordance with manufacturer's directions (waterproofing by Interactive water feature Contractor). The General Contractor shall coordinate with the interactive water feature contractor for method of finishing pit.

Chemical Storage Rooms: Chemical storage rooms and hardware shall be constructed of corrosive-resistant materials. Walls shall be of non-corrosive construction, resistant to the effects of storage of a corrosive material. Separate ventilation of each chemical roof shall be provided.

Sleeves: Install the sleeves necessary for required piping in the building walls. The Interactive water feature contractor will provide all sleeves. The General Contractor shall coordinate locations with the interactive water feature contractor. If the Interactive water feature Contractor fails to coordinate this work with the General Contractor and provide the required sleeves, couplings, and O-rings and the required sleeves are not installed, the Interactive water feature Contractor is responsible for concrete removal and installation of the sleeves or for any core-drilling required (only if

allowed by structural engineer). If the General Contractor fails to install the sleeves, couplings, and O-rings as coordinated by the Interactive water feature Contractor, the General Contractor is responsible for concrete removal and installation of the sleeves or for any core-drilling required (only if allowed by structural engineer).

Equipotential Bonding Grid: The General Contractor shall provide the equipotential bonding grid in and around the interactive water feature perimeter per the requirements of the National Electric Code, Article 680.

Deck Slab: Surrounding deck slabs shall be placed after interactive water feature installation has been completed, including the deck expansion joints with polysulfide sealant, as detailed on the interactive water feature plan and details.

Protecting Interactive water feature: Contractor shall take every practical precaution to prevent concrete from spattering on the finishes, etc., including covering same with protective materials. If splash occurs, wash off while still wet, any concrete which appears on these elements. Any damaged or broken material shall be immediately repaired.

Clean-up: Keep the interactive water feature excavation and interactive water feature free of construction residue and waste materials of his workmen or sub-contractors, removing said material from the interactive water feature should it collect.

Site Storage: Protect materials and equipment stored on job site.

Coordination at Start-up: Provide representative at time of interactive water feature start-up to coordinate work related to interactive water feature system.

1.15 RELATED WORK AND RESPONSIBILITY UNDER MECHANICAL / PLUMBING DIVISION:

General responsibilities of the Mechanical/Plumbing contractor shall be, but not limited to, as follows:

Harmful Chemicals: Mechanical/Plumbing Contractor shall not place any acid, alkaline chemicals or oil in contact with the interactive water feature which will be injurious to interactive water feature or materials.

Contact with Other Systems: Mechanical/Plumbing Contractor shall not hang or connect pipe, electrical conduit, or any other materials to the interactive water feature system unless specifically approved in writing.

The Mechanical/Plumbing Contractor under Mechanical Division shall perform the following related work in accordance with plans and specifications:

Provide drains and connect waste piping from equipment room floor drains and pump vault drains to sanitary sewer lines.

Provide separate ventilation of each of the chemical storage rooms to the outside.

Supply and install emergency shower/eyewash with tepid water and drain line at the locations shown on the pool drawings.

Furnish and run the potable water supply lines to the point or points shown on the drawings.

Provide a hose bib(s) per code requirements.

Coordination at Start-up: Provide representative at the time of interactive water feature start-up to coordinate work related to the interactive water feature system.

1.16 RELATED WORK AND RESPONSIBILITY UNDER ELECTRICAL DIVISION:

General responsibilities of the Electrical Contractor under Electrical Division shall be, but not limited to, as follows:

Provide electrical service (of adequate type and capacity required for the project) to equipment. Furnish all panels, start-stop stations, motor starters, line voltage conduit, disconnects, junction boxes, and wiring.

Make all electrical connections to the interactive water feature circulation and feature equipment, including interlocking and line voltage control wiring at the direction of the interactive water feature contractor. The interactive water feature contractor is responsible for low voltage (non-line voltage) control wiring, connections and any required conduit.

Be responsible for proper calibration, adjustment, and arrangement of terminal connections of wires to control equipment.

Perform all required grounding and bonding for pumps, filters, and other interactive water feature equipment in accordance with the National Electric Code Article 680 as well as state and local codes.

Furnish and install a Ground Fault Interrupter (G.F.I.) for all required equipment together with any and all other outlets and equipment in or around the interactive water feature as per N.E.C. Article 680.

Furnish and run all power to the chemical control system, chemical feed pumps, U.V. control system and control circuits to the support equipment.

Interlock the chemical control system to the interactive water feature circulation pump as directed by the interactive water feature contractor.

Interlock the chemical control system with the chemical feed system as directed by the interactive water feature contractor.

Interlock the Ultra Violet Disinfection system controller to the circulation pump as described on the interactive water feature plans.

Interlock the interactive water feature controller and components to the interactive water feature pump as directed by the interactive water feature contractor.

Furnish any temporary power needed by the General or Interactive water feature Contractor for de-watering, tools, etc., if required.

The well point or de-watering equipment (if required) must be continuously operated during construction. Therefore electrical service for such equipment must be sufficient to provide continuous service exclusive of temporary electrical service requirements of others.

Coordination at Start-Up: Provide representatives at the time of interactive water feature start-up to coordinate work related to interactive water feature system.

1.17 RELATED WORK AND RESPONSIBILITIES OF OWNER:

General responsibilities of the Owner shall be, but not limited to, as follows:

Harmful Chemicals: No one shall place any acid or alkaline chemicals or oil in contact with interactive water feature surfaces which will be injurious to the interactive water feature or materials.

Contact with Other Systems: No one shall hang or connect pipe, electrical conduit, or any other materials to the interactive water feature system unless specifically approved in writing by Interactive water feature Contractor.

Provide the following personal safety items for Interactive water feature Operator's use in handling chemicals: goggles, rubber aprons and rubber gloves.

Acknowledge receipt of operating Instructions at time of start-up.

The Owner shall provide the following repeated services:

Provide the designated interactive water feature operator(s) to the interactive water feature contractor for instruction and training at the time of initial filling. Make them available continuously (8:00 a.m. to 5:00 p.m. Monday through Friday) until acceptance of project.

Maintain the watertight integrity of all interactive water feature deck joints around interactive water feature for the life of the interactive water feature to minimize differential settlement.

1.18 LAYOUT WORK:

Before any interactive water feature excavation or construction is commenced, the Interactive water feature Contractor shall layout the perimeter of the interactive water feature.

1.19 EXCAVATION AND GRADING:

All labor and necessary equipment for rough machine excavation of interactive water feature areas, the interactive water feature balancing tank shall be provided. Also furnish all necessary labor and equipment required for hand trimming of interactive water feature excavation. The Contractor shall be fully responsible for directing all excavation operations in order to obtain proper depths and contours for the interactive water feature.

The contractor is responsible for removal of excess soil to a location on site. Removal of excess soil and materials from the site is the responsibility of the General Contractor and shall be done as directed by the Architect/Owner.

Any voids which may occur due to over-excavation or from removal of boulders shall be filled with a lean mixture of concrete or earth compacted to 95% Proctor or per soils report.

A tolerance of plus one inch shall be allowed in the excavation sub grade.

1.20 PLACE FITTINGS:

The Interactive water feature Contractor shall place, before the concrete work is commenced, all piping, fittings, nozzles, all special interactive water feature equipment, etc., that are to be embedded in concrete and shall be responsible for their positioning in accordance with the drawings.

1.21 GROUNDING AND BONDING:

After placing interactive water feature reinforcing, but before placing concrete surfaces, the General Contractor shall install all the bonding and grounding circuits required for steel reinforcement and all other metal and electrical items in or around the interactive water feature. The contractor shall extend the bonding and grounding systems to the equipment room in accordance with the requirements of the National Electrical Code, Article 680. No concrete shall be applied to interactive water feature surfaces until this requirement is complied with and the proper electrical inspection has been made and approval received.

1.22 BACKFILL:

Any necessary backfill around water balancing tank walls shall be a granular backfill. Granular backfill shall be a 'pea' gravel or ¾" to 1½" minus gap-graded gravel, or as specified by the Soils Engineer. Any back filling around water balancing tank and pump vault walls is the responsibility of the General Contractor (per Section 1.12 RELATED WORK AND RESPONSIBILITIES OF THE GENERAL CONTRACTOR).

1.23 DEWATERING:

If the interactive water feature, pump vault and/or balancing tank is constructed in a hydro-static area, the Interactive water feature Contractor shall install the necessary gravel pack well point or points and permanent piping for his use during construction. A readily accessible connection to this system for the future use of the Owner shall be provided. The method of this de-watering system shall be approved by the Architect and Interactive water feature Engineer prior to excavation. Also see Civil Drawings and/or Mechanical Drawings for sub-drain designs.

PART 2 - MATERIALS AND METHODS OF INSTALLATION:

2.01 STEEL REINFORCEMENT:

All reinforcing steel shall be standard sizes of deformed bars equal to the requirements of the "Standard Specifications for Billet Steel, Concrete Reinforcement", intermediate grade, serial designation A615 with required grade designation per plans as adopted by the American Society for Testing Materials.

All reinforcing steel shall be in place before concrete placing is commenced, shall be new, free from dirt, oil, paint, and mill scale, shall be positioned and of the size indicated on the drawings, and secured by not less than 16 gauge annealed tie wire. Metal chairs or concrete blocks shall be used to insure proper spacing.

Slab steel shall be securely wired together at as many points as necessary where bars cross to insure their maintaining their position. Splices shall be staggered a minimum of 4'-0", and laps shall be not less than 40 diameters.

2.02 SPECIAL INSTRUCTIONS:

After placing interactive water feature reinforcing and water feature footing reinforcing, but before pouring concrete surfaces, the Interactive water feature Contractor shall insure proper bonding and grounding circuits have been provided and tested for continuity by the Electrical Contractor to steel reinforcement, slab, fittings, nozzles, free standing features, and all other metal and electrical items in or around the interactive water feature, as required by the National Electrical Code, Article 680. No concrete shall be applied to interactive water feature surfaces or feature footings until requirement is complied with. Also see Electrical Division.

2.03 CEMENT:

All cement for concrete work shall conform to the requirements of the "Standard Specifications for the Portland Cement", serial designation C-150 of the ASTM and shall be Type as per soils report, and, except where transit-mixed concrete is to be employed, shall be delivered to the job site in original packages adequately protected from the weather during storage.

2.04 INTERACTIVE WATER FEATURE CONCRETE:

The sub grade shall be thoroughly wetted before concrete is placed.

The concrete shall have a water-reducing retarder added, Plastiment or equal, at a minimum rate of two fluid ounces per bag of cement, per manufacturer's recommendations according to the day time temperatures. Exact proportions of four to eight fluid ounces shall be determined by test at the job site. The concrete mix shall contain an average of 3% air entrainment, with no more than a 3½" slump, and a minimum 28 day strength of 4,000 p.s.i.

After finishing, the floor shall be covered with plastic sheeting for a period of five days. No curing compound will be allowed.

2.05 OTHER CONCRETE:

Furnish and place any required concrete for anchor blocks, water features, etc. as indicated on drawings. Provide thickened slab under play feature supports as required by the manufacturer.

Concrete shall be a mix developing a minimum strength of 4,000 PSI at 28 days.

2.06 INITIAL CURING:

All structural concrete shall be kept continuously wet for a minimum period of seven days, or as necessary to insure proper initial cure or adequate coverings with plastic sheeting through the curing period. No curing compound will be allowed.

2.07 INTERACTIVE WATER FEATURE DIMENSIONAL TEST:

Check size and dimensions of interactive water feature for deviations from design drawings as directed by Architect. Corrections shall be made if directed.

2.08 INTERACTIVE WATER FEATURE APPEARANCE:

Interactive water feature shall be free from cracks, honeycombing, spills, voids, and other defects. The interactive water feature shall have a non-slip surface.

2.09 INTERACTIVE WATER FEATURE DECK EXPANSION JOINT and JOINT SEALER:

All expansion joint material, joint sealer primer and joint sealer primer shall be resistant to the effects of chemically treated water.

The joint material shall be Deck-O-Foam, by W.R. Meadows, sized per the requirements of the architect. Joint sealant shall be either two-part Deck-O-Seal 125 (polysulfide sealant) or two-part Deck-O-Seal Gun Grade (polysulfide sealant). Color selection by the architect. Standard colors are Dura-White, Stone Gray and Desert Tan. Jet Black and Redwood are available upon special order).

Before applying the joint sealer, apply a two-part P/G epoxy primer by W.R. Meadows per the manufacturer's recommendations.

2.10 TILE (IF USED):

Acceptable tile manufactures for deck markings are In-lays, Inc. or approved equal. All tiles shall be resistant to chemical attack, shall have a water absorption of 0.5% or less, resist fading, and be designed for use in an interactive water feature environment.

All setting and laying of tile, and all materials and labor required for completion of the tile work shall be in accordance with the latest basic specifications issued by the Tile Manufacturer's Association, except as otherwise noted herein or shown on the drawings. All work shall be performed by mechanics skilled in the trade. Tile shall remain whole and firmly in place. Tile shall be placed flush and even with each other, parallel to the deck surface, and shall have clean cuts. Grout lines of tile shall line up unless otherwise approved by the Architect. Tile shall be placed flush and even with each other within a tolerance of plus or minus one-eighth inch. All tile shall be frost-proof.

Provide waterproofing compound to provide watertight finish. All waterproofing, adhesives, tiles, and grouts used in the interactive water feature shall provide a water tight finish and shall be suitable for use in freeze/thaw climates.

Setting materials:

Flexible acrylic Latex Portland Cement Mortar: Mapei – KERABOND/KERALASTIC, white color, two component flexible mortar system conforming to ANSI A118.10 standards or approved equal.
Flexible Fast Setting Latex Hydraulic Mortar: Mapei – KER 318 GRANI/RAPID, white color, two-component, flexible latex hydraulic thin-set mortar conforming to ANSI A118.10 standards or approved equal.

Grouting materials:

Sanded Tile Grout: Mapei – KER200 polymer-modified sanded Portland cement grout conforming to ANSI A-118.6 standards or approved equal.
Fast Curing Sanded Tile Grout: Mapei – KER 700 Ultra/Color polymer-modified hydraulic sanded tile grout conforming to ANSI 118.6 standards or approved equal.

2.11 WATER FEATURE ROCKS:

Large rocks and boulders are to be selected by the landscape architect. All rocks and boulders shall conform to the regulations as set forth by the local health department. The placement of the rocks shall be under the direction of the landscape architect for size, placement and orientation.

PART 3 - INTERACTIVE WATER FEATURE PIPING:

3.01 EXCAVATION, BACKFILL, PIPE TESTING AND LINE FLUSHING:

Make required pipe trench excavations and backfill. No backfilling of pipe trenches shall be made until the piping has met the proper pressure test. Backfilling of trenches shall be done in accordance with the requirements specified in Section 2. All interactive water feature feature piping, circulation system piping and water piping shall be given pressure tests. All piping leading to and from the splash pad / river feature shall be flushed clean of oil, pipe cuttings, and other foreign matter. Any stains on the interactive water feature finish due to foreign material from the piping are not acceptable and any stained surfaces shall be cleaned at the Interactive water feature Contractor's expense.

3.02 FRESH WATER LINES:

Reduced-pressure, backflow-prevented, potable water lines and valves shall be installed from the juncture point with the potable water lines as shown on the plumbing drawings to proper locations in the interactive water feature filter equipment room as shown on the drawings. See Plumbing Division for material types to be used, point of connections, additional requirements.

The fresh water lines and manual shut off-valve shall be installed to the point of connection shown on the plumbing drawings by the Plumbing Contractor. Interactive water feature contractor shall extend piping from this point of connection to locations noted on the interactive water feature drawings. All fresh water piping shall be completed in accordance with Plumbing Division. Interactive water feature contractor is responsible for coordination with the Plumbing contractor to assure installations are provided and properly located.

3.03 INTERACTIVE WATER FEATURE PIPING:

Furnish and install all piping, pipe fittings, and valves from the interactive water feature fittings to the junctures indicated on the drawings. Make necessary pipe trenching and do necessary back-filling, including sand bedding at 95% compaction, as required for piping and other work as hereunder specified to complete the interactive water feature plumbing installation as shown on the drawings and in the specifications. Piping is shown on drawings in diagrammatic form (U.O.N.) to indicate work to be done rather than show exact routing and locations. Make use of all data in contract documents, verify against developed field conditions, and install work in an orderly arrangement in a manner to overcome structural and mechanical interference. Piping and necessary valves should be placed such that the interactive water feature can be winterized (including all piping and components). All piping and components shall be installed in a manner to avoid freezing. Also see division 2 for additional pipe trenching requirements

3.04 OUTLETS AND RETURN PIPING:

All feature piping for the interactive water feature supply (return) piping and fittings shall be NSF approved Schedule 80 PVC as shown on the drawings. All interactive water feature circulation piping and fittings to and from the balancing tank shall be NSF approved Schedule 40 PVC as shown on the drawings. All piping shall be as manufactured by R & G Sloane, Spears, or approved equal. All piping under or in interactive water feature shall be fully encased in concrete unless otherwise noted on the drawings. All piping connections shall be solvent welded. Gasketed pipe is not acceptable.

If building codes, fire codes, or other codes require CPVC or other type of piping through certain building spaces, the most stringent code shall govern, and the contractor shall provide the type required by code. The contractor shall notify interactive water feature engineer to verify compatibility with other materials and chemicals being used in the system.

All piping to and from the interactive water feature shall be hydrostatically tested at 50 p.s.i. before any pipe is concealed. Pipe shall be maintained tight at this pressure for a minimum of 24 hours. All piping shall be maintained tight with 5 p.s.i. of pressure throughout the remaining construction period.

Pressure Tests: Hydrostatically test all water piping systems. Do not pneumatically pressure test. Conduct tests in accordance with ANSI B31.1 and as follows: Test piping systems after the lines have been cleaned as herein before specified. Test the piping system at a pressure of 50 p.s.i. with water not exceeding 100 deg. F. Before tests, remove or isolate gages, traps, and other apparatus subject to damage by test pressure. Install calibrated test gage in system to observe any loss of pressure. Close off system and retain required pressure for one hour minimum and then inspect all joints and connections for leakage. Maintain specified pressure in all lines for a minimum of 24 hours. Maintain 5 p.s.i. pressure in all lines throughout the remaining construction period. Each trade should verify the pressure maintenance before and after completion of work to insure piping integrity. All failures shall be satisfactorily repaired and the complete test performed again. Contractor shall log and maintain records of pressure test on site and maintained in contractors job file. Such logs shall be presented to engineer upon request.

Test Gages: Pressure test gages shall be currently certified as being accurate to within 1 percent of their full scale. Use gages with maximum scale between 1-1/2 and 2 times the test pressure.

Factory Tests: Factory test prefabricated piping sections and fittings to ensure compliance with this specification and to prove integrity of joints.

General: The Interactive water feature Contractor shall furnish all equipment and apparatus required for performing the inspections and tests, except water supplied by Owner, and shall correct all defects and repeat respective inspections and tests, as required for final approval.

3.05 FILTER ROOM PIPING AND FITTINGS:

The filter room piping shall be Schedule 40 PVC, Schedule 80 PVC, or CPVC with flanged PVC or CPVC fittings. All metal bolts, connectors, and other fasteners shall be stainless steel. All PVC piping connections shall be solvent welded and flanged. Gasketed pipe is not acceptable.

Filter room piping shall be identified by tagging and/or color coding. Piping flow shall be indicated by directional arrows on the piping.

3.06 CHEMICAL SOLUTION PIPING:

Chlorine and hydrochloric acid piping shall be Schedule 80 PVC pipe and fittings (solvent weld). Chlorine and hydrochloric acid tubing and fittings shall be polypropylene.

All Chemical piping that runs underground (or in inaccessible locations) shall be double containment piping. Underground or inaccessible double-containment piping shall be oversized and use sweep elbows to allow chemical tubing to be pulled through the piping in the future.

Chemical solution piping and tubing contents shall be identified by color coding and/or tagging. Flow direction of chemical solution piping and tubing shall be provided. The piping and tubing identifications shall be in compliance with all applicable requirements of local codes, health department, the IFC and ASME A13.1.

Chemical solution piping shall be installed with clip supports or hangers at 4'-0" c.c. max spacing. Chemical solution tubing shall be anchored to wall or ceiling @ 3'-0" c.c. max.

3.07 VALVES:

All valves for interactive water feature piping 3" and smaller shall be PVC ball valves, ASAHI American "Omni" or approved equal.

All valves for chemical piping 3" and smaller shall be PVC ball valves, ASAHI American "Omni" or approved equal.

All valves 4" and larger shall be butterfly valves ASAHI American "Pool Pro" or approved equal. Butterfly valves are to be manufactured of PVC with reinforced disks with stainless steel shafts. Valves shall be capable to handle hydrostatic pressures up to 100 p.s.i. without leaking. Valve stems and extensions shall be of stainless steel with adequate support.

Valves 4" and 6" shall be lever operated. Valves 8" and above shall be gear operated (except as noted on the plans). Valves 8" and above which are located in balancing tank shall be gear operated with handle extensions and the gear located above the concrete lid of the balancing tank.

All check valves shall be Spears thermoplastic (PVC or CPVC) check valves, flanged type, with internal parts compatible with chlorine / chemically treated water.

Pressure relief/sustaining valves shall be non-corrosive and resistant to treated water. Provide 0-75 psi adjustment range.

All flange bolts and nuts shall be 304 stainless steel. All components in the balancing tank shall be PVC and stainless steel as indicated on the drawings or in the specifications.

Identify valves by tagging and/or color coding.

3.08 MAKING UP PIPE:

All pipe shall be cleaned of scale, sand, dirt, and rust before installation. The ends of threaded pipe shall be reamed out full size, threads cut with new dies, and not more than two full threads shall be left exposed when the joint is made up.

Offsets shall be made with fittings. Pipe shall not be bent at any time except where copper water tubing, Type L is used. Offsets may be bent, but the radius of the bend must be such that no deformation of the tubing shall occur.

Joints for PVC Pipe: PVC pipe shall be cut square with a pipe cutter or a sharp saw. Free the joint of the feathered edge and ream to full size as necessary. Apply a cleaner and a liberal coat of solvent to the outside of the pipe and in the fitting making sure that the coated area is equal to the depth of the fitting socket. Insert the pipe quickly into the fitting and turn the pipe approximately 15 degrees so that the fitting does not push off the pipe. Do not interrupt the solvent welding of the joint once the solvent is applied. Wipe off all excess solvent to prevent weakening of the joints. Be sure that in going to the next joint that the pipe is not twisted, disturbing the last completed joint.

Joints in copper water tubing shall be thoroughly cleaned and made tight with a good grade of tin-lead solder making sure that the entire joint is properly sealed throughout its full area.

Joints in screw piping shall be made of the Grinnell Stainless Pipe Joint Cement.

3.09 PITCH OF PIPES:

Horizontal drainage lines shall be supported to a uniform slope. All piping shall be installed so as to avoid unnecessary turns in order that friction loss may be kept at a minimum. Piping shall be installed in order to prevent air traps. The minimum slope for all suction and return piping shall be a minimum 0.25% pitch.

3.10 PIPE HANGERS AND SUPPORTS:

The pipe hangers shall be adjustable B-line Figure B3105 stainless steel or equal. Pipe supports shall be adjustable B-line Figure B3092 stainless steel saddle support with Figure B3088T stainless steel stand or approved equal. Pipe hangers and supports shall be constructed of stainless steel and shall be located as needed to adequately support all piping and components. Interactive water feature contractor may fabricate special hangers or supports subject to approval of the Architect. PVC piping shall not be unsupported for lengths in excess of four (4) feet. Provide adequate supports and spacing as to avoid pipe sagging between supports and to support against the effects of water hammer. All interactive water feature piping larger than 3" must be supported for seismic loads in accordance with the International Building Code. The Interactive water feature contractor is responsible for the design and installation of all seismic bracing. Design of seismic bracing shall be submitted to the building department as a deferred submittal if required by the building inspector.

3.11 ASSEMBLY AND INSTALLATION - EQUIPMENT:

Furnish, assemble, and install a complete operational piping, filter circulation, chemical feed and sanitizing system and other mechanical equipment for interactive water feature as shown on drawings, and in accordance with the instruction furnished by the manufacturer supplying such equipment. Drawings indicate in diagram form the desired arrangement of the principal apparatus, piping, and equipment, and shall be followed as closely as practicable, exercising care in the work to secure proper head room and space conditions and a neat and workmanlike arrangement of piping and valves.

Furnish suitable tags for marking all valves. Provide identification and signs as required for the valves for the chemical solution piping per requirements of the International Fire Code, Section 27.

Obtain complete instructions for installing and operating all mechanical equipment. No equipment shall be put into operation without the assistance of a qualified operator familiar with the operation of such equipment.

PART 4 - INTERACTIVE WATER FEATURE FITTINGS:

4.01 TRENCH DRAIN FRAME AND GRATES (FITTINGS):

Trench frames and grates shall be CAST BRONZE unless otherwise noted on drawings. Secure all grates/covers to the frame with 304 stainless steel screws a minimum of 1 3/16" in depth. These screws shall be tamper proof. Submit patterns selections to the architect for selection.

4.02 BALANCING TANK INLET FITTINGS:

The balancing tank inlet fittings shall be custom assembled using PVC pipe per the details on the drawings. The drilled inlets openings shall be sized per plans.

PART 5 - INTERACTIVE WATER FEATURE CIRCULATION / FEATURE EQUIPMENT:

5.01 ASSEMBLY AND INSTALLATION:

Furnish, assemble, and install a complete operational pumping, piping, filter, chemical feed and chlorination system and other mechanical equipment for the interactive water feature as shown on the drawings, in accordance with the instructions furnished by the manufacturer supplying such equipment. Install seismic anchorage for piping, filters, chlorine storage tanks, acid storage tanks, and any other items indicated on drawings. Filtration and Chemical System Equipment shall be NSF listed. All metal connectors, bolts, washers, and other fasteners or anchors shall be stainless steel. The Interactive water feature Contractor shall be responsible for design installation of all seismic bracing for interactive water feature equipment. Design to be submitted as a deferred submittal as required by building official.

Drawings indicate in diagram form the desired arrangement of the principal apparatus, piping, equipment, and shall be followed as closely as practicable, exercising care in the work to secure proper head room and space conditions and a neat and workmanlike arrangement of piping and valves. The filtration system shall be completely ready for operation including all piping as shown on the drawings. Mark all lines with flow direction indicators. Furnish suitable tags for marking all valves.

Obtain complete instructions for installing and operating all mechanical equipment from the manufacturer. No equipment shall be put into operation without the assistance of a qualified operating technician familiar with the operation of such equipment.

5.02 ELECTRICAL CONNECTIONS:

The Interactive water feature Contractor shall furnish and install all interactive water feature equipment / electrical motors, low voltage interlocks and control wiring, etc., as required and specified, except as specifically noted otherwise for equipment described in this section of the specifications.

The Electrical Contractor shall furnish and install all panels, starters, start-stop stations, disconnects, junction boxes, line voltage interlocks and the running of conduit and wiring to such motors, etc., and their connections, and furnishing such electrical equipment as specified and shown on the drawings. The Electrical Contractor shall be responsible for proper calibration, adjustment, and arrangement of terminal connections of wires to the control equipment.

The Electrical Contractor shall provide conduit and wiring from the interactive water feature activators to the controllers located in the equipment room. The Interactive water feature contractor shall make the low voltage connections.

The circulation pump shall be electrically interlocked with the chemical feed system and the UV disinfection system control panel. Coordinate with electrical drawings and electrical contractor to assure that this work is included in the electrical contractor's scope of work. Any deficiencies should be communicated to the Architect and Engineers prior to bids being submitted.

The Interactive water feature Contractor shall coordinate with the electrical drawings and the Electrical Contractor to insure that all required components of the work are included and fully understood so that there are no deficiencies. No additional cost shall accrue to the Owner as a result of lack of coordination. The Interactive water feature Contractor and the Electrical Contractor shall complete the work so as to provide a complete operating system with no additional cost to the Owner for field wiring required related to the equipment.

5.03 BALANCING TANK:

The water-storage balancing tank shall be a prefabricated vault manufactured by Duracrete, Amcor (Oldcastle), or equal. The manufacturer shall be responsible for the structural design and exterior waterproofing of the balancing tank. The concrete tank shall contain a Xypex admixture, per Xypex manufacturer's recommendations. Tank shall not be jointed in the middle of the tank. Any joints shall be above the shut-down water level. Tank shall include manhole hatch (as specified on plans) and plastic ladder rungs for access. When ordering the balancing tank, the Contractor shall inform the tank manufacturer of the sizes and number of penetrations that will be field core-drilled into the sides of the tank.

The concrete construction of the pump pit is not part of this specification section. See responsibilities of General Contractor listed elsewhere in this section.

The interactive water feature contractor shall line the interior of the balancing tank with two coats of waterproofing. Prior to the application of waterproofing, the Interactive water feature Contractor shall notch any shrinkage cracks $\frac{1}{4}$ " X $\frac{1}{4}$ " and seal with W.R. Meadows "Deck-o-seal" two-part gun grade. Interactive water feature contractor is responsible to coordinate with the General contractor to assure that the concrete finishes of the balancing tank and backwash pit are adequate for installing waterproofing in accordance with manufacturer's instructions.

The interactive water feature contractor shall provide the required sleeves, couplings, and O-rings and shall coordinate with the General Contractor as to their required locations and elevations. The Interactive water feature Contractor is responsible for the installation of all mechanical seals around pipes and for assuring a watertight seal around all penetrations where mechanical seals are not required on the drawings. The General Contractor is responsible for the installation of all pipe sleeves, couplings, and O-rings that require installation prior to placement of concrete. The interactive water feature contractor shall provide to the general contractor all sleeves, PVC couplings with O-rings, and seals to be installed in the building wall as required and other locations shown on

drawings. If the Interactive water feature Contractor fails to coordinate this work with the General Contractor and provide the required sleeves, couplings, and O-rings and the required sleeves are not installed, the Interactive water feature Contractor is responsible for concrete removal and installation of the sleeves or for any core-drilling required (only if allowed by structural engineer). If the General Contractor fails to install the sleeves, couplings, and O-rings as coordinated by the Interactive water feature Contractor, the General Contractor is responsible for concrete removal and installation of the sleeves or for any core-drilling required (only if allowed by structural engineer).

5.04 MODULAR / MECHANICAL SEAL:

The mechanical seal shall consist of rubber links shaped to continuously fill the annular space between the pipe and the balancing tank and pump vault wall openings. Seal elements shall be constructed of EPDM rubber. The pressure plates shall be molded of glass reinforced nylon. Hardware shall be 316 stainless steel. When the pipe seal can be set prior to construction of the wall, utilize sleeves with integral hollow, molded water-stop ring 4 inches larger than the outside diameter of the sleeve itself. Sleeves shall be made of HDPE thermoplastic with reinforcing ribs (Century Line or equal).

5.05 CIRCULATION AND FEATURE PUMPS:

All filter circulation pumps shall be electrically interlocked with their associated equipment per part 5.02 of this specification. Coordinate with electrical drawings and electrical contractor to assure that this work is included in the electrical contractor's scope of work. Any deficiencies should be communicated to the Architect and Engineers prior to bids being submitted.

Pumps: \geq 5 HP:

Pumps 5 hp and greater shall be premium efficiency compatible to be used with a VFD. Pump shall be non-corrosive, plastic commercial grade. Pumps shall be close coupled, self-priming, complete with an integral hair and lint strainer. Pump shaft shall be stainless steel. Nuts and bolts shall be stainless steel. Provide pumps with sealed ball bearings, continuous duty-rated, 3450 RPM, open drip-proof design, with an automatic reset for thermal overload protection.

5.06 VARIABLE FREQUENCY DRIVE:

A. General:

The manufacturer of the VFD shall demonstrate a continuous period of manufacturing and development of VFD's for a minimum of 35 years.

An Automatic Energy Optimization (AEO) selection feature shall be provided in the VFD to minimize energy consumption in variable torque applications. Feature shall optimize motor magnetization voltage. This feature shall dynamically adjust output voltage in response to load, independent of speed. Output voltage adjustment based on frequency alone is not acceptable for single motor VT configurations.

Switching of the input power to the VFD shall be possible without interlocks or damage to the VFD at a minimum interval of 2 minutes.

Switching of power on the output side between the VFD and the motor shall be possible with no limitation or damage to the VFD and shall require no additional interlocks.

An Automatic Motor Adaptation (AMA) function shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to spin the motor shaft or decouple the motor from the load to accomplish this optimization. Additionally, the parameters for motor resistance and motor reactance shall be user-programmable.

The VFD shall have temperature controlled cooling fans for quiet operation, minimized internal losses, and greatly increased fan life.

B. Protective Features:

VFD shall have sealed electronics which used a heat sync to extract heat from drive, then cooled by a fan which also is connected to its own VFD. The drive's electronics do not come in contact with ambient air, therefore a ventilation fan and filter is unnecessary. Drives that incorporate the use of a ventilation fan and filter shall not be equal.

VFD shall have input surge protection utilizing MOV's, spark gaps, and Zener diodes to withstand surges of 2.3 times line voltage for 1.3 msec.

VFD shall include circuitry to detect phase imbalance and phase loss on the input side of the VFD. VFD shall have built-in DC Coils to reduce voltage ripple and increase capacitor life. Drives without DC Coils shall provide a 5% input line reactor.

Automatic "No-Flow Detection" shall be available to detect a no-flow situation in pump systems where all valves can be closed. This shall be functional in closed loop control or when controlled by an external signal.

Dry-pump detection shall be available to detect if the pump has run dry and trip the drive. A timer shall be included to prevent nuisance tripping.

End-of-Pump curve detection shall stop motor when the pump is operating outside of its programmed pump curve.

VFD shall include current sensors on all three-output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.

VFD shall auto-derate the output voltage and frequency to the motor in the presence of sustained ambient temperatures higher than the normal operating range, so as not to trip on an inverter temperature fault. The use of this feature shall be user-selectable and a warning will be exported during the event. Function shall reduce switching frequency before reducing motor speed.

VFD shall auto-derate the output frequency by limiting the output current before allowing the VFD to trip on overload. Speed can be reduced, but not stopped.

C. Interface Features:

VFD shall provide an alphanumeric backlit display keypad (LCP) which may be remotely mounted using standard 9-pin cable. VFD may be operated with keypad disconnected or removed entirely. Keypad may be disconnected during normal operation without the need to stop the motor or disconnect power to the VFD.

VFD Keypad shall offer an INFO key that, when pressed, shall offer the contents of the programming manual for the feature that is currently in the display. The contents shall explain the feature and how the settings can be made

Keypad shall provide an integral H-O-A (Hand-Off-Auto) and Local-Remote selection capability, and manual control of speed locally without the need for adding selector switches, potentiometers, or other devices.

VFD Display shall have the ability to display 5 different parameters about the VFD or load including: GPM, amps, RPM's, KWh, PSI, savings calculator, output voltage, or other values from a list of 92 different parameters.

A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.

Two-level password protection shall be provided to prevent unauthorized changes to the programming of the VFD. The parameters can be locked via a digital input and/or the unit can be programmed not to allow an unauthorized user to change the parameter settings.

A quick setup menu with factory preset typical parameters shall be provided on the VFD to facilitate commissioning. Use of macros shall not be required.

A digital elapsed time meter and kilowatt hour meter shall be provided in the display.

VFD shall offer as standard an internal clock. The internal clock can be used for: Timed Actions, Energy Meter, Trend Analysis, date/time stamps on alarms, Logged data, Preventive maintenance, or other uses. It shall be possible to program the clock for Daylight Saving Time / summertime, weekly working days or non-working days including 20 exceptions (holidays etc.). It shall be possible to program a Warning in case clock has not been reset after a power loss.

D. Drive Inputs

All inputs and outputs shall be optically isolated. Isolation boards between the VFD and external control devices shall not be required.

There shall be six fully programmable digital inputs for interfacing with the systems external control and safety interlock circuitry. Two of these inputs shall be programmable as inputs or outputs. The VFD shall have two analog signal inputs. Inputs shall be programmable for either 0 -10V or 0/4-20 mA.

One programmable analog output shall be provided for indication of a drive status. This output shall be programmable for output speed, voltage, frequency, motor current and output power. The analog output signal shall be 0/4-20 mA.

The VFD shall provide two user programmable relays with 75 selectable functions. Two form 'C' 230VAC/2A rated dry contact relay outputs shall be provided.

Drive shall be able to connect to auto backwash controller and automatically change to set backwash speed when called for.

A digital flow meter with 4-20mA output can be connected to drive, and GPM may be displayed on drive screen.

Drive shall be capable of using pressure transducers to monitor and control programs using these PSI inputs.

E. Operation:

Four complete programming parameter setups shall be provided, which can be locally selected through the keypad or remotely selected via digital input(s), allowing the VFD to be programmed for up to four alternate control scenarios without requiring parameter changes.

Drive has up to eight programmable speeds that can be set to facility specific parameters. Separate speeds for backwash, off hours, or seasonal conditions may be initiated by relay input, sensor input, time, or manually. Drive may also send signals out to protect other mechanical equipment such as heaters during backwash.

Drive shall have ability to communicate remotely via Ethernet, Mod Bus, and RS 485 connections. Keypad may also be mounted remotely.

Drive has the ability to incorporate a fused bypass or circuit breaker bypass option. If activated, power will feed directly to the motor of the circulation pump and run at full speed.

F. Service Conditions:

The ambient operating temperature of the VFD shall be -10°C to 50°C (14 to 122°F), with a 24 hour average not to exceed 45°C. Storage temperatures shall be -13° F (-25° C) to 149/158° F (65/70° C).

0 to 95% relative humidity, non-condensing.

Elevation to 3,300 feet (1000 meters) without derating.

VFD's shall be rated for line voltage of 525 to 690VAC, 380 to 480VAC, or 200 to 240VAC; with +10% to -15% variations. Line frequency variation of ± 2% shall be acceptable.

G. Quality Assurance:

The manufacturer shall be both ISO-9001 and ISO-14001 certified.

To ensure quality and minimize infantile failures on the jobsite, all VFD's shall be completely tested by the manufacturer. The VFD shall operate a dynamometer at full load and speed under elevated temperature conditions.

H. Start-up, Support and Warranty

A factory-authorized service technician shall perform start-up on each drive. Start-up costs provided with the bid shall include time and travel for the estimated number of visits required, but shall not be less than at least one half-day with travel. Additional labor or return trips to the site shall be billed at Danfoss' published straight-time rates. Upon completion, a start up service report shall be provided.

A 1-year on-site warranty shall be provided such that the owner is not responsible for any warranty costs including travel, labor, parts, or other costs for a full 1 years from the date of installation. An additional warranty of up to 6 years is offered as an option. The cost of the warranty shall be included in the bid.

Technical questions regarding drive installation and functions may be answered by contacting the Dan Foss Tech Support department, available 24 hours a day.

5.07 BASKET STRAINER:

Basket strainers shall be manufactured by Hayward. Strainer construction shall be PVC. Provide complete with optional Type 316 stainless steel, 20 mesh basket. Minimum 100 psi pressure rating.

5.08 FILTERS (MANUAL BACKWASH):

The filter system shall be a pressure high-rate, permanent media filter equipped with a manual high-flow multi-port valve for backwashing filter.

The filter system shall be the standard cataloged product of a company regularly engaged in the manufacturer of water filtration equipment with a minimum of five years of experience in manufacturing high-rate filters for public and institutional applications.

The filter system shall be of the type suitable for a single grade of media, and shall be listed by the National Sanitation Foundation for a maximum flow of 20 gpm per square foot of filter area with a maximum 3 p.s.i. pressure loss across any filter tank at a flow rate of 20 gpm per square foot.

The filter system shall consist of a filter tank with internal distribution and collection systems, operating valves, high-flow multi-port backwash control valve, pressure gauge, and air relief system.

The filter media shall be of a single grade and consist of uniformly graded, angular shaped, crushed silica sand which shall be free of limestone or clay. Filter media shall be Grade #20, effective size .45 millimeter with a uniformity coefficient of 1.5 maximum.

Once installed, the system shall be capable of withstanding, without damage or leakage, a 24-hour hydrostatic pressure test at a static load of at least 50 pounds per square inch.

5.09 FLOW METER:

Sensor-Powered Flow Monitor & Sensor

Flow meter shall be complete with sensor-powered remote flow indicator, polypropylene flow sensor and sensor installation fitting. The interactive water feature shall utilize the Chemical Controller as its circulation flow meter.

Flow meter sensor shall be installed downstream from the filter and upstream from the chlorine and acid injection point. Flow meter sensor shall be installed with the manufacturer recommended straight distances of pipe both upstream and downstream from the flow meter.

5.10 AUTOMATIC CHEMICAL CONTROLLER:

A. GENERAL

The water chemistry control system shall provide continuous monitoring and control of sanitizers (standard ORP sensor), oxidizers, pH, temperature, system flow rate monitoring, total dissolved solids (TDS), turbidity, chemical inventory levels, surge tank water level, system pressures, and water chemistry balance calculations. Installation of the system shall be per the manufacturer's specification and no exceptions shall be allowed. A factory trained / authorized representative shall provide training to the owner.

Requests for substitutions for the specified make and model will not be considered unless equal to the specified system in every respect. Requests for substitutions must include a sample controller with all specified features; complete documentation relating to all the specified features; and manufacturer's sales literature, engineering drawings and, installation, operation, and maintenance manuals. Failure to provide these or any other information necessary to confirm that all specified features are provided will be cause for rejection of substitution request.

B. CERTIFICATIONS

The controller shall carry the following product certifications:

- UL 61010-1
- (CSA) C22.2 Number 61010-1

C. SENSORS

STANDARD SENSORS

The controller shall come with pH, ORP, and temperature sensors meeting the following requirements:

1. pH

The controller shall provide a measurement of pH by utilizing a sensor with the following characteristics:

- 0-14 sensing range
- ABS body with 1/2" NPT process connection
- Minimum of 32 millimeters of inorganic electrolyte gel. Organic electrolytes, susceptible to breakdown in the presence of strong oxidants, shall not be considered equal.
- A porous Teflon liquid junction to provide a stable, low impedance reference contact, and to prevent fouling and clogging of the liquid junction
- A silver / silver chloride (Ag / AgCl) reference element
- A general purpose glass membrane pH sensing element
- Operating temperature range of 32 to 136 degrees F (0 to 80 degrees C)
- Operating pressure range of 0 to 100 psiG

The controller shall continuously monitor, display and data log pH with 0.1 to 0.01 resolution (programmable).

2. ORP

The controller shall provide a measurement of ORP by utilizing a sensor with the following characteristics:

- -1000 to +1000mV sensing range
- ABS body with 1/2" NPT process connection
- Minimum of 32 millimeters of inorganic electrolyte gel. Organic electrolytes, susceptible to breakdown in the presence of strong oxidants, shall not be considered equal.
- A porous Teflon liquid junction to provide a stable, low impedance reference contact, and to prevent fouling and clogging of the liquid junction
- A silver / silver chloride (Ag / AgCl) reference element
- A solid platinum or solid gold ORP sensing element with a minimum of 1 cm² surface area. Platinum plated or gold plated sensing elements, which are susceptible to abrasives, shall not be considered equal
- Operating temperature range of 32 to 136 degrees F (0 to 80 degrees C)
- Operating pressure range of 0 to 100 psiG

The controller shall continuously monitor, display and data log ORP with 1mV resolution.

3. Temperature

The controller shall provide a measurement of water temperature by utilizing a sensor with the following characteristics:

- 32 to 212 degrees F (0 to 100 degrees C) sensing range
- 2 wire, 100 Ω resistive temperature detector (RTD) with a 0.00385 Alpha

The controller shall continuously monitor, display and data log temperature with 1 degree F resolution.

OPTIONAL 4-20mA SENSORS

The controller shall be capable of reading a total of four (4) of the following optional 4-20mA output sensor, or two (2) if the conductivity / TDS sensor is used.

Provide the following Optional 4-20mA Sensor:

4. Liquid Level Sensor

The controller shall provide measurement of liquid levels for backwash holding tank by utilizing liquid level sensor(s) with the following characteristics:

- Field configurable sensing range from 3 ft to 16 ft
- Field calibration for various tank levels, shapes and sizes
- Non-contacting sensing elements enclosed in PVC

The controller shall continuously monitor, display and data log liquid level(s).

D. USER INTERFACE

1. Standard Display

The standard display shall be a backlit transfective LCD with 14 line. 40 alpha/numerica graphical characters that will continuously display information related to the following:

- All installed sensor readings
- Set points, with current control status
- All active alarms, including time activated
- Smart menus with integrated on-screen help.

Contrast adjustment of the backlit LCD shall be provided through clearly marked keys on the front-panel without the need for access to internal controller circuitry. After initial adjustment, controller shall monitor internal temperature and automatically adjust contrast to prevent LCD blackout in extreme ambient temperature conditions. Controllers that do not include front-panel contrast adjustment and automatic temperature compensation shall not be considered equal.

The standard user interface shall include single-touch access to Set Points, Relay Modes, Calibrations, Menu access, and Reset Fail/Safes. An alphanumeric keypad shall be provided for ease of system configuration.

E. CONTROL FUNCTIONS

1. Water Chemistry

A. pH Control: The controller shall continuously control pH. Chemical feed shall be configurable for feed-up, feed-down, or dual feed and either on/off or time-based proportional feed.

B. Sanitizer Control: The controller shall continuously control sanitizer based upon the ORP reading, the amperometric sensor, or both with a bracketed control program. Chemical feed shall be configurable for either on/off or time-based proportional feed.

C. Bracketed Sanitizer Control: With the amperometric ppm sensor, the controller shall be configurable for bracketed sanitizer control; The bracketed control algorithm shall allow either the ORP or ppm setpoint to be chosen as the primary control point, while using other parameter to create a secondary boundary (min and max settings) that must be maintained in addition to the primary control point.

D. Sanitizer Booster Feed: The controller shall have a sanitizer booster program with selectable ORP and/or ppm set points with separate ending set points, allowing the option of the booster sanitizer to control to a lower set point while the primary system can recovers.

E. Ozone / UV Control: The controller shall provide feed-up control of an ozone or UV system based upon ORP and/or ppm set points. A Fireman Cycle feature shall turn off the Ozone/UV relay 0 to 60 minutes (settable) prior to backwash initiation or recirculation pump shutdown. The Ozone/UV control algorithm shall include an Energy Conservation mode, with on/off set time and secondary set point.

F. Super-chlorination: The controller shall have a programmable superchlorination function, based ORP or ppm superchlor setpoint, which is triggered manually.

G. De-chlorination: The controller shall have a programmable dechlorination function, based upon ORP or ppm dechlor setpoint, which is triggered either manually or by the completion of the superchlorination function.

H. LSI & RSI: The controller shall compute the Langelier Saturation Index and the Ryznar Saturation Index based upon current inputs and the Ca Hardness and Alkalinity entered by the operator.

2. Expanded

A. Flow Monitoring: The controller shall continuously monitor, display, and datalog system flow, maintaining a total flow volume. A low flow alarm shall be operator settable, which can be programmed to disable chemical feeds.

B. Surge Tank Monitoring: The controller shall continuously monitor, display, and data log surge tank levels.

C. Autofill: The controller shall automatically control a water makeup relay to add makeup water to maintain interactive water feature level set point, based upon surge tanks (or equivalent) level, with an overflow delay feature. The controller shall provide a programmable alternate set point (4 event 28 day timer).

D. Sensor Wash: The controller shall include a programmable sensor wash with start and end time, feed duration, and number of cycle to allow multiple feed cycles per day.

3. Energy Conservation

A. Alternate Setpoints: The controller shall have alternate Sanitizer, Heater and Autofill setpoints, based upon a 4 event 28 day timer.

B. Energy Conservation Mode: The controller shall have the capability to disable all mechanical and chemical functions during programmed conservation cycle. The Energy Conservation Mode shall include the ability to periodically monitor and satisfy all operation requirements based upon a programmed time schedule.

4. Main Recirculation Pump

A. On-Off Control with Relay
Controller shall provide the capability to interface to and control a recirculation pump with a programmable relay. The controller shall include the following capabilities, available as appropriate based up on installed sensors and implemented features:

1. Fireman Switch: The following events shall satisfy Fireman Switch timing requirements prior to turning off the recirculation pump:

Energy Conservation Mode (24 hr, 7 day function)

a.

b.

Manual Off

2. Immediate: The following events immediately turn off recirculation pump, regardless of Fireman Switch timing requirements:

a. Surge Tank Level Low Alarm: Turn off pump immediately (surge tank is almost empty)

ty)

b. Strainer Vacuum High Alarm: Turn off pump immediately (possible entrapment)

c. Emergency Shut Down – Triggered by front panel

Emergency Off: Turns off pump

immediately (per Operator)

B. Total Dynamic Head (TDH)
Controller shall provide the capability to continuously monitor the Total Dynamic Head (TDH) of the main recirculation pump, directly calculated by the controller from recirculation pump influent vacuum and filter influent pressure transducers. TDH shall be displayed on the user interface and recorded in data logs, with user-programmable High and Low TDH Alarm settings.

C. VFD Interface with 4-20mA Signal
Controller shall provide the capability to interface to and control a recirculation pump equipped with a Variable Frequency Drive (VFD) through a 4-20mA signal. The controller programming shall allow the operator to manage the VFD entirely from the water chemistry controller, by providing the following capabilities:

- Programmable setpoint specified as either flow rate, effluent filter pressure, or fixed setting
- Four programmable operator-triggered alternate profiles (“Manual Turndowns”)
- Four programmable scheduled alternate profiles (“Scheduled Turndowns”)
- Override setting for backwash
- Ramp up and ramp down settings
- Minimum output setting

Remote access to current VFD status and all VFD parameters shall be provided through the software provided with controller. The name of each alternate profile shall be changeable by the

operator, so that VFD menus and data log entries are intuitive and recognizable by the users of the system.

Systems that do not provide both local and remote management of the VFD through the water chemistry controller shall not be considered equal.

F. CONTROL OUTPUTS

1. Relay Outputs

The controller shall come with a total of 4 integral line or dry contact 5A solid-state relay outputs capable of switching 3A under all normal operating condition, accounting for the effects of the temperature gradient inside the NEMA 4X enclosure. Systems that utilize relays that are not de-rated must submit an engineering evaluation justifying the use of relays at their full, optimal condition capacity.

G. SAFETY FEATURES

1. Manual-On Limit

The controller shall have built-in limits to the amount of time any relay control output may be forced on (i.e. in Manual On mode). This is an important safety feature to prevent control outputs from inadvertently being left on after service or diagnostics.

2. High / Low Alarm Settings & Control Lockouts

The controller shall have programmable high and low alarm settings for pH, ORP, PPM, temperature, low flow & no flow and chemical overfeed, turbidity, pressure & vacuum, surge tank levels, chemical inventory.

The controller shall have a programmable lockout of sanitizer feed upon pH high or low alarm.

3. No Flow Alarm & Flow Restored Delay

The controller shall activate a No Flow alarm when the dedicated sample stream flow switch indicates there is insufficient flow through the sample stream. This No Flow alarm shall lockout all chemical feed control operations.

The controller shall include a Flow Restored Delay, which shall extend the No Flow lockout user-programmable amount of time after the No Flow alarm ends (i.e. flow is restored). This feature is necessary to assure that the system has valid, stable sensor readings of circulating water prior to making chemical feed control decisions.

4. Feed Limit Alarms

The controller shall trigger a FailSafe alarm if a chemical feed relay remains on longer than the programmable Feed Limit Timer. Chemical feeds shall automatically be disabled if the corresponding reading goes into a FailSafe alarm condition.

5. Emergency Off

The controller shall have a dedicated Emergency Off button on the front panel of the system, which immediately halts all chemical feeds and control outputs when pressed. This feature shall be password protectable, which shall require entry of one of the Security passwords.

6. Safety Shield

The controller shall include a safety shield or other mechanism for allowing fuse replacement without access to high voltage circuitry or wiring.

H. SECURITY

The controller shall have three security password levels: six for operators, two for managers and one for the distributor providing for a history of access identified by the user.

I. DATA LOGGING

The controller shall have 512K battery backed-up RAM for input level recording and events. All input level shall be recorded for 10 to 56 days depending on sample rate (2 to 10 minutes).

The controller shall record and maintain the latest 1100 events over a maximum of 14 days recording all alarms, parameter changes, user logins, and operational cycles related to all control features.

J. LOCAL ALARMS INDICATORS

The controller shall signal all alarm conditions with the following indicators:

- A bright red flashing LED on the front of the controller
- Activation of a master alarm signal provided as a dry contact relay enabling the use of 0-240 VAC alarms
- Each active alarm listed on the LCD display along with time activated

K. REMOTE COMMUNICATION, ACCESS & ALARM NOTIFICATION

1. Ethernet

The controller shall come with a standard, integral 100BaseT Ethernet connection. The controller shall be capable of providing Remote Access via PC with Ethernet connection and Alarm Notification via email or text message via an Ethernet connection to the Internet.

The controller shall come with a 57,600 bps data modem. The controller shall be capable of providing Remote Access via PC with modem connection and Alarm Notification via pager or fax.

2. Remote Access

The controller manufacturer shall provide graphical remote operation software, for interactive connection to the controller from a PC. Remote operation software shall be Windows 7 compatible, and have all of the following operational modes:

A. Site Data Base – for organizing and accessing multiple controllers on site, or at multiple sites.

B. Graphical Operator's Console – to display current readings, setpoints, alarm points, Ryzner in an easy-to-read graphical mode.

C. Data Log Graphing – to review data logs with time-synchronized event data; data log traces shall be configurable, with color and line style selectable by operator

D. Full Menu Tree – All system parameters accessible through a full menu tree interface.

E. Auto-Polling – to allow automatic download of data logs from all controllers in site database.

3. Alarm Notification

The controller shall be capable of providing alarm notification to 8 different recipients. Each recipient shall be individually configurable to receive alarm notification by one of the following methods:

A. Email: Notification of message shall include system type, serial number, location, system ID, and all active alarm including the date and time each alarm was triggered.

B. Text Message: Notification of message shall include system type, serial number, location, system ID, and all active alarm including the date and time each alarm was triggered.

C. Fax: Notification of message shall include system type, serial number, location, system ID, and all active alarm including the date and time each alarm was triggered.

D. Numeric Pager: Notification message shall include callback number. Controller shall acknowledge pager notification when callback is received, and not notify subsequent recipients programmed for pager notification.

L. ENCLOSURE

The controller shall be housed in a NEMA 4X polycarbonate enclosure

M. FLOW CELL

1. PVC Flow Cell

The flowcell shall have a PVC body with two ½" NPT ports for pH and ORP sensors, two ¼"NPT ports for temperature sensor and sensor wash acid injection, and a clear acrylic front viewing window. The flowcell design shall provide precise sample flow rate and water velocity regulation past the probes. The flowcell shall come provided with PVC ½" isolation ball valves, PVC ¼" wet test valve and standard reed or optional rotary flow switch.

Each flowcell shall be equipped with a pressure-sensing device. The pressure sensor shall consist of a compound pressure/vacuum gauge manufactured in stainless steel, 2 ½" diameter, liquid filled with an operating pressure range of 0 to 60 psig and vacuum of 0 to -30 in./ Hg.

N. WARRANTY, START-UP & MANUALS

Controller shall be covered by a standard manufacturer's 5 year warranty.

Standard sensors shall be covered by a standard manufacturer's 2 year warranty.

Optional sensors and flow cell components shall be covered by a standard manufacturer's 1 year warranty.

The control system shall be provided with on-site start-up, on-site operator training, and 1 year on-site warranty service performed by a representative trained and authorized by the controller manufacturer.

Manufacturer shall supply an Operators Manual describing features and operating instructions.

5.11 CHLORINE FEED AND ACID FEED SYSTEMS (Liquid Chlorine & Hydrochloric Acid):

The chemical feed systems shall consist of peristaltic feed pump(s) as specified on drawings.

The feed pumps shall be interlocked with the chemical controller. This work shall be done by the electrical contractor (except low voltage control wiring shall be installed by Interactive water feature Contractor).

Signs and/or identification markings shall be provided indicating the presence of chlorine and acid at the injection points, storage containers, doors / entry to the chemical storage rooms, and valves as required by all local and national codes.

Provide readily accessible manual valves or automatic remotely activated fail-safe emergency shutoff valves installed on the supply piping and tubing at the point of use and at the tank, cylinder or bulk source. The manual emergency shutoff valves shall be identified and the location shall be clearly visible, accessible and indicated by means of a sign.

5.12 CHEMICAL (CHLORINE & PH CONTROL) FEED PUMPS:

Chemical injector pumps shall be peristaltic type pumps unless otherwise noted on drawings. Output volume shall be adjustable from zero to a capacity in accordance with the size and chemical requirements of the interactive water feature. The pump shall be totally enclosed with no exposed moving parts. Electronics shall be enclosed in a chemical resistant enclosure at rear end of pump. Pumps shall be equipped with an acrylic pump head and 115V/60Hz motor. Sufficient tubing is to be provided with connections to install properly. Pump shall be mounted on the wall in a location close to the chemical storage containers. Pumps shall be complete with check valve / backflow prevention.

5.13 CHEMICAL STORAGE TANKS:

The liquid chlorine storage tanks shall be for sodium hypochlorite, 12% strength with a specific gravity of 1.20. The acid storage tanks shall be for muriatic / hydrochloric acid, 35% strength.

The chemical storage tanks shall be marked with the appropriate hazard identification signs per requirements of the NFPA 704. Provide identification placards on the entry doors to the storage area as required by the NFPA 704.

5.14 UV DISINFECTION SYSTEM:

Ultraviolet disinfection equipment shall operate within the UVC electromagnetic spectrum emitting wavelengths in the range of 200 nm to 400 nm. This required wavelength will provide constant disinfection / inactivation of bacteria, algae, molds, viruses and destruction of monochloramines, trichloramines and dichloramines.

The UV system shall have an MET or equivalent (ETL, CSA or UL) listing, and be NSF 50 certified.

A. Equipment General Description:

The Ultraviolet System shall be provided in a complete package to include: 316L

Stainless Steel Chamber, Control System located in a NEMA 12 rated panel, Medium Pressure Bulb(s) designed to emit wavelengths within the UVC electromagnetic spectrum, strainer basket, automatic wiper system and Project Commissioning by a Certified Ultraviolet Technician.

Ultraviolet manufacturer to offer unit capability of a Horizontal OR Vertical installation application using state of art design and direct flow through characteristics. Direct flow will be required in order to reduce total head loss through the system. Unit shall be a Multiple Lamp medium pressure system with a bulb range of (2) 1.5kW – (4) 3.3kW power range. Multiple lamp system is required in order to maintain quality disinfection in the event of a single bulb failure.

The Ultraviolet System shall be sized to emit a minimum dose of 60 mJ/cm², with flow rates of up to 972 gpm, within a 8" schedule 80 PVC pipe.

B. Ultraviolet Chamber:

Ultraviolet chamber shall be pressure rated for 100 psi (tested to 150 psi), and pressure drop across the unit will be minimal. The unit shall be constructed of 316L stainless steel to prevent corrosion within the harsh interactive water feature environment. The Ultraviolet chamber shall come complete with the following equipment:

- Ultraviolet Intensity monitor with built-in alarm system to notify operator when output level drops below required level of 60 mJ/cm². The Ultraviolet monitor output shall be transmitted via a 4-20ma signal to the control system. The Ultraviolet probe shall be rated to IP67 and be capable of being removed from the unit without having to drain the system. The lamp output shall be displayed on the control system as an intensity and % output.
- Ultraviolet temperature control system shall be provided to maintain system integrity in the event of flow interruptions to the chamber.
- Ultraviolet chamber shall come complete with annealed quartz sleeve with "O" ring seals for water tightness.
- Chambers shall be complete with ANSI flanges and all ports or vents shall be threaded NPT. The Ultraviolet chamber must be capable of installation in the system so that it remains full under all conditions.
- The Ultraviolet unit must be complete with appropriate brackets or feet for ease of installation.

C. Ultraviolet Lamp

- Ultraviolet lamp shall be medium pressure high intensity. Lamp shall be designed to emit continuous Ultraviolet wavelengths in the range of 200nm to 400nm. This will provide optimal disinfection benefits and destruction of the Monochloramine, Dichloramine and Trichloramine compounds. Lamp must remain unaffected by temperature variance of 0 degrees to 200 degrees Fahrenheit.
- The lamp unit must provide a dose not less than 60 mJ/cm² at the end of the lamp life and this must be based on the full re-circulating flow rate, not on a side stream treatment.

D. Automatic Wiper System

An automatic cleaning system shall be provided for cleaning of quartz sleeve and Ultraviolet monitor probe. The system shall travel the entire length of the quartz sleeve twice per desired cleaning cycle. Precision molded wiper rings shall be provided to ensure thorough quartz tube cleaning and quartz tube protection. Wiper cycle shall be user selectable and adjustable within a range of 15 minutes to 24 hours depending on anticipated application and deposit build-up. At a minimum the Automatic Wiper System shall have the following characteristics:

- System shall utilize direct Belt Drive with square mated pulleys and shafts to prevent slippage and pin shearing. Systems utilizing shear pins or complicated gear boxes will be unacceptable.
 - Wiper power supply shall be 24 volt DC for improved safety.
 - System shall incorporate Direct Shaft Encoding for positional location. Systems relying on external proxy switches or internally located magnets will be unacceptable.
 - Wiper interval shall be operator selectable with optional override switch.
 - Wiper faults are to be indicated on the control system display.
 - Wiper System to utilize “Intelligent Operation” for automatic start-up commissioning.
- Records wiper position @ chamber ends. Position must be fixed and not dependent on a timed interval or component striking end of chamber.

- Establish a travel run without setting limit adjustments to ensure system integrity and longevity.

E. Ultraviolet Control System

System shall be epoxy coated NEMA 12 rated cabinet.

Three levels of operation shall be provided to meet the needs of the operator and Interactive water feature environment: Simple Control – (Start, Stop & Reset), Full Parameter Display, and Customized Operator Configuration. Modes of operation shall be password protected to secure system critical setup functions. Control system shall have clearly identifiable Start, Stop and Reset control buttons (suitable for gloved operation) with Running and Fault LCD indicators.

- Two-line LCD screen shall display a minimum of the following: Ultraviolet dose (derived from flow and intensity inputs), Ultraviolet intensity (as a % and mw/cm²), Lamp Current, Flow rate (accepts signal from optional flow meter – displayed as gallons per minute), Chamber temperature (displayed as deg. F), Operation hour meter, System spares listing, Lamp fault, low Ultraviolet & temperature alarm, Ground fault trip, Wiper fault. All alarm functions shall have simple text message display to assist in fault finding.

- Control system shall have a minimum of the following system interface control: Remote operation, Process interrupt features (from valves, flow meters), Low UV dose (configurable to shutdown or alarm only, Flow meter input, Auto-restrike, Half to full power Ultraviolet setting with 24hr/7day settable timer).
- Control system shall have built in data-logging capabilities to record the following information: Ultraviolet intensity required, Ultraviolet intensity measured, Lamp current, Chamber temperature, Flow rate (if flow meter connected), Time and date stamp, All alarms generated.

F. Project Commissioning

Ultraviolet Chamber and Control Panel shall be commissioned by a qualified factory trained technician. During this time period, final electrical and control cabling will be connected from the control cabinet to the Ultraviolet disinfection chamber. Daily operation and simple maintenance instructions shall be provided during this commissioning process. A factory trained representative of the manufacturer shall perform all warranty work. Manufacture to warranty Ultraviolet Chamber and Spectra Control panel for a period of 12 months. Medium pressure Ultraviolet bulbs. shall be warranted for a period of 4000 hours. Intermittently operated bulbs (≥ 1 on/off cycles per day) will be replaced free of charge should failure occur prior to 3000 hours and replacement will be prorated between 3000 and 4000 hours. A detailed warranty sheet shall accompany this document upon request.

5.15 AUTOMATIC WATER LEVEL CONTROL:

Water level control of the balancing tank water levels shall be provided through the functions of the chemical controller. Provide all necessary sensors, wiring, conduit and calibration to provide water level control.

5.16 INTERACTIVE WATER FEATURE CONTROLLER:

The enclosure shall be made from corrosion resistant hot compression molded fiberglass reinforced polyester which do not contain halogens. The enclosure shall be capable of withstanding continuous temperature from -58 degrees F to up to 302 degrees F and shall provide indirect electrical contact protection for equipment and operators. Enclosures shall be UL listed per UL Standard 508 for NEMA 3, 4, 4X, 12 and 13; CSA certified per Standard C22.2-0,0.4, 0.7, 0.6, 94 Type 3, 3R, 4, 4X, 12 and 13.

Programmable logic controller shall be sized according to the number of outputs it is required to control. The programmable logic controller shall be factory programmed with a variety of light sequences designed according to the requirements of the project. It shall have the flexibility to modify the sequences using either a transportable memory cartridge or via the touch pad user interface.

The owner/operator shall be able to set the operational hours of the facility via the touch pad user interface. The 24hr/7day timer can be programmed with up to two time intervals that can be scheduled each day.

The operating system's touch pad user interface shall allow for manual override controls for each connected device, activation device(s), and timer. (i.e. Manual, Off and Automatic modes)

The operating system shall be housed in a corrosion resistant molded fiberglass NEMA 4X rated enclosure. All exposed hardware shall be 304/304L stainless steel and shall include a lockable access door.

The operating system shall have the capacity to receive signals from an activation devices, operating on 24VDC.

The operating system shall contain a 120 VAC primary / 24 VAC secondary transformer with built-in electrostatic shield protection.

The operating system shall have the ability to automatically purge all water lines based on the user selected time and duration (i.e. every day at 5 am). It shall also, be configured to purge all lines after a user defined period of inactivity (i.e. after 4 hours of inactivity).

The operating systems shall have the ability to provide a 24VAC auxiliary signal. This signal can be used to trigger a relay for Pumps, Lights, etc.

The operating system will softly start ramp up and will softly ramp down.

The operating system can activate up to a maximum of three play area.

The sequence time could be changed on site.

All main power electrical connections to the Splashpad Controller are to be performed per local codes.

Product drawings and installation manuals shall be supplied by the manufacturer for ease of installation.

PART 6- INTERACTIVE WATER FEATURE AND DECK EQUIPMENT:

6.00 VACUUM CLEANING EQUIPMENT

Vacuum pump shall be portable, electric, and 110 volt, Single phase, 155 Square Foot Filter. Vacuum pump shall be complete with a 1.0 horsepower pump, waterproof switch, suction connection with check valve, discharge connection with gate valve, hose bib connection for priming, stainless steel pump cart, internal GFI protections, and 100 feet of power cord.

Supply 24" polymer vacuum head for 2" hose, 2" dia. heavy duty Spiral Lock vacuum hose and 1.5" dia. anodized aluminum 12' handle sections with screwed connection. Vacuums should only be connected to GFI protected outlets specifically provided for the model vacuum specified.

6.01 LEAF SKIMMER AND WALL BRUSH:

Leaf skimmers shall have a head of stainless steel with removable screen, handle of aluminum or fiberglass, sixteen feet in length. Wall brushes shall be 24" long, bristles to be 1½" long of nylon, with handle of aluminum or fiberglass, sixteen feet in length.

6.02 TEST KIT:

Test kit shall have chlorine scales 0.4 to 3.0 ppm and pH range from 6.8 to 8.0. It shall have reagents for determining total alkalinity-acid demand and alkalinity demand. Test kit shall include testing abilities for cyanuric acid.

6.03 SAFETY SIGNS:

Safety signs shall be displayed in applicable areas. Lettering shall be contrasting and the size and color specified on the plans and required by code. See Interactive water feature drawings for required verbiage.

6.04 AQUATIC PLAY FEATURES:

Aquatic play features shall be manufactured, installed, maintained, and operated per ASTM F2376-08 and ASTM F-2461-09 standards.

Aquatic play features shall be as specified on the plans. Because of precise engineering parameters, flows, head losses are design for the specified fittings, substitutions will not be considered.

GENERAL CLAUSES:

The aquatic play products shall be suitable for installation in municipal and commercial aquatic facilities and public play areas. Products shall be specifically designed for the use by children and adults and follow the ASTM F2461-09 norm. In addition, products shall be manufactured by a

company that has at least five (5) years of experience in the design and engineering of children's aquatic play areas.

PRODUCT DELIVERY, STORAGE AND HANDLING

1. All aquatic play products and associated equipment must be properly wrapped and secured in place while in transport to the project site. Care shall be observed during offloading and handling to prevent excessive stress and abrasions.
2. At the site, the play products and associated equipment are to be stored in safe areas, out of the way of traffic and other construction activities, until the actual time of installation. If required, safety barricades or other like precautions must be taken for the protection of public and adjacent property.
3. Protective wrapping on the aquatic play features must be left in place until construction work for the water feature is complete.

COMMISSIONING OF THE INTERACTIVE WATER FEATURE

Upon completion of construction, the general contractor shall provide the owner/operator adequate training on facility operations and maintenance. The contractor may request that the equipment manufacturer and/or manufacturer's representative provide on-site start-up and training for the owner/operator.

6.05 EXECUTION:

The manufacturer shall furnish the purchaser with at least two sets of complete installation and operating manuals. The installation manual will illustrate the installation of the entire system. It shall describe the start-up procedure and day- to- day operation of the system.

PART 7 - FINAL PROVISIONS:

7.01 RECORD DRAWINGS, ADDITIONAL TRAINING, OPERATION AND MAINTENANCE MANUALS, AND INSTRUCTIONS:

Upon final acceptance of interactive water feature and related equipment, the following shall be furnished to the Owner:

One set of complete, as built drawings, showing exact location of all piping and of all equipment actually furnished and placed noting any deviations from the contract drawings and specifications, so that the original drawings may be revised.

Five complete sets of printed, indexed instructions, bound in a durable cover, for operation and maintenance of all equipment specified herein and shown on the drawings. These instructions shall also include precise directions for:

- a. Maintenance and operation of each component of the filtration system equipment and water feature systems equipment
- b. Maintenance and operation of the chemical control system, including complete chemical treatment, water balance
- c. Design circulation rates listed of the circulation filtration system.
- d. Precise directions for draining and/or winterizing of all circulation equipment and interactive water feature equipment and components (including water features).

7.02 GUARANTEES AND WARRANTIES:

Construction: The successful bidder shall guarantee the interactive water feature structure and finishes against leaking, cracking, failures, and overall water-tightness to the Owner for the period of one (1) year from the date of final completion. The successful bidder shall guarantee the, fittings

and equipment to the Owner for the period of one year, or per the equipment manufacturer's warranty, whichever is greater.

A 24 hour response time is required for servicing warranty items. In the event that the interactive water feature contractor fails to provide the required service within 24 hours, the interactive water feature contractor is liable for any cost the owner incurs if the owner chooses to provide the service (assuming the interactive water feature contractor's 24 hour response time has lapsed). If parts are needed from out of state, they shall be air freight delivered. Failure to respond within 24 hours may result in owner providing service from another source and the interactive water feature contractor back charged.

7.03 OWNER TO BE TRAINED BY INSTALLING CONTRACTOR:

The water feature contractor shall provide adequate training of the Owner's representative on the operation, use, and maintenance of all systems and all equipment, including the backwash protocol to landscaping.

The Owner's representative shall be a Certified Pool Operator (CPO).

Training shall occur during normal work-day hours (e.g. from 8:00 a.m. 5:00 p.m.) and on normal workday(s) (e.g. Monday through Friday). The owner's representative shall make himself or herself available to be trained during any normal times and days when the trainer (installing contractor) requests-- with advance notice--to schedule the training.

7.04 ANIMATION PANEL SIMULATION AND COMMISSIONING:

The Critical Phase Observations:

Fountain equipment manufacturer shall also provide two (2) on-site critical phase observations during the construction of the fountain. Contractor shall provide a minimum twelve (12) working days notification before attendance to site.

In-House Choreography and Base Programming

Fountain controller manufacturer shall provide submittal of programs of the fountain (or approved equal). These programs will be issued to the owner group and the aquatic designer for approval well prior to on-site aesthetic commissioning period.

Aesthetic Commissioning

Fountain equipment manufacturer shall provide aesthetic commissioning services to work with the control panel programmer to achieve the desired programs as approved by the owners group and the aquatic designer.

Animation Control Panel Programming and Training

The fountain-equipment manufacturer shall provide adequate on-site programming services to program the fountain to the satisfaction of the owner's group, landscape architect, and aquatic designer.

The fountain-equipment manufacturer shall provide adequate training for owner's staff on the equipment that they have supplied and programmed.

7.05 TRAINING PERIOD:

The successful interactive water feature contractor shall provide the Owner a training period not to exceed 30 days to acquaint the operators in the use and operations of all the various systems and interactive water feature related components (interactive water feature equipment / components, circulation systems, water feature systems). The interactive water feature contractor shall also provide the operators with instruction on draining and /or winterizing all equipment and interactive

water feature components. Training session days shall be on a day(s) that falls Monday through Friday from 8:00 A.M. 5:00 P.M.

END OF SECTION 131213

DIVISION 22 – PLUMBING

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SECTION 22 0500 - GENERAL PROVISIONS

PART 1 - GENERAL

- A. Provisions of this section apply to all work specified in all sections under Division 22.
 - B. In addition, work in Division 22 is governed by the provisions of the Bidding Requirements, Contract Forms, General Conditions and all sections under Division 1, General Requirements.
- 1.2 Examination of Premises: Visit the site, verify all measurements and job conditions, and pay all costs necessary to perform the work.
- 1.3 The Plumbing Contractor shall be licensed and hold a current contracting license that has been valid for a minimum of two years in the State of Utah as a plumbing contractor.
- 1.4 The Plumbing Contractor shall have a minimum of five years experience installing commercial plumbing systems similar to those described in these specifications and provide a list of previous projects, including name of project and contact person names and phone numbers.
- 1.5 The Plumbing Contractor shall be able to bond work he is bidding to perform and shall provide a written statement from the bonding agency proposed to be used for this project as a separate document in addition to the plumbing bid submitted by the General Contractor. The bonding agency shall be one having a Best's insurance rating of A or A+. (Verify all bonding with General Contractor)
- 1.6 Regulations, Permits, Fees, Charges, Inspections: (Verify with General Contractor)
- A. Regulations: Comply with all applicable codes, rules and regulations. All materials and work must comply with local construction, mechanical, plumbing, electrical and fire codes. As a minimum, comply with the following: 1991 IMC, IPC, NEC, UFC, NFPA codes and all City and State codes.
 - B. Fees and Permits: Pay all connection, installation, use, development, etc., fees and/or charges. Obtain and pay for all required permits and licenses. Refer to Division 1.
 - C. Inspections: All work must be inspected and approved by local authorities. Prior to final approval, furnish the Architect with certificates of inspections and approvals by the local authorities in accordance with Division 1.
- 1.7 Drawings and Specifications:
- A. Refer to Division 1 for information on submittals and shop drawings.
 - B. If a conflict exists between the drawings and specifications, promptly notify the Architect.
- 1.8 Record Drawings: Provide record drawings for all work under sections in Division 22. See Division 1 for detailed requirements covering preparation of record drawings.

- 1.9 Work and Materials: Unless otherwise specified, all materials must be new and of the quality specified. The workmanship shall be of a quality that is acceptable to the Architect and is comparable to the standards of the trades. Contractor must staff the project with sufficient skilled workmen, including a fully qualified construction Superintendent, to complete the work in the time allotted. The Superintendent must be qualified to supervise all of the work in his work category.
- 1.10 Approvals of Materials and Equipment: Refer to Division 1 for description of material and equipment for prior approvals and substitutions.
- 1.11 Maintenance Manual:
- A. Prior to completion of the project, compile a complete equipment and maintenance manual for all equipment supplied under sections of Division 22, as described in Division 1.
- B. Manuals shall be bound in a three-ring binder. A preliminary submittal of the manual shall be made to the Architect 90 days after receiving approved submittals. Final submittal of the manual shall be made four weeks prior to substantial completion of the project.
- 1.12 Shop Drawings:
- A. Engineer's Review: The Engineer shall review and take appropriate action on shop drawings, product data, samples and other submittals required by the contract documents. Such review shall be only for general conformance with the design concept and general compliance with the information given in the contract documents. It shall not include review of quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with the work of other trades or construction safety precautions, all of which are the sole responsibility of the Contractor. The Engineer's review shall be conducted with reasonable promptness consistent with sound professional practice. Review of a specific item shall not indicate acceptance of an assembly of which the item is a component. The Engineer shall not be required to review and shall not be responsible for any deviations from the contract documents not clearly noted by the Contractor, nor shall the Engineer be required to review partial submissions or those for which submissions for correlated items have not been received.
- B. Submit shop drawings in accordance with Division 1 and all data for all equipment provided under Division 22 within 30 days after award of contract. Index all submittals and reference to these specifications. Submit all shop drawings in a single batch at one time. Submit shop drawings for all equipment provided under Division 22, including the following:
1. Insulation materials and finishes for all types of piping.
 2. Water heaters of all types.
 3. Access doors.
 4. Access panels.
 5. Plumbing fixture cuts, trim and fittings, rough-in dimensions and special supports.

6. Plumbing fixtures, equipment and specialties.
 7. Domestic water pipe, fittings, valves, hangers and specialties showing manufacturer and type.
 8. Waste and vent piping, fittings, couplings, hangers.
 9. All other equipment as shown, indicated, specified, required and as directed by Architect.
- 1.13 Equipment Purchases: Arrange for purchase and delivery of all materials and equipment within 15 days after approval of submittals.
- 1.14 Cooperative Work:
- A. Correct without charge any work requiring alteration due to lack of proper supervision or failure to make proper provision in time. Correct without charge any damage to adjacent work caused by the alteration. See Division 1 for additional requirements.
 - B. Cooperative Work Includes:
 1. General supervision and responsibility for proper location, rough-in and size of work related to Division 22 but provided under other divisions of these specifications.
 2. Installation of sleeves, inserts and anchors bolts for work under sections in Division 22.
 3. Electrical work as specified herein. Refer to Division 26 for requirements.
- 1.15 Identification:
- A. Pipe:
 1. Mark each individual pipe with Brady, Seton, Brimar, or Set Mark identification markers of snap-on type after pipe has been painted or insulated where exposed.
 2. Install stencils at all major branch takeoffs, risers and at 10-foot intervals on straight runs and at each entrance or exit from pipe shafts. Markers shall be located for maximum visibility from expected personnel approach.
 3. Identification material sizes shall be as follows:

2" and under 1/2" high letters

Over 2" 1" high letters

Provide a typewritten schedule of all markers used, with identification framed under glass and posted in the mechanical equipment room.

4. Identify pipe with following:

<u>Service</u>	<u>Abbreviation</u>
Domestic Cold Water	CW
Domestic Hot Water	DHW
Sanitary Sewer	SS
Vent	V

1.16 Substitutions:

- A. Where Manufacturer's names appear, other Manufacturers may be substituted upon obtaining written approval of Architect **at least 10 days prior to opening of bids**. The contractor will be required to complete and sign a "Proposed Substitution Request Form" that will be reviewed by the Architect, Engineer, and Owner. The submission of the "Proposed Substitution Request Form" shall be **at least 10 days prior to opening of bids**.
- B. Any prior approval of alternate equipment does not automatically exempt the supplier from meeting the intent of these specifications. Failure to comply with the operational and functional intent of these specifications may result in the total removal of the alternate system at the expense of the contractor.

1.17 Guarantee: Guarantee all material, equipment, and workmanship for all sections under Division 22 in writing to be free from defects of material and workmanship for one year from date of final acceptance as outlined in Division 1. Replace without charge any material or equipment proving defective during this period. The guarantee shall include performance of the equipment under all conditions of load, installing any additional items of control and/or protective devices as required and the replacing of any refrigerant lost.

1.18 Electrical Work:

- A. Electrical wiring, all raceways, wiring, outlet and junction boxes, and labor for installation of the wiring and equipment shall be included in Electrical Division 26 of the specifications.
- B. Before ordering any equipment. Verify the available voltage and phase for all motors with the Electrical Contractor.
- C. Submit a complete list of all motors prior to final closeout of job indicating the locations, horsepower, voltage, phase and amperage draw of each motor.
- D. All field wiring and equipment must conform to the applicable sections of the Electrical specifications, Division 26.

PART 2 - PRODUCTS

2.1 Equipment Design and Installation:

- A. Uniformity: Unless otherwise specified, provide all equipment of same type or classification by the same manufacturer.
- B. Design: Design all equipment in accordance with ASME, AGA, UL and other applicable technical standards as follows:

Electric appliances - UL labeled

Fans - AMCA rated and stamped

PART 3 - EXECUTION

3.1 Verification of Dimensions:

- A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions at site, and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.
- B. Drawings are essentially diagrammatic and many offsets, bends, special fittings and exact locations are not indicated. Carefully study drawings and premises in order to determine best methods, exact locations, routes, building obstructions, and install apparatus and equipment in available locations. Install apparatus and equipment in manner and in locations to avoid obstructions, preserve headroom, and keep openings and passageways clear.

3.2 Cutting and Patching: Cut work and patch per Division 1 as necessary to properly install the new work. As the work progresses, coordinate necessary openings, holes, chases, etc., in their correct location. If the required openings, holes and chases are not in their correct locations, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members without the consent of the Architect. Patching by General Contractor at Mechanical, Plumbing or Fire Protection Contractor's expense. Include as a part of the work under this contract all structural framing required by penetrations through the roof and necessary steel to support ducts and pipes between structural steel unless shown on the structural drawings.

3.3 Closing-in of Unfinished Work: Cover no work until inspected, tested and approved. Where work is covered before inspection and test, uncover it, and when inspected, tested and approved, restore all work to original proper condition.

3.4 Excavation and Backfill:

- A. Perform all necessary excavation, shoring and backfilling required for the proper laying of all pipes and conduits inside the building and premises, and outside as may be necessary. Conform to Division 2 requirements. Remove all excess excavated materials from the site or dispose of on site as directed by General Contractor.
- B. Excavate all trenches open cut, keep trench banks as nearly vertical as practicable, and sheet and brace trenches where required for stability and safety. Excavate trenches true to line and make bottoms not less than 18" wide but no wider than necessary to provide

ample work room. Grade trench bottoms accurately to provide uniform bearing and support for each section of pipe on undisturbed soil along its entire length. Dig "bell" holes after the trench bottom has been graded. Machine grade only to the top line of the pipes, doing the balance by hand. Do not cut any trench near or under footings without first consulting the Architect. Comply with OSHA requirements.

- C. Provide backfilling and compaction in accordance with requirement of Division 2 and under the direction of the Architect and the Owner's testing firm to the required density. Make the first 2 feet of fill in 6" layers, each thoroughly compacted as directed, and free from rocks, large clods of earth, leaves, branches, and debris. Compact the rest of the backfill to prevent settlement as directed, using in the backfill no rocks larger than 4" in diameter, and using no rocks at all in the top 12".

3.5 Accessibility:

- A. Install valves, dampers, thermometers, gauges, traps, cleanouts, control devices or other specialties requiring reading, adjustment, inspection, repairs, removal or replacement conveniently and accessibly throughout the finished building. Where any of these devices are shown on the contract drawings to be installed above any inaccessible ceiling, the Mechanical Contractor shall furnish access doors or panels as required.
- B. All access doors or panels in walls and ceilings required for access to control devices, traps, valves and similar devices are to be furnished and installed as part of the work under this section. Provide type as specified under Division 8.
- C. Refer to drawings and "Finish Schedule" for type of wall and ceiling in each area and for rated construction.
- D. Coordinate work of various sections to locate valves, traps, and dampers with others to avoid unnecessary duplication of access doors.

3.6 Roof Flashings: Flash and counterflash all piping, conduits and ductwork penetrating roofing membrane with flashing per roofing manufacturer's recommendations. Refer to architectural drawings for detailing of duct and pipe penetrations through roof.

3.7 Equipment Rough-in:

- A. Rough in all equipment and fixtures as designated on the drawings and in the specifications. The drawings indicate only the approximate location of rough-ins. The exact rough-in locations must be determined from large-scale certified drawings. The Contractor shall obtain all certified rough-in information before progressing with any work for rough-in final connections.
- B. Be responsible for providing all outlets and services of proper size at the required locations.
- C. Minor changes in the contract drawings shall be anticipated and provided for under this division of the specifications.
- D. Rough-in only (unless otherwise designated on the drawings) shall include the following:

1. Plumbing: Provide all services designated and required, including waste and water. Valve and cap all stub-outs for water and gas. Cap all waste and vent outlets.

3.8 Owner-Furnished and Other Equipment:

- A. Rough-in only for all Owner-furnished equipment (see Division 1) and all equipment furnished under other sections of the specifications, except as otherwise specified and/or noted on the drawings.
- B. Provide all services designated, valve and cap all piping and cap all waste piping and leave in a clean and orderly manner.
- C. Rough-in requirements shall be as outlined in the preceding paragraph titled "Equipment Rough-In."

3.9 Equipment Final Connections:

- A. Provide all piping final connections for all equipment under Division 22 as required herein specified and indicated on the drawings.
- B. Plumbing: Provide final plumbing connections complete with shutoff valves, risers, traps, vacuum breakers and indirect wastes for all equipment furnished and installed under other sections of these specifications, except as otherwise designated. Included under the Plumbing section of the specifications are the final connections to the following:
 1. Miscellaneous equipment specified to be furnished and installed under other divisions of the specifications.

3.10 Pipe and Equipment Supports:

- A. Where supports, foundations, stands, suspended platforms for machinery, tanks, or other equipment are indicated or specified, perform the following:
 1. Locate support members to avoid equipment strains and interference with piping connections, tube pulling or other maintenance operations.
- B. Grout under all equipment after leveling, filling completely the space between machinery bed plate and foundation surface as specified in Division 3. Finish exposed surface of grout for a neat appearance.
- C. Floor Stands: Where equipment is mounted standard or on legs, construct of structural steel or steel pipe and fittings, cross-brace and fasten with flanges or plates bolted to floor.
- D. Ceiling or Wall Supports: Use suspended platform, strap hangers, bracket or shelf, whichever is most suitable for equipment and location. Construct of structural steel members, steel plates, rods or pipe as required. Cross-brace and fasten to building structure or inserts in an approved manner.

- E. Steel Work: Neatly fabricate and erect steel work with burrs and welding spatter ground off. Paint after fabrication with a rust-inhibitive primer.

3.11 Cleanup:

- A. In addition to cleanup specified under Division 1, thoroughly clean all parts of the equipment. Where exposed parts are to be painted, thoroughly clean off any splattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.
- B. Thoroughly flush and clean out all water circulating systems. Remove, clean and replace all strainer elements.
- C. During the progress of the work, keep the premises clean and free of debris.

3.12 Painting:

- A. Except as otherwise specified or indicated in the architectural drawings and/or specifications, paint all exposed unfinished metal with one coat of rust-inhibiting primer. (Galvanized ductwork and factory painted equipment shall be considered as having primed surface.)
- B. Finished painting is specified under Division 9.

3.13 Connections to Services: Provide all connections to existing sanitary sewer lines, water lines, electrical services furnished under other contracts, except as otherwise specifically designated. Provide all necessary tees, taps and connections required to properly connect to all mains. Verify all required City requirements before making any piping connections to sanitary sewer or water piping and conform to them during installation.

3.14 Objectionable Noise and Vibration: Construct and brace the metal partitions, ducts and sheet metal housings to prevent vibration or rattling when systems are in operation. Install connections to equipment so noise and vibration will not reach the conditioned area through ducts, piping, conduit, sheet metal work, or the building structure. Provide power-driven equipment suspended from the structure with spring type isolation.

END OF SECTION 22 0500

SECTION 22 0501 - SUMMARY OF WORK FOR PLUMBING

PART 1 - GENERAL

1.1 Description of Work

- A. This section describes the work required under the Plumbing sections of these specifications.

1.2 General and Supplementary Conditions

- A. The General and the Supplementary Conditions of this project apply in every respect to all of the sections under this division of these specifications.

1.3 Related Work Specified Elsewhere

- A. Concrete, Division.
- B. Finished Painting, Division.
- C. Mechanical, Division 23.
- D. Electrical, Division 26.

1.4 Scope

- A. For general convenience these specifications are divided into divisions and sections. The work for the plumbing contract is in general described in Division 22. The work under these sections include furnishing and installing plumbing systems. The work includes, but is not necessarily limited to, the installation of the following:
 - 1. Complete sanitary plumbing waste and vent systems with connections to all plumbing fixtures and equipment to existing sanitary sewer system as indicated in Plumbing Plans.
 - 2. Domestic water piping with services to all fixtures and equipment, including connection to existing domestic water system as indicated in Plumbing Plans.
 - 3. Domestic hot water heating equipment including piping, valves, etc. as indicated on the drawings and specified.
 - 4. Insulation specified herein for domestic hot water supply piping, and other pipe as specified.
 - 5. Adequate supervision of erection, balancing and adjustments and instructions for proper operation and maintenance.
 - 6. Plumbing fixtures as specified herein and shown on the drawings.
 - 7. Payment for all plumbing permits, inspection and installation fees. (Coordinate with General Contractor)
 - 8. Sterilization of potable water system.

1.5 Alternate Equipment

- A. Specification of all equipment and materials in Division 22 by brand name is intended to establish a standard of quality. Further, this equipment has been checked as to size and

weight requirements, and space allocations have been made accordingly. The Contractor is responsible to verify prior to bidding that all specified and alternate items to those specified will be available in time for installation during timely progress of the work.

- B. Submittal of equipment by other acceptable manufacturers must be made in accordance to "Instructions to Bidders" section and shall be complete in every detail including space requirements, weight, complete performance data, and supplemental data requested by the Architect. Contractor shall be responsible for assurance that the equipment meets all requirements detailed in this and other sections and as shown on the drawings.
- C. The following is a list of manufacturers whose equipment is acceptable as to manufacture, subject to conformance with all drawings.
- D. Approved Plumbing Equipment Manufacturers: (Note some items may not be required)
- Plumbing Fixtures: American Standard, Kohler, Toto, Gerber, Watts, Zurn, AMTC.
- Security Plumbing Fixtures: Metcraft, Bradley, Acorn, Willoughby.
- Plumbing Faucets: Chicago, American Standard, Symmons, Delta, Kohler, Speakman, T & S, Moen, Gerber, Zurn, AMTC.
- Flush Valves: Sloan, Delany, Zurn, Moen, American Standard, Gerber, Zurn, AMTC.
- Plumbing Supply Stops: Eastman, Crane, Kohler, Wolverine, McGuire, Brasscraft, EBC.
- P-Traps: Crane, Kohler, McGuire, Brasscraft, Dearborn, EBC, Zurn.
- Floor Drains and Floor Sinks: Zurn, Smith, Wade, Josam, Ancon, Mifab, Watts, Sun.
- Cleanouts: Zurn, Smith, Wade, Josam, Mikro, Mifab, Watts, Sun.
- Shock Absorbers: Zurn, Smith, Wade, Josam, PPP, Sioux Chief, Watts, Mifab.
- Valves: Milwaukee, Crane, Kennedy, Stockham, Mission, Grinnell, Keystone, Watts.
- Electric Domestic Hot Water Heaters: Ruud, National, PVI, State, Rheem, Bradford White, A.O. Smith,
- Pipe Hangers and Supports: Grinnell, Elcen, Kin-Line, Unistrut, F & S, B-Line, Michigan, Piping Technology & Products.
- Pressure Gauges: Weksler, Trerice, Palmer, Marsh, Weiss.
- Pipe and Equipment Insulation: Owens-Corning, CertainTeed, Manville, Pittsburgh, Armstrong, LSP Products.
- Thermostatic Tempered Water Valves: Symmons, Powers, Leonard, Bradley, Watts, Moen.

END OF SECTION 22 0501

SECTION 22 0594 - TESTING

PART 1 - GENERAL

1.1 This section describes the labor, materials and services required for the testing of all systems.

PART 2 - EXECUTION

2.1 Test Procedures

- A. Make tests before the rough work is covered. When the tests show the work in any way defective, remove defective material or equipment from the premises and retest.
- B. Make piping tests on all piping as required by code. Pressure test for four hours, unless otherwise noted.

2.2 Testing out

- A. Check out and test operate all equipment installed under the sections of these specifications, including a check of all work performed under the Electrical and Mechanical divisions in conjunction with the equipment installed under all sections of this division.
 - 1. Fill water pipe lines, flush and drain, and then refill with clear water (area affected by the work of this project). Repeat this procedure three times, under the observation of the Architect's Representative.
 - 2. When the test or observations show that the work is in any way defective or at a variance with the specification requirements, immediately make all changes necessary to correct the work and remedy the defects to the satisfaction of the Architect. Remove any defective material or equipment from the premises. In the event the Contractor does not remedy all defects and make all changes demanded by the Architect within a reasonable time, the right is reserved to have the defects remedied or changes made and to charge the cost of the work against the account of the Contractor.
 - 3. Furnish all appliances, equipment and labor for the tests and meet all expenses of the tests.

2.3 Final Tests

- A. Before acceptance and at a time designated, make a complete test to demonstrate that all controls are adjusted and that, in general, the system is placed into proper operation. Furnish a skilled operating engineer for a period of at least four hours, at time or times designated by the Owner, to instruct the Owner's representative in the operation and maintenance of the equipment.

END OF SECTION 22 0594

SECTION 22 0716 - GENERAL PIPING REQUIREMENTS

PART 1 - GENERAL

1.1 WORK SPECIFIED HEREIN

- A. This section describes the workmanship, labor, services and miscellaneous equipment and materials required for the installation of all piping in Division 22.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. Do not close up, furr in, or cover piping before it has been tested and inspected as specified.
- B. Cover or plug openings in pipes, drains, fittings and equipment during construction to keep system free of foreign matter.
- C. Conceal all piping unless otherwise indicated or specified.
- D. Install piping to maintain headroom, keep access openings clear and offset piping as required to maintain clearances.
- E. Install piping at right angles or parallel to adjacent walls.
- F. Keep piping free from sags, traps and unnecessary bends.
- G. Do not spring, bend or force pipe into place. Use fittings for all offsets and changes of alignment in piping.
- H. Do not use street elbows, bushings and longscrew nipples.
- I. Do not install any pressure piping in floor slabs or in ground under floor slabs, unless otherwise indicated or specified.
- J. Do not locate piping in electrical equipment rooms unless it serves that room. Do not locate it directly above electrical equipment in any room. Where piping is located in an electrical equipment room which it serves, provide a 20 gauge galvanized sheet metal drip pan with drain line to floor drain.
- K. Where change in pipe size occurs, use appropriate reducing fittings, no bushings.

3.2 UNIONS, FLANGES AND DIELECTRIC COUPLINGS

- A. Unions Required: On inlet or outlet of all valves and equipment with connections 2" and smaller and elsewhere as indicated on the contract documents.
- B. Flanges Required: On inlet or outlet of all equipment having connections 2-1/2" and larger. On inlet or outlet of all valves and fittings having flanged ends or requiring companion flanges. Do not use slip-on flanges on short radius ells, tees, reducers and fittings that do not have sufficient straight length to permit proper alignment and construction of a flange joint.
- C. Dielectric Couplings: Provide dielectric couplings at all points where copper or brass pipe or equipment is joined to ferrous pipe and equipment. This requirement does not apply to brass valves in steel lines or joints between copper and cast iron drainage lines.

3.3 PIPE SLEEVES AND ESCUTCHEONS

- A. Sleeve all pipes passing through masonry or concrete floors and walls.
- B. Provide piping passing through masonry, concrete, tile and gypsum wall construction with not lighter than 22 gauge galvanized steel sleeves with lock seam, except as otherwise indicated.
- C. Sleeves through floor construction shall be provided.
- D. Floor sleeves shall extend a minimum of 2" above the floor.
- E. Pipes passing through walls labeled on the architectural drawings as fire-rated shall be sleeved and sealed with fireproof caulking. Refer to the contract drawings for additional information and details.
- F. Sleeves for insulated pipe must be large enough to clear insulation.
- G. Where sleeves are placed in exterior walls below grade or in floor of finished areas. Make the entire penetration watertight.
- H. Where pipe motion due to expansion and contraction will occur, make sleeve of sufficient diameter to permit free movement of the pipes.
- I. Provide chrome-plated or stainless steel escutcheons at all pipe penetrations through walls, ceilings or floors of all finished areas.

3.4 VALVES

- A. General: Locate and arrange valves for complete regulation and/or removal of equipment.
- B. Location: Install valves as indicated and at all the following locations:
 - 1. Pressure connections to equipment.

2. Takeoff from vertical risers.
3. Domestic connections to utilities.

- C. Concealment: Unless otherwise indicated, conceal all valves in the finished parts of the building.
- D. Grouping: Wherever possible, group valves to provide a neat appearance with all parts accessible.

3.5 PIPE JOINTS

- A. Screwed Joints: Cut accurately to measurements established at the building. Ream pipe and remove all burrs. Cut threads per ANSI B2.1 with clean sharp die to full thickness of die. Apply pipe dope or teflon tape to male thread prior to jointing. After jointing, leave not more than 3 full threads exposed.
- B. Solder Joints: Cut square and remove burrs. Thoroughly clean outside of male end and inside of female fitting to a bright finish. Coat pipe and fitting with solder flux, applied with brush. Solder joint as specified and remove excess solder. Remove the internal parts of soldered valves prior to soldering. Carefully follow equipment manufacturer's directions for soldering on or adjacent to his equipment.
- C. Welded Joints:
 1. Electric weld all piping using ASME certified welders (refer to Section 15000 for additional requirements on welding). Carefully follow equipment manufacturers directions for welding on or adjacent to his equipment. Use outlets, fittings and joints designed for welded piping. Use long radius ells at all pump connections and where indicated and butt-welded or socket-welded fittings at all offsets or bends.
 2. Make connections to mains with Schedule 40 welding fittings when the branch is the same size as the main or one size smaller. Use "Weldolet" fittings when the branch is 2 or more sizes smaller than the main. Use "Threadolet" fittings for branches 2" or smaller.
- D. Mechanical Joints: Install with mechanical couplings or compression joints in strict compliance with the manufacturer's instructions.
- E. Solvent Weld Joints: Install solvent welded joints in strict compliance with the manufacturer's instructions and remove all excess solvent.

3.6 PIPE HANGERS

- A. General: Secure all piping in place using approved hangers, supports and anchors designed to support the weight of the pipe, fluid and insulation. Arrange hangers to prevent transmission of vibration from the piping to the building structure, with hangers and supports designed to allow for expansion and contraction.

- B. Pipe Support: Support piping at each change of direction, at ends of branches, at base and top of riser pipes and drops, and wherever necessary to prevent sags, bending or vibration.
- C. Insulation Guards: Size hangers on insulated piping to fit outside the covering. Protect insulation from crushing at hanger locations with sheet metal pipe saddles. Use rigid insulation under saddle.
- D. Riser Piping: Support at top and bottoms as specified for horizontal piping. Support at intermediate floors by means of pipe clamps bolted to piping. In addition, support soil and waste piping at base of stack. Where pipe sleeves extend above floor, support from underside of slab.

3.7 EXPANSION AND CONTRACTION

- A. Install all pipe work and conduit in such a manner that its contraction and expansion will not do any damage to the pipes, conduit, the connected equipment or the building. Install offsets, swing joints, expansion joints, pipe clamps and anchors as required to prevent excessive strains in the pipe work. Install all supports to permit the systems to contract and expand freely without putting any stress or strain in the respective systems.

END OF SECTION 22 0716

SECTION 22 0718 - PIPING SPECIALTIES

PART 1 - GENERAL

1.1 WORK INCLUDED HEREIN

- A. Provide and install piping specialties as specified herein and as shown on the drawings.

PART 2 - PRODUCTS

2.1 PIPE HANGERS

- A. Piping 2-1/2" and Smaller: Use adjustable, split ring malleable iron type (Grinnell Fig. 104) or adjustable steel clevis type (Grinnell Fig. 260) with threaded solid steel hanger rods.
- B. Grouped Piping: Trapeze type hangers with rollers may be used where 2 or more pipes run parallel to each other.
- C. Size all hangers on insulated piping to fit outside covering.
- D. Hanger Rod Sizes:

<u>Pipe Size</u>	<u>Rod Diameter (Inches)</u>
2" and smaller	3/8
2-1/2" and 3"	1/2
4" and 5"	5/8
6"	3/4
8" through 14"	7/8

- E. Hanger Rod Spacing (Horizontal Piping):

<u>Pipe</u>	<u>Max. Hanger Spacing</u> <u>(Ft. O.C.)</u>
Steel pipe 3/4" and smaller	6
Steel pipe 1"	8
Steel pipe 1-1/4" through 12"	10
Steel pipe 14" and larger	12
Copper tubing 1-1/4" and smaller	6
Copper tubing 1-1/2" and larger	8
PVC & ABS piping	4
Special piping materials	As recommended by manufacturer.

2.2 SAFETY COVERS

- A. Install Handy-Shield, as manufactured by Plumberex Specialty Products, safety covers on all supply piping and waste piping beneath handicapped lavatories. Shields shall meet the requirements of Uniform Federal Accessibility Standards 4.19.4 GSA and ANSI Document A117-1-1980.
- B. Use safety covers where required for exposed supply and drain piping. Note that security covers that cover supply and drain piping will not require safety covers.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

- A. Refer to structural drawings and details for acceptable methods and locations of attachment to structural members.
- B. Provide hangers at all offsets, tees, within 12" of all horizontal elbows, and elsewhere as herein described.
- C. Support all piping from walls, structural members, or from the ceiling as specified or as detailed.
- D. Support vertical piping as specified or as detailed.
- E. Where structural or piping conditions or clearance requires other than the specified means of supporting the pipes, use means as directed by the Architect.
- F. Wrap piping wherever lines run through joists, studs and framing 12" in length with felt on paper backing to prevent the pipe from rubbing.
- G. Install chrome-plated split escutcheons around all pipes passing through finished walls, floors and ceilings.
- H. Sleeve and seal air and watertight all piping passing through exterior walls, through plenum or fire walls above ceilings, and elsewhere as designated. All sealers shall be waterproof and fireproof.

END OF SECTION 22 0718

SECTION 22 0719 - PIPE INSULATION FOR PLUMBING

PART 1 - GENERAL

1.1 SCOPE

- A. Apply insulation after piping has been installed, tested, approved, dry, and in a clean condition.
- B. Hot water pipe insulation shall be a minimum of one inch where required by code. See Comcheck for requirements.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Premolded fiberglass insulation, maximum K factor 0.24 at 75°F mean temperature, minimum 3.75-pound density. Insulation shall have all-service jacket with white finish.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Piping: Insulation end joints to be tightly butted together with butt joint strips and the longitudinal seam stapled closed with outward clinch staples 2" on centers. Where possible, locate all longitudinal seams out of sight. Coat all staples with adhesive. Cover exposed pipe insulation with 6-ounce canvas jacket coated 100% with Foster lagging adhesive 30-36.
- B. Valves, Fittings and Flanges (Concealed): Insulate all concealed valves, fittings and flanges with Zeston premolded sectional covering.
- C. Valves, Fittings and Flanges (Exposed): Insulate all exposed valves, fittings and flanges as specified for concealed fittings, and cover with 6-ounce canvas coated 100% with Foster lagging adhesive 30-36.
- D. Hangers and Rollers: Provide a protective shield covering of 18 gauge galvanized steel placed centrally at all hangers and rollers. Shield shall cover half of the insulation and have a length of not less than 12". Insert a 12" section of cellular glass or calcium silicate at each hanger and roller location.

3.2 INSULATION THICKNESS

- A. Hot water pipe insulation shall be as indicated in the plumbing details.

END OF SECTION 22 0719

SECTION 22 1116 - DOMESTIC WATER SYSTEM

PART 1 - GENERAL

- 1.1 Provide PVC Sleeves for PEX Piping where it passes under slabs.
- 1.2 Provide and install copper termination at wall for shut-off valves, transition from pex to copper inside wall. Pex shall not be visible at wall penetration to shut-off valve.

PART 2 - PRODUCTS

- 2.1 Piping: (Shall meet the standards set forth in IPC Tables 605.3, 605.4, 605.5.)
 - A. Water lines that are 2-inches and smaller will be PEX. Provide appropriate transitional fittings at locations where the water piping material changes.
 - B. Provide and install copper termination at wall for water supply stop (transition from PEX to copper for termination).
- 2.2 Fittings:
 - A. Shall be compatible with piping material.
- 2.3 Backflow Preventers: Specified in Plumbing Specialties section.

PART 3 - EXECUTION

- 3.1 Extend water piping to all fixtures, outlets and equipment. Provide shutoff valves or fixture stops as required for proper service.
- 3.2 Provide capped or plugged and valved outlets where indicated for future equipment connections.
- 3.3 Hold lines which are specified to be insulated a sufficient distance from other work to permit installation of insulation. Insulation shall be placed between the piping and the exterior of the building.
- 3.4 Provide necessary allowance in piping systems to handle expansion and contraction. Install ample swings or offsets in branch connections to avoid undue strains on fittings or short pipe supplies. Provide expansion loops and pipe anchors as indicated on the drawings.
- 3.5 Where shown on the drawings or required by local plumbing code, install Trap Guard in floor drains, floor sinks, etc.
- 3.6 Provide approved pressure type backflow prevention devices required by governing authorities.
- 3.7 Coordinate overhead piping with mechanical ductwork and electrical conduits.
- 3.8 Provide a mechanical shock absorber at any fixtures using a quick-closing valve device (flush valves, fridge water connection, washing machines, etc.).
- 3.9 Sterilization: Sterilize the entire water distribution system thoroughly with a solution containing not less than 50 parts per million of available chlorine. For the chlorinating material use sodium hypochlorite solution, conforming to Federal Specification 0-8-441, Grade D, and introduce into the system in a manner approved by the Architect. Allow the sterilizing solution to remain in the system for a period of 8 hours, during which time all valves and faucets shall be opened and closed several times. After sterilization, flush the solution from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million, unless otherwise directed. ***

NOTE: CONTRACTOR SHALL PROVIDE ARCHITECT/ENGINEER WITH CERTIFICATION OF TEST RESULTS. ***

- 3.10 Test: Fill system with water and pressurize to 125 psi and hold for four (4) hours with no pressure drop. Test and obtain approval on all underground piping before covering work.

END OF SECTION 22 1116

SECTION 22 1313 - SANITARY WASTE AND VENT SYSTEM

PART 1 - PART 1 GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. The Drain Waste and Vent System will be Schedule-40 PVC Piping rating for Drain Waste and Vent.
 - 2. Furnish and install soil, waste, and vent piping systems within building and connect to outside utility lines 5 feet out from building. Continuation of sewer system will be indicated on Civil Plans.
 - 3. Perform excavation and backfill required by work of this Section.

1.2 REFERENCES

- A. [American Society For Testing And Materials](#)
 - 1. ASTM D 2235-96a, 'Standard Specification for Solvent Cement for ABS Plastic Pipe and Fittings'
 - 2. ASTM D 2321-00, 'Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications'
 - 3. ASTM D 2564-96a, 'Standard Specification for Solvent Cements for Poly (Vinyl Chloride)(PVC) Plastic Piping Systems'
 - 4. ASTM D 3034-00, 'Standard Specification for Type PSM Poly Vinyl Chloride)(PVC) Sewer Pipe and Fittings'
 - 5. ASTM F 628-00, 'Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings with a Cellular Core'
 - 6. ASTM F 656-96a, 'Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride)(PVC) Plastic Pipe and Fittings'
 - 7. ASTM F 789-95a, 'Standard Specification for Type PSM Poly (Vinyl Chloride)(PVC) Plastic Gravity Flow Sewer Pipe and Fittings'
 - 8. ASTM F 891-00, 'Standard Specification for Coextruded Poly (Vinyl Chloride)(PVC) Plastic Drain, Waste, and Vent Pipe Fittings with a Cellular Core'

PART 2 PRODUCTS

2.1 COMPONENTS (Shall meet the standards set forth in IPC Tables 702.1, 702.2, 702.3, 702.4.)

- A. Indicated in Section Summary.

B. Buried Piping

1. Minimum size of waste piping installed under floor slab on grade shall be 2 inches.

PART 3 EXECUTION

3.1 INSTALLATION

A. Excavate and backfill as specified

1. Runs shall be as close as possible to those shown on Drawings.
2. Excavate to required depth and grade to obtain fall required. Grade soil and waste lines within building perimeter in direction of flow.
3. Bottom of trenches shall be hard. Tamp as required.
4. Remove debris from trench prior to laying of pipe.
5. Do not cut trenches near footings without consulting Architect.

B. Thermoplastic Pipe And Fittings

1. General - Piping and joints shall be clean and installed according to Manufacturer's recommendations. Break down contaminated joints, clean seats and gaskets and reinstall.
2. Above Grade - Locate pipe hangers every 4 feet on center maximum and at elbows.
3. Below Grade -
 - a. Install in accordance with Manufacturer's recommendations and ASTM D 2321.
 - b. Stabilize unstable trench bottoms.
 - c. Bed pipe true to line and grade with continuous support from firm base.
 - 1) Bedding depth - 4 to 6 inches.
 - 2) Material and compaction to meet ASTM standard noted above.

C. Install piping so cleanouts may be installed as follows

1. Where shown on Drawings and near bottom of each stack and riser.
2. At every 135 degrees of accumulative change in direction for horizontal lines.
3. Every 100 feet of horizontal run.
4. Extend piping to accessible surface. Do not install piping so cleanouts must be installed in carpeted floors. In such locations, configure piping so wall type cleanouts may be used.

- D. Vent entire waste system to atmosphere. Join lines together in fewest practicable number before connection to existing vent through roof indicated on Plumbing Sheets.
- E. Furnish and install firestopping at penetrations of fire-rated structures.

3.2 FIELD QUALITY CONTROL

- A. Site Tests
 - 1. Conduct tests for leaks and defective work. Notify Architect prior to testing.
 - 2. Thermoplastic Pipe System -
 - a. Before backfilling and compacting of trenches, cap all open ends and pressure test to 20 psi for 4 hours with no leaks. Correct leaks and defective work.
 - b. After backfilling and compacting of trenches is complete but before placing floor slab, re-test as specified above. Uncover pipe and correct leaks and defective work. Re-backfill and compact and re-test.

END OF SECTION 22 1313

SECTION 22 3430 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 Scope

- 1.2 All electrical equipment and controls shall be UL listed. Provide ASME approved temperature and pressure relief valves on all domestic heating equipment.

PART 2 - PRODUCTS

2.1 Domestic Water Heaters

- A. Provide water heater of size, capacity and make as scheduled on the drawings. Heaters shall be fully warranted for a minimum of 3 full years after final acceptance of the building. Furnish heaters with the following accessories:
1. ASME combination temperature and pressure relief valve rated in excess of heater input. Run full size drain to atmosphere.
 2. Automatic thermostat actuated controls with 100% shutoff.
 3. Dual high-limit controls.
 4. Tank drain.
 5. Brass nipples for pipe connections.
 6. Heater shall be factory insulated and sheet metal jacketed.
 7. Water heater drain pan with drain as indicated in plumbing detail.
- B. Design Standard: See Plumbing Fixture Schedule

END OF SECTION 22 3430

SECTION 22 4200 - PLUMBING FIXTURES

PART 1 - GENERAL

- 1.1 Use polished chrome-plated, adjustable brass P-traps with wall escutcheons at all exposed locations. Fixtures and supply fitting shall be of one manufacturer. Provide diaphragm type, polished chrome-plated flush valves with integral vacuum breakers and screwdriver stops. Provide fixture stops or valves ahead of all equipment or fixtures. After fixtures are set in place and secured to walls, caulk all around between fixtures and wall with either Dow Corning #780 or G.E. Construction Sealant white silicone caulking compound. See Section 22 0501 for other acceptable and approved plumbing equipment manufacturers.
- 1.2 All brass plumbing fixtures shall have lifetime warranty.

PART 2 - PRODUCTS

- 2.1 See Plumbing Fixture Schedule for additional information.
- 2.1 Wall Mounted Stainless Lavatory:
 - A. All lavatories and sinks shall include supply stops, p-trap, and necessary mounting hardware.
 - B. Provide drain with grid strainer. Provide with cover for drain piping. This fixture will be used where a plumbing chase has been provided.
- 2.1 Floor Drains
 - A. Provide with Trap Guard insert (or approved equal). Floor drain shall be compatible with flooring in area of installation.
- 2.1 Water Closets
 - A. Wall Mounted Stainless Steel with Flush Valve. Provide with carrier rated for use with chase. This fixture will be used where a plumbing chase has been provided.
 - B. See architectural details for all ADA requirements.
- 2.2 Urinal
 - A. Stainless Steel with Flush Valve: Provide with carrier rated for use with chase. This fixture will be used where a plumbing chase has been provided.
- 2.3 Mop Sink
 - A. Provide with steel spring rim guard and mop sink hose.
- 2.4 Drinking Fountain – Outdoor
 - A. Provide with cover (supply and drain lines) and make provisions for winterization.

END OF SECTION 22 4200

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DIVISION 23 – MECHANICAL

23 0501	GENERAL PROVISIONS
23 0594	TESTING
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SECTION 23 0501 - GENERAL PROVISIONS

PART 1 - GENERAL

- 1.1 Scope:
- A. Provisions of this section apply to all work specified in all sections under Division 23.
 - B. In addition, work in Division 23 is governed by the provisions of the Bidding Requirements, Contract Forms, General Conditions and all sections under Division 1, General Requirements.
- 1.2 Examination of Premises: Visit the site, verify all measurements and job conditions, and pay all costs necessary to perform the work.
- 1.3 The Mechanical Contractor shall be licensed and hold a current contracting license that has been valid for a minimum of two years in the State of Utah as a Mechanical Contractor.
- 1.4 The Mechanical Contractor shall have a minimum of five years' experience installing commercial cooling and heating systems similar to those described in these specifications and provide a list of previous projects, including name of project and contact person names and phone numbers as a separate document in addition to the mechanical bid submitted by the General Contractor.
- 1.5 The Mechanical Contractor shall be able to bond work he is bidding to perform and shall provide a written statement from the bonding agency proposed to be used for this project as a separate document in addition to the mechanical bid submitted by the General Contractor. The bonding agency shall be one having a Best's insurance rating of A or A+. (Verify bonding with General Contractor)
- 1.6 Regulations, Permits, Fees, Charges, Inspections: (Verify with General Contractor)
- A. Regulations: Comply with all applicable codes, rules and regulations. All materials and work must comply with local construction, mechanical, plumbing, electrical and fire codes. As a minimum, comply with the following: 1991 IMC, IPC, NEC, UFC, NFPA codes and all City and State codes.
 - B. Fees and Permits: Pay all connection, installation, use, development, etc., fees and/or charges. Obtain and pay for all required permits and licenses. Refer to Division 1.
 - C. Inspections: All work must be inspected and approved by local authorities. Prior to final approval, furnish the Architect with certificates of inspections and approvals by the local authorities in accordance with Division 1.
- 1.7 Drawings and Specifications:
- A. Refer to Division 1 for information on submittals and shop drawings.
 - B. If a conflict exists between the drawings and specifications, promptly notify the Architect.

- 1.8 Record Drawings: Provide record drawings for all work under sections in Division 23. See Division 1 for detailed requirements covering preparation of record drawings.
- 1.9 Work and Materials: Unless otherwise specified, all materials must be new and of the quality specified. The workmanship shall be of a quality that is acceptable to the Architect and adheres to the standards of the trades. Contractor must staff the project with sufficient skilled workmen, including a fully qualified construction Superintendent, to complete the work in the time allotted. The Superintendent must be qualified to supervise all of the work in his work category.
- 1.10 Approvals of Materials and Equipment: Refer to Division 1 for description of material and equipment for prior approvals and substitutions.
- 1.11 Maintenance Manual:
- A. Prior to completion of the project, compile a complete equipment and maintenance manual for all equipment supplied under sections of Division 23, as described in Division 1.
 - B. Manuals shall be bound in a three-ring binder. A preliminary submittal of the manual shall be made to the Architect 90 days after receiving approved submittals. Final submittal of the manual shall be made four weeks prior to substantial completion of the project.
- 1.12 Shop Drawings:
- A. Engineer's Review: The Engineer shall review and take appropriate action on shop drawings, product data, samples and other submittals required by the contract documents. Such review shall be only for general conformance with the design concept and general compliance with the information given in the contract documents. It shall not include review of quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with the work of other trades or construction safety precautions, all of which are the sole responsibility of the Contractor. The Engineer's review shall be conducted with reasonable promptness consistent with sound professional practice. Review of a specific item shall not indicate acceptance of an assembly of which the item is a component. The Engineer shall not be required to review and shall not be responsible for any deviations from the contract documents not clearly noted by the Contractor, nor shall the Engineer be required to review partial submissions or those for which submissions for correlated items have not been received.
 - B. Submit shop drawings in accordance with Division 1 and all data for all equipment provided under Division 23 within 30 days after award of contract. Index all submittals and reference to these specifications. Submit all shop drawings in a single batch at one time. Submit shop drawings for all equipment provided under Division 23, including the following:
 - 1. Intake/exhaust hoods and caps, penthouses, curbs.
 - 2. Insulation materials and finishes for all types of piping.
 - 3. Ductwork, dampers, air distribution accessories, louvers.

4. Fans.
 5. Access doors.
 6. Access panels.
 7. All other equipment as shown, indicated, specified, required and as directed by Architect.
- 1.13 Equipment Purchases: Arrange for purchase and delivery of all materials and equipment within 15 days after approval of submittals.
- 1.14 Cooperative Work:
- A. Correct without charge any work requiring alteration due to lack of proper supervision or failure to make proper provision in time. Correct without charge any damage to adjacent work caused by the alteration. See Division 1 for additional requirements.
 - B. Cooperative Work Includes:
 1. General supervision and responsibility for proper location, rough-in and size of work related to Division 23 but provided under other divisions of these specifications.
 2. Installation of sleeves, inserts and anchors bolts for work under sections in Division 23.
 3. Electrical work as specified herein. Refer to Division 26 for requirements.
- 1.15 Substitutions:
- A. Where Manufacturer's names appear, other Manufacturers may be substituted upon obtaining written approval of Architect **at least 10 days prior to opening of bids**. The contractor will be required to complete and sign a "Proposed Substitution Request Form" that will be reviewed by the Architect, Engineer, and Owner. The submission of the "Proposed Substitution Request Form" shall be **at least 10 days prior to opening of bids**.
 - B. Any prior approval of alternate equipment does not automatically exempt the supplier from meeting the intent of these specifications. Failure to comply with the operational and functional intent of these specifications may result in the total removal of the alternate system at the expense of the contractor.
- 1.16 Guarantee: Guarantee all material, equipment, and workmanship for all sections under Division 23 in writing to be free from defects of material and workmanship for one year from date of final acceptance as outlined in Division 1. Replace without charge any material or equipment proving defective during this period. The guarantee shall include performance of the equipment under all conditions of load, installing any additional items of control and/or protective devices as required and the replacing of any refrigerant lost.

1.17 Mechanical Wiring:

- A. Provide all temperature control wiring, all interlock wiring, and equipment control wiring for the equipment that is to be provided under this Division unless specifically shown on electrical drawings.
- B. All wiring shall be not less than No. 14 insulated, color coded wire in electrical metallic tubing. Installation shall comply with Division 26.
- C. The following schedule is intended to summarize the division of work material responsibilities between the Mechanical Contractor and the Electrical Contractor.

	Furn.	Set	Power	Control
<u>Item</u>	<u>By</u>	<u>By</u>	<u>Wiring</u>	<u>Wiring</u>
Equipment motors	MC	MC	EC	--
Motor starters, contactors and overload heaters	MC*	EC	EC	MC
Fused and unfused disconnect switches	EC	EC	EC	--
Manual operating switches, multispeed switches, push- button stations and pilot lights	EC	EC	EC	EC
Control relays and transformers	MC	MC	EC	MC
Thermostats, time switches**	MC	MC	EC	MC
Smoke detectors	MC	MC	EC	CC
Motor and solenoid valves, damper motors, switches	PE and EP			
	MC	MC	--	MC
Refrigeration equipment controls	MC	MC	EC	MC

MC = Mechanical Contractor

EC = Electrical Contractor

CC = Controls Contractor

** Motor-drive units which are controlled from line voltage automatic controls such as line voltage thermostats, float switches or time switches which conduct full load current of the motor shall be wired for both power and control circuit under the electrical contract. However, if the control device does not conduct full load current, then the responsibility shall be that set forth in the above schedule. (Example: A 208 volt, 3-phase, 3-wire motor requires 120 volt control.) Electrical Contractor shall furnish a 120 volt circuit for control and 208 volt circuit for power and wire the power circuit. Mechanical Contractor shall wire the control circuit.

- D. Under this section provide all shop drawings and wiring diagrams complete with all connection details. Wiring diagrams must be free from confusing optional methods that do not apply. Wiring diagrams must be complete with all necessary information and must correctly indicate the conditions of this specific job.
- E. Under this section be responsible for the checking and testing of all controls and interlocks for a complete and satisfactory operating system.
- F. Before ordering motors, equipment, etc., verify the available voltage and phase with the electrical trades.

1.18 Electrical Work:

- A. Electrical wiring, including power wiring and control wiring (except as otherwise specified under Automatic Temperature Controls), all raceways, wiring, outlet and junction boxes, and labor for installation of the wiring and equipment shall be included in Electrical Division 26 of the specifications.
- B. Under the Automatic Temperature Control section of these specifications, furnish and install all wiring, conduit, electric automatic temperature control devices, thermostats, relays, automatic control switches and pilot lights. See the Automatic Temperature Control Section, for additional detailed information.
- C. All loose starters and control devices for equipment furnished under Division 23 (except as otherwise specified under Automatic Temperature Control Section) are to be furnished under that particular section of Division 23 and installed under the electrical division.
- D. Contractor shall provide all shop drawings and wiring diagrams complete with all connection details. Wiring diagrams must be free from confusing optional methods that do not apply. Wiring diagrams must be complete with all necessary information and must correctly indicate the conditions of this specific job.
- E. Contractor shall be responsible for the checking and testing of all controls and the interlocks for a complete and satisfactory operating system.

- F. Before ordering any motors and equipment. Verify the available voltage and phase for all motors with the Electrical Contractor.
- G. Submit a complete list of all motors prior to final closeout of job indicating the locations, horsepower, voltage, phase and amperage draw of each motor.
- H. All field wiring and equipment must conform to the applicable sections of the Electrical specifications, Division 26.

PART 2 - PRODUCTS

2.1 Machinery Drives:

- A. Use V-belts designed for 150% of capacity for all belt drives. For multiple belt drives, use matched sets, so marked at the factory.
- B. On drives with not more than two belts, provide adjustable pitch motor sheaves with the midpoint of the adjustment range such as required to achieve the specified fan capacity.
- C. On motors with drives with more than two belts, furnish nonadjustable sheaves, providing the specified fan capacity.

2.2 Machinery Accessories:

- A. Lubricating Devices: Provide all oil level gauges, oil pressure gauges, grease cups, grease gun fittings, as required by the equipment. Extend all lubricating fittings to readily accessible locations.
- B. Guards: Provide totally-enclosed OSHA type belt guards for all rotating equipment. Design guards to be readily removable for access to belt drives.

2.3 Equipment Design and Installation:

- A. Uniformity: Unless otherwise specified, provide all equipment of same type or classification by the same manufacturer.
- B. Design: Design all equipment in accordance with ASME, AGA, UL and other applicable technical standards as follows:
 - Electric appliances - UL labeled
 - Fans - AMCA rated and stamped
 - Cooling equipment - ARI certified
 - Fire dampers, smoke dampers, combination fire and smoke dampers - UL listed

PART 3 - EXECUTION

- 3.1 Verification of Dimensions:
- A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions at site, and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.
 - B. Drawings are essentially diagrammatic and many offsets, bends, special fittings and exact locations are not indicated. Carefully study drawings and premises in order to determine best methods, exact locations, routes, building obstructions, and install apparatus and equipment in available locations. Install apparatus and equipment in manner and in locations to avoid obstructions, preserve headroom, and keep openings and passageways clear.
- 3.2 Cutting and Patching: Cut work and patch per Division 1 as necessary to properly install the new work. As the work progresses, coordinate necessary openings, holes, chases, etc., in their correct location. If the required openings, holes and chases are not in their correct locations, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members without the consent of the Architect. Patching by General Contractor at Mechanical, Plumbing or Fire Protection Contractor's expense. Include as a part of the work under this contract all structural framing required by penetrations through the roof and necessary steel to support ducts and pipes between structural steel unless shown on the structural drawings.
- 3.3 Closing-in of Unfinished Work: Cover no work until inspected, tested and approved. Where work is covered before inspection and test, uncover it, and when inspected, tested and approved, restore all work to original proper condition.
- 3.4 Accessibility:
- A. Install valves, dampers, traps, control devices or other specialties requiring reading, adjustment, inspection, repairs, removal or replacement conveniently and accessibly throughout the finished building. Where any of these devices are shown on the contract drawings to be installed above any inaccessible ceiling, the Mechanical Contractor shall furnish access doors or panels as required.
 - B. All access doors or panels in walls and ceilings required for access to control devices, traps, valves and similar devices are to be furnished and installed as part of the work under this section. Provide type as specified under Division 8.
 - C. Provide ducts which pierce a fire separation with fire dampers of same fire rating as the separation.
 - D. Refer to drawings and "Finish Schedule" for type of wall and ceiling in each area and for rated construction.
 - E. Coordinate work of various sections to locate valves, traps, and dampers with others to avoid unnecessary duplication of access doors.

- 3.5 Roof Flashings: Flash and counterflash all piping, conduits and ductwork penetrating roofing membrane with flashing per roofing manufacturer's recommendations. Refer to architectural drawings for detailing of duct and pipe penetrations through roof.
- 3.6 Equipment Rough-in:
- A. Rough in all equipment and fixtures as designated on the drawings and in the specifications. The drawings indicate only the approximate location of rough-ins. The exact rough-in locations must be determined from large-scale certified drawings. The Contractor shall obtain all certified rough-in information before progressing with any work for rough-in final connections.
 - B. Be responsible for providing all outlets and services of proper size at the required locations.
 - C. Minor changes in the contract drawings shall be anticipated and provided for under this division of the specifications.
 - D. Rough-in only (unless otherwise designated on the drawings) shall include the following:
 - 1. Mechanical: Provide all services as indicated and required, including all ductwork, piping and valves. Cap all ductwork stub-outs in a manner suitable for future extension.
- 3.7 Owner-Furnished and Other Equipment:
- A. Rough-in only for all Owner-furnished equipment (see Division 1) and all equipment furnished under other sections of the specifications, except as otherwise specified and/or noted on the drawings.
 - B. Rough-in requirements shall be as outlined in the preceding paragraph titled "Equipment Rough-In."
- 3.8 Equipment Final Connections:
- A. Provide all piping and duct final connections for all equipment under Division 23 as required herein specified and indicated on the drawings.
 - B. Air Conditioning, Heating, and Ventilating: Provide final connections complete with necessary valves, drains, unions, flanges and duct connections for equipment furnished and installed under other sections of the specifications, except as otherwise designated. Included under the HVAC sections of the specifications are the final connections to the following:
 - 1. Condensate piping from air conditioning equipment.
 - 2. Supply, return, relief, outside air and exhaust duct connections for all equipment including exhaust fans.
 - 3. Piping connections for all equipment.

- 3.9 Machinery Drives: After tests have been performed on the air conditioning and air handling systems, make without cost not more than two changes in the size of the nonadjustable sheaves to obtain the required air quantities.
- 3.10 Machinery Accessories:
- A. Application: Do not install any equipment in an application not recommended by the manufacturer.
 - B. Installation: Align, level and adjust all equipment for proper operation. Install so connecting and disconnecting of piping and accessories can readily be done and so all parts are readily accessible for inspection, service and repair. Install equipment in accordance with manufacturer's recommendations.
- 3.11 Pipe and Equipment Supports:
- A. Where supports, foundations, stands, suspended platforms for machinery, tanks, or other equipment are indicated or specified, perform the following:
 - 1. Locate support members to avoid equipment strains and interference with piping connections, tube pulling or other maintenance operations.
 - 2. Mount power-driven equipment on common base with driver.
 - B. Ceiling or Wall Supports: Use suspended platform, strap hangers, bracket or shelf, whichever is most suitable for equipment and location. Construct of structural steel members, steel plates, rods or pipe as required. Cross-brace and fasten to building structure or inserts in an approved manner.
 - C. Steel Work: Neatly fabricate and erect steel work with burrs and welding spatter ground off. Paint after fabrication with a rust-inhibitive primer.
 - D. Roof Mounted Equipment (Steel Supported): Provide curbs and flashings for metal support structures as shown in the latest SMACNA manual for roof supports.
- 3.12 Cleanup:
- A. In addition to cleanup specified under Division 1, thoroughly clean all parts of the equipment. Where exposed parts are to be painted, thoroughly clean off any splattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.
 - B. During the progress of the work, keep the premises clean and free of debris.
- 3.13 Painting:
- A. Except as otherwise specified or indicated in the architectural drawings and/or specifications, paint all exposed unfinished metal with one coat of rust-inhibiting primer and a finish coat as directed by architects representative and as described in the contract

documents. (Galvanized ductwork and factory painted equipment shall be considered as having primed surface.)

B. Finished painting is specified under Division 9.

- 3.14 Objectionable Noise and Vibration: Construct and brace the metal partitions, ducts and sheet metal housings to prevent vibration or rattling when systems are in operation. Install connections to equipment so noise and vibration will not reach the conditioned area through ducts, piping, conduit, sheet metal work, or the building structure. Provide power-driven equipment suspended from the structure with spring type isolation.

END OF SECTION 23 0501

SECTION 23 0594 - TESTING

PART 1 - GENERAL

1.1 This section describes the labor, materials and services required for the testing of all systems.

PART 2 - EXECUTION

2.1 Test Procedures

- A. Make tests before the rough work is covered. The system may be tested in parts if approved.
- B. When the tests show the work in any way defective, remove defective material or equipment from the premises and retest.
- C. Make piping tests on all piping as required by code.

2.2 Testing out

- A. Check out and test operate all equipment installed under heating, ventilating and air conditioning sections of these specifications, including a check of all work performed under the Electrical and Mechanical divisions in conjunction with the equipment installed under all sections of this division.
 - 1. Check electrical work to see that the power is properly supplied to all electrical motors and that all electric controls are properly hooked up in the control circuits. Furnish a list of the voltage and current readings taken under load of all motors.
 - 2. Check all work and see that all controls are in good working order and properly adjusted. After the equipment has been properly adjusted, start up and run all equipment enough to determine that the controls and equipment are all operating properly and that the installation is complete.
 - 3. When the test or observations show that the work is in any way defective or at a variance with the specification requirements, immediately make all changes necessary to correct the work and remedy the defects to the satisfaction of the Architect. Remove any defective material or equipment from the premises. In the event the Contractor does not remedy all defects and make all changes demanded by the Architect within a reasonable time, the right is reserved to have the defects remedied or changes made and to charge the cost of the work against the account of the Contractor.
 - 4. Furnish all appliances, equipment and labor for the tests and meet all expenses of the tests.

2.3 Final Tests

- A. Before acceptance and at a time designated, make a complete test to demonstrate that the air quantities are balanced for even temperatures throughout, that all controls are adjusted and that, in general, the system is placed into proper operation. Furnish a skilled operating engineer for a period of at least four hours, at time or times designated by the Owner, to instruct the Owner's representative in the operation and maintenance of the equipment.

END OF SECTION 23 0594

SECTION 23 3114 - SHEET METAL DUCTWORK (LOW PRESSURE)

PART 1 - GENERAL

- 1.1 Scope: Furnish all labor, materials, equipment and services necessary for the installation of all low pressure sheet metal duct systems as herein described and as indicated on the drawings. Each system shall be complete with all accessories, etc., as described herein and in other sections of these specifications.
- 1.2 Galvanized Sheet Metal: For all ductwork except as otherwise specified.

PART 2 - PRODUCTS

- 2.1 Galvanized Ductwork: Galvanized, prime-grade, lock-forming, quality steel (LFQ) having galvanized coating of 1-1/4 ounces total for both sides of 1 square foot of a sheet. Cross-break all sides of ducts.
- 2.2 Longitudinal Seams: Pittsburgh lock groove, hammered flat. Tape all transverse joints of supply, return and exhaust ducts with open weave fiberglass, canvas and Arabol, or reinforced Hardcast.
- 2.3 Flexible Duct: Flexible, preinsulated, vinyl coated fiberglass with corrosion-resistant, steel spiral reinforcing, designed for low velocity application. All duct, insulation and adhesives shall be fire and smoke resistant in conformance with NFPA 90A and UL 181 for Class 1 duct. Duct shall be Thermaflex Type M-KC as manufactured by Flexible Tubing Co. or approved.
- 2.4 Flexible Connections: 24-ounce glass fabric that is flameproof, airtight, ozone resistant, and a minimum of 3" wide with 3" of metal on each side of 3" of fabric using a grip lock seam, Duro-Dyne "Durolon".
- 2.5 Access Doors:
 - A. Uninsulated Ducts: Construct access doors of galvanized sheet metal gauges heavier than duct with rolled edges, hinges, and Ventfabrics, Inc. "Ventlock" #260 latch. Make airtight with felt strips or neoprene gasketing and provide 1" x 1" x 1/8" galvanized iron frame for installation in ductwork.
- 2.6 Access Panels and Access Openings in Ductwork: Galvanized, sheet steel, 2 gauges heavier than the duct with rolled edges, felt strips or neoprene gasketing and attached to duct with sheet metal screws a maximum of 6" on center.
- 2.7 Duct Supports:
 - A. Ducts 47" and Smaller: 14 gauge steel hanger straps 1" wide riveted to seams of ducts, maximum of 6'-0" on center. Alternate support for horizontal ducts must be by (2) 1/4" bolts or 2 or more #14 sheet metal screws.
- 2.8 Duct Construction: All duct construction must conform to local code or to the SMACNA Duct Construction Standards Manual, whichever is more stringent.

PART 3 - EXECUTION

- 3.1 Fabrication: Fabricate all ductwork and install using skilled mechanics in strict conformance with the SMACNA Manual. Provide supplemental stiffening as required to prevent drumming and provide a structurally sound assembly.
- 3.2 Construction: Construct all fittings, elbows, and transitions to provide a minimum of noise and resistance. Where space permits, use elbows with a minimum radius of 1-1/2 times the width (or

depth). Where space conditions necessitate abrupt changes in direction (or as otherwise indicated), use square elbows with double radius turning vanes. Transitions increasing in the direction of airflow shall not change greater than 1" in 7" and transitions decreasing in the direction of airflow shall not change greater than 1" in 5".

A. Ductmate and Ward duct connectors are allowed when fabricated and installed in strict compliance with manufacturer's instructions.

- 3.3 Taping: Tape all cross-joints in concealed or insulated sheet metal ductwork with Arabol and canvas or reinforced Hardcast.
- 3.4 Weatherproofing: Make all ductwork exposed to weather weathertight, seal all joints with a minimum of 2 coats of asphalt-based roofing compound painted with aluminum paint.
- 3.5 Duct Openings: Construct duct openings at grilles or registers so that the plaster will not crack when the registers are attached.
- 3.6 Measurements: Before fabrication, check all ductwork with the building construction for dimensions, locations, clearances, etc. Make up duct with any necessary variations to conform to the details of the construction of the building, to suit the space available, and to fit the equipment furnished. The entire duct system must be substantially constructed, rigidly erected and free of any duct vibration or noises.
- 3.7 Flashing: Flash all ducts passing through the roof, floor or through exterior walls.

END OF SECTION 23 3114

DIVISION 26 – ELECTRICAL

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SECTION 260001 – ELECTRICAL GENERAL PROVISIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Architectural, Structural, Mechanical and other applicable documents also apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. The contract documents indicate the extent of electrical work. Provide all labor, materials, equipment, supervision and service necessary for a complete electrical system as described in divisions 26, 27, and 28.

1.3 RELATED SECTIONS:

- A. Other Divisions relating to electrical work apply to the work of this section. See other applicable Divisions including, but not necessarily limited to:
 - 1. Division 1 – General and Supplementary Conditions
 - 2. Division 2 – Existing Conditions
 - 3. Division 3 – Concrete
 - 4. Division 5 – Metals
 - 5. Division 6 – Wood, Plastics, and Composites
 - 6. Division 7 – Thermal and Moisture Protection
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 - 10. Division 22 – Plumbing
 - 11. Division 23 – Heating Ventilating and Air Conditioning
 - 12. Division 27 – Communications
 - 13. Division 28 – Electronic Safety and Security

1.4 INTERPRETATIONS OF DRAWINGS AND SPECIFICATIONS:

- A. Prior to bidding the job, submit requests for clarification in writing to the Architect/Engineer prior to issuance of the final addendum.
- B. After signing the contract, provide all materials, labor, and equipment to meet the intent, purpose, and function of the contract documents.
- C. The following terms used in Division 26, 27, and 28 documents are defined as follows:
 - 1. "Provide" - Means furnish, install, and connect, unless otherwise indicated.
 - 2. "Furnish" - Means purchase new and deliver in operating order to project site.
 - 3. "Install" - Means to physically install the items in-place.
 - 4. "Connect" - Means make final electrical connections for a complete operating piece of equipment. This includes providing conduit, wire, terminations, etc. as applicable.

5. "Or Equivalent" - Means to provide equivalent equipment. Such equipment must be approved by the Engineer prior to bidding.

1.5 EXAMINATION OF SITE:

- A. Visit the site and verify existing field conditions prior to submitting bid.
- B. All costs arising from site conditions and/or preparation shall be included in the base bid. No additional charges will be allowed due to inadequate site inspection.

1.6 QUALITY ASSURANCE:

- A. Perform work in accordance with all governing codes, rules, and regulations including the following minimum codes (latest editions or as otherwise accepted by the Authorities Having Jurisdiction):
 1. National Electric Code (NEC)
 2. International Building Code (IBC)
 3. International Fire Code (IFC)
 4. International Mechanical Code (IMC)
 5. International Plumbing Code (IPC)
 6. American Disability Act (ADA)
 7. National Electrical Safety Code (NESC)
 8. Local Codes and Ordinances
- B. Comply with all standards where applicable for equipment and materials including the following minimum standards:
 1. Underwriter's Laboratories (UL)
 2. American Society for testing Materials (ASTM)
 3. Certified Ballast Manufacturers (CBM)
 4. Insulated Cable Engineers Association (ICEA)
 5. National Electrical Manufacturer's Institute (NEMA)
 6. American National Standards Institute (ANSI)
 7. Electrical Testing Laboratories (ETL)
 8. National Fire Protection Association (NFPA)
 9. Institute of Electrical and Electronics Engineers (IEEE)
 10. American Institute of Electrical Engineer's Electrical Power
 11. Systems and Grounding in Commercial Construction
 12. Illuminating Engineers Society (IES)
- C. Provide new electrical equipment conforming to all requirements as set forth in the above standards. Provide UL labeled equipment where such label is applicable.
- D. Comply with all state and local codes and ordinances. When conflicts occur among codes, standards, drawings, and/or specifications, the most stringent requirements shall govern.
- E. Obtain all permits, inspections, etc. required by authority having jurisdiction. Include all fees in bid. Provide a certificate of approval to the owner's representative from the inspection authority at completion of the work.
- F. Provide only first-class workmanship from competent workers, conforming to the best electrical construction practices.
- G. The contractor shall have a current state contracting license applicable to type of work to be

performed under this contract.

1.7 SUBMITTALS:

- A. The contractor shall submit complete shop drawings and other required submittals. Incomplete submittals will be returned to the contractor unreviewed. No time extensions or cost increases will be allowed for delays caused by the return of incomplete submittals.
- B. Shop Drawings: After the contract is awarded, but prior to manufacture or installation of any equipment, submit eight (8) complete sets of shop drawings. Partially complete sets of shop drawings are not acceptable. Submit all shop drawings in one complete submittal package. Prior to submitting shop drawings, review and certify that they are in compliance with the contract documents; Sign all approved shop drawings. Allow a minimum of two weeks for architect/engineer to review shop drawings. Refer to architectural general provision section for additional requirements.
- C. Provide equipment catalog "cut sheets", brochures and/or drawings which clearly describe the proposed equipment. Include plans, elevations, sections, isometrics, and detailed engineering and dimensional information as applicable including equipment room layouts. Electrical room layouts are required to show all electrical equipment locations for all projects that include electrical rooms. Do not submit catalog sheets which describe several different items in addition to those items to be used, unless all relevant information is clearly identified. Bind each information set in three ring binder or binders of sufficient size or sizes to enclose all information. Organize all information by section. Provide separate tabbed covers for each section of Divisions 26, 27, and 28, indicating section number for each section requiring submittals.
- D. Include on front cover of binder or binders the name and location of the project, architect, electrical engineer, general contractor, electrical contractor, subcontractors, supplier/vendor, order number, volume, date, and any other applicable information. Certify that shop drawings are submitted in accordance with the contract documents with a written statement indicating compliance. Submittals will be reviewed and comments produced two times maximum. Additional reviews will be billed at current rates.

1.8 OPERATION AND MAINTENANCE MANUALS:

- A. Submit four (4) complete sets of operating instruction and maintenance manuals for all equipment and materials provided under Divisions 26, 27, and 28.
- B. Provide manufacturer's recommended operating and maintenance instructions, cleaning and servicing requirements, serial and model number of each piece of equipment, complete list of replacement parts, performance curves and data, wiring diagrams, warranties, and vendor's name, address, and phone numbers. Do not submit information which describes several different items in addition to those items to be used, unless all relevant information is clearly identified. Assemble all data in completely indexed volume or volumes. Engrave the job title, and name, address, and phone numbers of the contractor on the front cover and on the spine. Incomplete O&M manuals will be returned to the contractor for corrections / additions.

1.9 RECORD DRAWINGS:

- A. Maintain on a daily basis a complete set of "Red-Lined Drawings", reflecting an accurate record of all work including addendums, revisions, and changes. Indicate precise dimensioned locations of all concealed work and equipment, including concealed or embedded conduit, junction boxes, etc. Record all "Red-Lined Drawing" information on a set of full sized prints of the contract drawings.

- B. Certify the "Red Lined Drawings" for correctness. Indicate on each drawing the name of the general and electrical contractors with signatures of each representative responsible for the work.
- C. The electrical engineering design firm will create record (as-built) drawings from the certified red-lined drawings; however, the general and electrical contractors retain the responsibility for the accuracy of the record drawings.

1.10 WARRANTY:

- A. Ensure that the electrical system installed under this contract is in proper working order and in compliance with drawings, specifications, and/or authorized changes and is free from electrical defects. Without additional charge, replace or repair, to satisfaction of the owner's representative, except from ordinary wear and tear, any part of the installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance or as otherwise indicated in individual sections, but in no case less than one year. Warranty incandescent and fluorescent lamps only for a period of two months from the date of substantial completion.
- B. Provide complete warranty information for each item including beginning of warranty period, duration of warranty, names, addresses, and telephone numbers and procedures for filling a claim and obtaining warranty services. Written warranties and guarantees are to be submitted separately as:
 - 1. Originals bound in a binder clearly identified with the title, "WARRANTIES AND GUARANTEES," the project name, the project number, and the Contractor's business name.
 - 2. Electronic documents in *.pdf format.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. All materials shall be new and shall bear the manufacturer's name, trade name, and the approved testing laboratory such as the UL label in every case where a standard has been established for that particular material. Used materials are acceptable only if specifically indicated on drawings.

2.2 SUBSTITUTION OF MATERIALS:

- A. Provide only specified products or products approved by addendum. Substitutions will be considered if two copies of the proposal is received at the architect's/engineer's office eight (8) working days prior to the bid day. Include in the proposal the specified and proposed catalog numbers of the equipment under consideration and a catalog cut sheet(s) with pictorial and descriptive information. Certify that the equipment proposed is equal to that specified, that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents.
- B. It is the responsibility of the contractor to make all substituted equipment comply with the intent of the contract documents and bear all cost associated with conflicts arising from the use of substituted equipment.
- C. Provide samples if so required by the architect or engineer before or after bid day.

2.3 SPARE PARTS:

- A. Provide spare parts as specified in Divisions 26, 27, and 28 sections. Deliver all spare parts to owner's representative prior to substantial completion.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Workmanship: Provide only first class workmanship from competent workers. Defective materials or workmanship will not be allowed on the project. Provide competent supervision for the work to be accomplished. Keep same foreman on the job, unless a change is authorized by the engineer.
- B. Coordination: Prior to construction, layout electrical work and coordinate work with other trades. Sequence, coordinate, and integrate installation of materials and equipment for efficient flow of the work. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components. Coordinate with all utilities including power, communication, and data installations.
- C. Provide cutting, drilling, channeling, etc. only as necessary for proper completion of the work. Do not cut structural members unless authorization is issued in writing by the architect/engineer.
- D. Repairs: Repair damage to building, grounds, or utilities as a result of work under this contract at no additional cost to the owner.
- E. Dimensioning: Electrical drawings indicate locations for electrical equipment only in their approximate location, unless specifically dimensioned. Do not scale electrical drawings for dimensional information. Refer to architectural drawings and shop drawings where applicable for locations of all electrical equipment. Field verify all dimension on the job site.
- F. Provide block-outs, sleeves, demolition work, etc., required for installation of work specified in this division.
- G. Standards: Provide electrical installation in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- H. All workmen doing work of any nature on State of Utah projects must at all times carry their electrician's license with them and show it upon request. The acceptable ratio of apprentice to journeyman electricians on the job is 1:1.

3.2 REQUESTS FOR INFORMATION:

- A. When it is clearly apparent that information is not adequately described in the construction documents or when a coordination problem exists, submit a request for information (RFI) through proper contractual channels. The electrical engineering design firm will provide a response through its contractual channel. Although verbal direction may be given to expedite changes, responses are not considered part of the contract documents until a change order has

been issued and signed by the Owner or his designated representative. The Contractor shall bear all costs associated with proceeding on any change order that has not been approved by the Owner or his designated representative.

- B. Any damages caused by construction delays due to frivolous RFI's, will be born solely by the Contractor.

3.3 SAFETY PRECAUTIONS:

- A. Provide all necessary guards or construction barriers and take all necessary precautions to insure the safety of life and property.

3.4 CLEAN:

- A. Clean up all equipment, conduit, fittings, wire, packing cartons, plastic, and other debris that is a direct result of the installation of the work of this division, both during the execution, and at the conclusion, of the project. Keep the site clean and safe during the progress of the work. Clean fixtures, interior and exterior of all equipment, and raceways prior to final acceptance. Vacuum interior of all electrical panels and equipment. Correct any damaged equipment. Touch-up or repaint if necessary.

3.5 TEMPORARY POWER:

- A. Make arrangements with the proper institution authority for all temporary electricity.
- B. Provide temporary power, complete with metering and wiring for lighting and power outlets for construction tools and equipment. Report the initial meter reading to the owner/institution, or otherwise as may be directed.
- C. Service shall be provided with a main disconnect and all 20 ampere receptacles protected by 20 amp GFI, single-pole breakers. No attempt is made herein to specify construction power requirements for equipment in detail. Provide all electrical equipment and wiring as required.
- D. As soon as permanent power and metering is available, the temporary power supply shall be disconnected and removed from the project site.
- E. All temporary wiring shall meet the requirements of NEC Article 305 and the State Industrial Commission.

3.6 POWER OUTAGES:

- A. All power outages required for execution of this work shall occur during non-standard working hours and at the convenience of the owner. Any electrical service interruption will be coordinated at least 7 days in advance of the power shut-off. Include all costs for overtime work in bid. Coordinate all outages and proceed only after receiving authorization from the owner's representative. Keep all outages to an absolute minimum.

3.7 STORAGE AND PROTECTION OF MATERIALS:

- A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. Lost or damaged materials will be replaced at no additional cost to owner. Do not store materials and apparatus in any public thoroughfare or in any area on the site where such storage would constitute a hazard to persons in the vicinity. Protect completed work, work underway, and apparatus against loss or damage.

3.8 EXCAVATING FOR ELECTRICAL WORK:

- A. Verification: Prior to excavating, locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling. Observe all State and Local codes prior to excavating. Do not disturb walls, footings, and other structural members in any way.
- B. Protection: Provide barricades, warning signs, and illumination to protect persons from injury at excavations. Provide temporary coverings and heat as necessary to protect bottoms of excavations from freezing and frost action. Do not install electrical work on frozen excavation bases or subbases.
- C. Coordination: Do not excavate for electrical work until the work is ready to proceed without delay.
- D. Excavated Materials: Temporarily store excavated materials near excavation in manner which will not interfere with or damage excavation or other work. Dispose of and remove excavated materials which are either in excess of quantity needed for backfilling or do not comply with the requirements for backfill material.
- E. Burial Depths: Burial depths must comply with NEC Section 300-5 (or State of Utah requirements, whichever is more stringent), unless noted otherwise on drawings.
- F. Excavation Permits: Obtain all shut-down and excavation permits as may be required for proper completion of the work.

3.9 BACKFILL MATERIALS:

- A. For buried conduits or cables (other than below slab-on-grade, or concrete-encased), provide 2" thickness of well-graded sand on all sides of conduits or cables.
- B. For trench backfill to within 6" of final grade, provide soil material suitable for compacting to required densities.
- C. For top 6" of excavation, provide top soil.
- D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment:
 - 1. Lawn/Landscaped Areas: 85 percent for cohesive soils, 95 percent for cohesionless soils.
 - 2. Paved Areas, other than roadways: 90 percent for cohesive soils, 95 percent for cohesionless soils.
- E. Where subsidence is observable at electrical work excavations during project warranty period, remove surface, add backfill material, compact, and replace surface treatment. Restore surface to original condition.

3.10 LABELING:

- A. Engraved black plastic laminated, with white-core labels, 1/16" thick, shall be permanently attached on both the interior and exterior the following electrical equipment:
 - 1. Branch panels

2. Switchgear
3. Disconnect switches
4. Motor starter and controls junction boxes (power and auxiliary)
5. Push buttons
6. Thermal switches
7. Time switches
8. Motor control centers
9. Transformer
10. Similar equipment.
11. Lighting contactors and associated switches
12. Junction boxes larger than 4x4x1/2.

- B. The labels shall have 1/4" high, engraved letters, such as EF-1, AC-1, Panel A, etc.

3.11 CONCRETE BASES:

- A. Concrete bases: Refer to Section [260551 – Exterior Area Lighting](#).

3.12 TESTS:

- A. Notify engineer prior to all testing specified herein at least three business days prior to testing. Engineer shall observe all tests to insure the proper operation of the electrical system.

3.13 PROJECT FINALIZATION AND START-UP:

- A. Upon completion of the work, have each factory representative and/or subcontractor assist in start-up and testing of their respective systems.
- B. Have each representative give personal instructions on operating and maintenance of their equipment to the owner's maintenance and/or operation personnel.
- C. Have representatives certify each system with a written statement indicating that they have performed start-up and final check out of their respective systems.

3.14 FINAL REVIEW:

- A. Have the project foreman accompany their reviewing parties and remove coverplates, panel covers, access panels, etc. as requested, to allow review of the entire electrical system.

END OF SECTION 260001

SECTION 260070 – ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to electrical connections.

1.2 DESCRIPTION OF WORK:

- A. Extent of electrical connections for equipment include all final electrical connections for all equipment having electrical requirements including, but not necessarily limited to the following:
 - 1. Equipment specified under all divisions of the contract. Refer to other divisions for specific electrical requirements.
 - 2. Owner-furnished equipment
 - 3. Kitchen Equipment

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to [Section 260001 – Electrical General Provisions](#) as applicable.
- B. SHOP DRAWINGS: Not required.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. Provide all materials for electrical connections including, but not necessarily limited to the following:
 - 1. Raceways
 - 2. Fittings
 - 3. Conductors
 - 4. Wiring devices
 - 5. Pressure connectors
 - 6. Lugs (CU-AL)
 - 7. Electrical insulating tape
 - 8. Heat-shrinkable tubing
 - 9. Cable ties
 - 10. Wire nuts
 - 11. Other items and accessories as required.
- B. Crimp on or slip-on type splicing materials designed to be used without wire stripping are not acceptable.

- C. Power Distribution Blocks: Provide Square D Type LB or Equivalent.
- D. Refer to other Division 26, 27, and 28 Sections for specification of electrical materials as applicable.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Make electrical connections in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 CONNECTIONS:

- A. Permanently Installed Fixed Equipment:
 - 1. Install conductors in flexible conduit from junction box to equipment control panel or connection point.
 - 2. Where such installations are subject to moisture, install in liquid-tight flexible conduit.
- B. Movable equipment:
 - 1. Provide wiring devices, cord caps, and multi-conductor cables as required.
- C. Other methods as required by the NEC and/or as required by special equipment or field conditions.
- D. Power Distribution Blocks: Unless noted otherwise on drawings, provide power distribution blocks only for tapping of feeders and branch circuits. Locate in junction box or gutter in NEMA ratings to suit application.

3.3 MANUFACTURER'S INSTRUCTIONS:

- A. Obtain manufacturer's instruction and wiring diagram regarding electrical connections of each piece of equipment and provide connections in accordance therewith.

3.4 VERIFICATION OF LOAD CHARACTERISTICS:

- A. Verify electrical load characteristics of all equipment prior to rough-in. Review respective shop drawings of all other Divisions and Owner's equipment manuals. Report any variances from electrical characteristics noted in the contract documents to the Architect/Engineer prior to rough-in.
- B. Value of rough-in work, electrical equipment, etc. installed and/or purchased by the contractor not meeting equipment requirements shall be credited back to the owner.

END OF SECTION 260070

SECTION 260072 – ELECTRICAL SUPPORTS AND SEISMIC RESTRAINTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Seismic restraints for electrical equipment and systems.
 - 3. Construction requirements for concrete bases.

1.3 DEFINITIONS:

- A. IBC: International Building Code.
- B. Seismic Restraint: A structural support element such as a metal framing member, a cable, an anchor bolt or stud, a fastening device, or an assembly of these items used to transmit seismic forces from an item of equipment or system to building structure and to limit movement of item during a seismic event.

1.4 SUBMITTALS:

- A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support and seismic-restraint component used.
 - 1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - 2. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Shop Drawings: Indicate materials and dimensions and identify hardware, including attachment and anchorage devices, signed and sealed by a qualified professional engineer. Include the following:
 - 1. Fabricated Supports: Representations of field-fabricated supports not detailed on Drawings.
 - 2. Seismic Restraints: Detail anchorage and bracing not defined by details or charts on Drawings. Include the following:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Detail fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
 - c. Preapproval and Evaluation Documentation: By an agency acceptable to

authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

- C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
 - D. Welding certificates.
 - E. Qualification Data: For professional engineer and testing agency.
 - F. Field quality-control test reports.
- 1.5 QUALITY ASSURANCE:
- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
 - B. Testing of Seismic Anchorage Devices: Comply with testing requirements in Part 3.
 - C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS:

- A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.
- B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly.
 - 1. Available Manufacturers:
 - a. Cooper B-Line; a division of Cooper Industries.
 - b. ERICO International Corporation.
 - c. Allied Support Systems; Power-Strut Unit.
 - d. GS Metals Corp.
 - e. Michigan Hanger Co., Inc.; O-Strut Div.
 - f. National Pipe Hanger Corp.
 - g. Thomas & Betts Corporation.
 - h. Unistrut; Tyco International, Ltd.
 - i. Wesanco, Inc.
 - 2. Finishes:

- a. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.
3. Channel Dimensions: Selected for structural loading and applicable seismic forces.
- C. Raceway and Cable Supports: As described in NECA 1.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 1. Verify suitability of fasteners in subparagraph below for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick.
 2. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers:
 - 1) Hilti, Inc.
 - 2) ITW Construction Products.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co. Inc.
 3. In the following subparagraph, use stainless steel anchors in corrosive environments.
 4. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers:
 - 1) Cooper B-Line; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc
 - 3) Hilti, Inc.
 - 4) ITW Construction Products.
 - 5) MKT Fastening, LLC.
 - 6) Powers Fasteners.
 5. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 6. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
 7. Toggle Bolts: All-steel springhead type.
 8. Hanger Rods: Threaded steel.

2.3 SEISMIC-RESTRAINT COMPONENTS:

- A. Rated Strength, Features, and Application Requirements for Restraint Components: As defined in reports by an agency acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least five times the maximum seismic forces to which they will be subjected.

- B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.
- C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.
 - 1. Available Manufacturers:
 - a. Amber/Booth Company, Inc.
 - b. Loos & Co., Inc.
 - c. Mason Industries, Inc.
 - 2. Seismic Mountings, Anchors, and Attachments: Devices as specified in Part 2 "Support, Anchorage, and Attachment Components" Article, selected to resist seismic forces.
 - 3. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod, of design recognized by an agency acceptable to authorities having jurisdiction.
 - 4. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to type and size of anchor bolts and studs used.
 - 5. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

2.4 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES:

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 – EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for raceways as within 12 inches of coupling, fitting, and box, at each 90 degrees bend, minimum of two supports per ten foot run. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps, or as otherwise required by an agency acceptable to authorities having jurisdiction.

3.2 SUPPORT AND SEISMIC-RESTRAINT INSTALLATION:

- A. Comply with NECA 1 for installation requirements, except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, raceways may be supported by openings through structure members, as permitted in NFPA 70.

- C. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.
 - D. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
 - E. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 Spring-tension clamps.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
 - F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
 - G. Do not drill or core cut holes for anchors or use powder-activated fasteners in post-tension slabs, joists, and beams.
- 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS:
- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
 - B. Field Welding: Comply with AWS D1.1/D1.1M.
- 3.4 CONCRETE BASES:
- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and seismic criteria at Project.
 - B. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so expansion anchors will be a minimum of 10 bolt diameters from edge of the base.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of the base.
 - 2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete

- base, and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 6. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete.

3.5 INSTALLATION OF SEISMIC-RESTRAINT COMPONENTS:

- A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Restraint Cables: Provide slack within maximums recommended by manufacturer.
- D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.6 FIELD QUALITY CONTROL:

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing: Test pullout resistance of seismic anchorage devices.
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Record test results.

END OF SECTION 260072

SECTION 260080 – ELECTRICAL DEMOLITION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to electrical demolition.

1.2 DESCRIPTION OF WORK:

- A. Extent of electrical demolition work is indicated by drawings.
- B. Electrical demolition items are shown to give a basic description of the extent of demolition work, but may not be inclusive.
- C. Do not assume that the electrical drawings reflect as-built conditions. Visit and observe the project prior to submitting bid and determine extent of electrical demolition work.

1.3 QUALITY ASSURANCE:

- A. Standards: Refer to [Section 260001 - Electrical General Provisions](#) as applicable.

PART 2 – PRODUCTS - Not Used.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Demolition work shall be laid out in advance to eliminate unnecessary cutting, drilling, channeling, etc. Where such cutting, drilling, or channeling becomes necessary, perform with care, use skilled mechanics of the trades involved. Cutting work of other contractors shall be done only with the consent of that contractor. Cutting of structural members is not permitted. Repair damage to building and equipment as a result of electrical demolition work under this contract at no additional cost to owner.
- B. Obtain permission from the architect before penetrating any ceiling, floor, and wall surfaces.

3.2 METHODS:

- A. Disconnect and remove any/all fixtures, devices, equipment, etc. required for proper completion of the work whether shown or not.
- B. Relocate, rewire, and/or reconnect any/all fixtures, devices, equipment, etc. that for any reason obstructs construction.

- C. Maintain circuit integrity and continuity of all existing circuits/feeders, and systems that interfere with or are interrupted by remodel work, unless those circuits/feeders are to be abandoned completely. Maintain all circuits and systems in operation during construction. Provide temporary panels, temporary wiring and conduits, etc. as required.
- D. Leave all existing fixtures, devices, equipment, etc. In portions of the building not being remodeled, in working condition.
- E. Remove and dispose of all raceways, conductors, boxes, devices, equipment, etc., that are not to be reused. Terminate at accessible junction box by providing proper knockout closure, tape conductors, and label as "spare" with circuit no., Zone no., or other characteristic identifying source.
- F. Existing raceways may be reused, if in place, where in compliance with the contract documents and the National Electrical Code. Upgrade and/or provide new conduit supports where necessary for all raceways being reused. Insure integrity of existing raceways before re-use.
- G. Return to owner all light fixtures which are to be removed. Dispose of all light fixtures if so directed by owner in accordance with local environmental laws and policies. Those fixtures indicated for re-use shall be thoroughly cleaned, repaired as required, re-lamped, and installed as indicated. When storing fixtures for reuse, store in area and/or provide protective covering that will keep construction dust and materials off fixtures.
- H. Completely remove all telephone or data cables which are to be removed back to source or as directed by owner.
- I. Disconnect and remove all sound system equipment including speakers, amplifiers, etc. And return to owner. Completely remove and dispose of all associated conduit and wire.

3.3 PATCHING AND REPAIR:

- A. Finished Surfaces: The electrical contractor is responsible for patching and repair of all existing interior surfaces pertaining to the installation of work under this Division, unless specifically noted elsewhere in the contract documents. Where patching and repair is necessary, surfaces shall be finished (painted, etc.) to match the adjacent materials, finished, and colors.
- B. Hard Surfaces: Whenever excavation or trenching is required for the installation of electrical work, it shall be the responsibly of the electrical contractor to make repairs and/or replacements of hard finish surfaces such as concrete, asphalt, etc.

3.4 CONCEALING:

- A. All raceways shall be concealed within the ceilings, walls, and floors, except in locations where exposed raceways are specifically permitted, such as equipment rooms and unfinished storage areas.
- B. Surface-mounted raceways or systems shall be permitted only where approved by Architect/Engineer.

END OF SECTION 260080

SECTION 260110 – CONDUIT RACEWAYS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to conduit raceways.

1.2 DESCRIPTION OF WORK:

- A. Extent of raceways is indicated by drawings and schedules.
- B. Types of raceways in this section include the followings:
 - 1. Rigid Metal Conduit
 - 2. PVC Externally Coated Rigid Steel Conduit
 - 3. Intermediate Metal Conduit
 - 4. Electrical Metallic Tubing
 - 5. Flexible Metal Conduit

1.3 QUALITY ASSURANCE:

- A. Standards: Refer to [Section 260001 – Electrical General Provisions](#) as applicable. Provide conduit raceway installation in accordance with recommendations of the American Iron and Steel Institute "Design Manual on Steel Electrical Raceways", latest edition.
- B. Manufacturers: Firms regularly engaged in the manufacture of raceway of types and sizes required, whose products have been in satisfactory service for not less than three (3) years.
- C. Shop Drawings: Not required.

PART 2 – PRODUCTS

2.1 CONDUITS:

- A. Rigid Metal Conduit (RMC): Provide zinc-coated, hot-dipped galvanized, rigid metallic conduit in accordance with Federal Specification WW-C-0581 and ANSI C80.1.
- B. PVC Externally Coated Rigid Metal Conduit: Provide hot-dipped galvanized, rigid metallic conduit externally coated with Polyvinyl Chloride (PVC) in accordance with ANSI C80.1 and NEMA Std. Pub. No. RN 1.
- C. Intermediate Metal Conduit (IMC): Provide hot-dipped galvanized, intermediate metal conduit in accordance with Federal Specification WW-C-581.
- D. Electric Metallic Tubing (EMT): Provide electric metal tubing in accordance with Federal

Specification WW-C-563 and ANSI C80.3.

- E. Flexible Metal Conduit: Provide zinc-coated, flexible metal conduit in accordance with Federal Specification WW-C-566.

2.2 FITTINGS:

- A. Rigid Metal Conduit, Intermediate Metal Conduit, and PVC Externally Coated Rigid Metal Conduit: Provide fully-threaded, malleable steel fittings, rain-tight and concrete-tight as applicable. Provide double locknuts and metal bushings at all conduit terminations. Install OZ Type B bushings on conduits 1-1/4" and larger.
- B. Electric Metallic Tubing: Provide insulated throat, non-indenter, set screw, malleable steel fittings. Screws must have a full set. Provide concrete-tight compression-type fittings in suspended slabs. All EMT fittings shall be fabricated from steel. Die-cast fittings or fittings made from pot metal shall not be allowed. Indenter type fittings are not acceptable. Install OZ Type B bushings on conduits 1" and larger.
- C. Flexible Metal Conduit: Provide flexible metal conduit fittings in accordance with Federal Specification W-F-406, Type 1, Class 1, and Style A. Commercial "greenfield" not less than 1/2" diameter or as otherwise specified on drawings is acceptable.
- D. Expansion Fittings: OZ Type AX, or equivalent to suit application.
- E. Sealing Bushings: Provide OZ Type FSK, WSK, or CSMI as required by application. Provide OZ Type CSB internal sealing bushings.
- F. Cable Supports: Provide OZ cable supports for vertical risers, type as required by application.

2.3 SIZES:

- A. Provide conduits in sizes as indicated in contract documents or as otherwise specified herein, but not less than 3/4".

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install raceway and accessories in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 LOCATIONS:

- A. Rigid Metal Conduit and Fittings: Use for conduit bends greater than 22 degrees where buried below grade or slab on grade. Install RMC where raceway passes vertically through slab-on-grade. Where raceways penetrate building, manholes, or vault walls and floors below grade, provide RMC for a minimum distance of 10' on the exterior side of the floor or wall. Use RMC for exposed runs where conduit is subject to moisture, weather, or mechanical injury. Use in hazardous locations in accordance with all NEC requirements.
- B. Intermediate Metal Conduit and Fittings: Use for exposed runs where conduit is subject to moisture, weather, or mechanical injury. Use in hazardous locations in accordance with all NEC

requirements.

- C. Electric Metal Tubing and Fittings: Use for above-grade feeders, branch circuits, and signal and control circuit, unless specifically noted otherwise on drawings. Install in suspended slabs subject to local code requirements and fire rating considerations.
- D. Flexible Metal Conduit and Fittings: Use as whips for lighting fixtures, fixed equipment where not exposed to weather or moisture, other devices where required by NEC, and as requested by the Engineer. Maximum length not to exceed 6', unless specifically approved by the Electrical Engineer.

3.3 METHODS:

- A. Maintain a minimum of 12" clearance between steam or hot water lines or other hot surfaces. Where such clearance is impractical, insulate conduit with approved materials.
- B. Install conduits parallel with or at right angles to lines of the structure. Route conduits symmetrically where possible.
- C. Field bends and offsets shall be made without flattening, kinking, rippling or destroying the smooth internal bore or surface of the conduit and to not less than NEC minimum radius. Conduit that shows signs of rippling or kinking shall not be installed. Conduits installed with wrinkles or kinks or otherwise in an unworkmanlike manner shall be replaced at no additional cost to owner.
- D. Precaution shall be exercised to prevent accumulation of water, dirt or concrete in the conduits during the execution of the project. Conduits in which water or foreign matter has been permitted to accumulate shall be thoroughly cleaned or the conduits runs replaced where such accumulation cannot be removed by methods approved the engineer.
- E. Any conduit which pierces airtight spaces or plenums shall be sealed to prevent air leakage with mastic acceptable to the Architect.

3.4 BURIED CONDUITS:

- A. Comply with all burial depths as defined in NEC Section 300-5. Bury all conduits at least 24" below grade, unless specifically indicated otherwise on drawings. Provide magnetic 6" wide "Yellow Warning" ribbon 12" directly above conduit and 6" below finished grade measured from the top of the conduit or duct bank. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single marker.
- B. Slope all conduits toward manholes or pull boxes for proper drainage. Use weep holes. Gravel drainage pockets are not permitted.
- C. Coat all metal conduits with an approved asphaltic compound or wrap with two layers of PVC tape.
- D. Under Concrete Slab on Grade: Horizontal conduit must be installed a minimum of 2" below the bottom of the concrete slab. Conduits should not be installed in concrete slabs.
- E. Concrete Encasement: Where concrete-encasement is indicated on drawings, provide ductbank construction using red 3000 psi at 28 day strength concrete. Provide minimum 4" cover on all sides of exterior conduits. Provide conduit spacers where applicable. Coat all metal conduits with an approved asphaltic compound or wrap with two layers of PVC tape.

- F. Where conduits are extended for future use, cap and clearly mark.

3.5 ELECTRICAL CONTINUITY:

- A. Provide electrically continuous conduit systems throughout.

3.6 FIELD CUTS AND THREADS:

- A. Cut all conduits square. Remove all sharp or rough edges and ream all burrs, inside and outside. Provide clean sharp threads on RMC and IMC.
- B. Engage at least five full threads on all RMC and IMC fittings. Before couplings or fittings are attached, apply one coat of red lead or zinc chromate to male threads of RMC or IMC. Apply coat of red lead, zinc chromate or special compound recommended by manufacture to conduit where conduit protective coating is damaged.

3.7 SUSPENDED SLABS:

- A. When conduit is installed in the suspended slab, it shall be limited to conduits having a diameter of 1" (25 mm) or less, or less than 1/3 the concrete cover, and no crossovers occur, and conduit spaced at least 18" (450 mm) apart with a 3/4" (20 mm) cover.

3.8 CONDUIT ENDS:

- A. Cap all spare conduits. Cap or plug conduit ends during construction to prevent entrance of foreign material.

3.9 SPARE CONDUITS:

- A. Provide five (5) 3/4" empty conduits from panel stubbed into accessible ceiling space and five (5) 3/4" conduits into accessible floor space. When floor is not accessible, provide six (6) 3/4" empty conduits from panel stubbed into accessible ceiling space. Cap and label all conduits.
- B. Install a 200 lb. polypropylene pull cord in each empty conduit run.

3.10 HAZARDOUS LOCATIONS:

- A. Install RMC and IMC in all hazardous locations as defined by the NEC. Provide suitable fittings, seal-offs, boxes, etc. to comply with all NEC requirements and/or as shown on the drawings. Provide inspection fittings with hazardous location rated drains to prevent water from accumulating in conduit runs.

3.11 CLEANING:

- A. Pull mandrel and swab through all conduits before installing conductors.

END OF SECTION 260110

SECTION 260120 – CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to conductors and cables.

1.2 DESCRIPTION OF WORK:

- A. This section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.
- B. Types of conductors and cables in this section include the following:
 - 1. Copper Conductors.
- C. Applications for conductors and cables required for project include:
 - 1. Feeders.
 - 2. Branch Circuits.

1.3 SUBMITTALS:

- A. Product Data: For each type of conductor and/or cable indicated.
- B. Field Quality-Control Test Reports: From Contractor. Refer to [Section 260001 – General Electrical Provisions](#).

1.4 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.
- B. Comply with NFPA 70.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. Manufacturers: In other Part 2 articles where subparagraph titles below introduce lists, provide products by the manufacturer specified, subject to compliance with requirements.
- B. Ambient Conditions: Conductors used for branch circuits in areas where the ambient conditions exceed 30 degree C. shall be provided with insulation approved for that temperature.

- C. Wire Sizes: As indicated on electrical drawings or as specified herein, but in no case less than No. 12 AWG.

2.2 COPPER CONDUCTORS:

- A. Manufacturers:
 - 1. Cerro Wire & Cable Company.
 - 2. General Cable Technologies Corporation.
 - 3. Encore Wire Corporation.
 - 4. Southwire Incorporated.
- B. Refer to Part 3 "Conductor and Cable Applications" Article for application requirements.
- C. References and Ratings:
 - 1. ICEA S-95-658 / NEMA WC70.
 - 2. ASTM.
 - 3. UL Standard 83.
 - 4. UL Standard 1063 (MTW).
 - 5. Federal Specification J-C-30B.
 - 6. NEC.
- D. Conductor Material: Copper.
- E. Stranding: Solid conductor for No. 12 AWG, stranded for No. 10 AWG and larger.
- F. Conductor Insulation Types: Thermoplastic-insulated, Type THHN / THWN-2.

2.3 ALUMINUM CONDUCTORS:

- A. Not allowed.

2.4 MC FLEXIBLE METAL CLAD COPPER CABLES:

- A. Not allowed.

2.5 CONNECTORS AND SPLICES:

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. AMP Incorporated/Tyco International.
 - 3. Hubbell/Anderson.
 - 4. O-Z/Gedney; EGS Electrical Group LLC.
 - 5. 3M Company; Electrical Products Division.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- C. Splices for wire sizes #10 and smaller shall be screw-on type similar to scotch or ideal wing nut connectors. Crimp-on splices designed to be used without wire stripping are not acceptable.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install conductors, cables, and accessories as indicated, in compliance with manufacturer's written instruction, applicable requirements of NEC, NECA's "Standards of Installation", and in accordance with recognized industry practices to ensure that products fulfill requirements.

3.2 CONDUCTOR AND CABLE APPLICATIONS:

- A. Feeders: As indicated on the electrical drawings.
- B. Branch Circuits:
 - 1. Exposed, including in crawlspaces: Copper conductors in raceway.
 - 2. Concealed in ceilings, walls, and partitions: Copper conductors in raceways.
 - 3. Concealed in concrete and below slabs-on-grade: Copper conductors in raceway.
- C. Cord Drops, Reels, and Portable Appliance Connections: Flexible cord.
- D. Class 1 Control Circuits: Copper conductors in raceway.

3.3 INSTALLATION:

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- D. When raceway is not required, install concealed cables parallel and perpendicular to surfaces of structural members, and follow surface contours where possible.
- E. Support cables according to other applicable specification sections.
- F. Seal around cables penetrating fire-rated elements to comply with applicable fire stop specification sections.
- G. Color Coding: Color code secondary service, feeder, and branch circuit conductors. Colors shall remain consistent throughout the project and shall match existing coding system where applicable.
 - 1. Conductor sizes No. 6 AWG and smaller: Colored insulation.
 - 2. Conductors sizes No. 4 AWG and larger: 2 inch (51 mm) band of Colored adhesive marking tape applied at all terminations, junction boxes, and pull boxes.
 - 3. Branch circuit switched-legs and travelers: Colored insulation (in colors other than those indicated below).
 - 4. Color-code 120/208V system conductors:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral A: White with Black stripe.
 - e. Neutral B: White with Red stripe.
 - f. Neutral C: White with Blue stripe.

- g. Neutral (Shared when allowed): White
- h. Ground: Green.
- i. Isolated Ground: Green with yellow tracer.

3.4 HOMERUN CIRCUITS:

- A. Homerun circuits may be combined in common conduits at the option of the contractor in compliance with the following:
 - 1. Three-Phase Installations: Not more than three single-phase circuits in one conduit, unless specifically noted otherwise, if each circuit is from a different phase (a, b, or c).
 - 2. Single-Phase Installations: Not more than two single-phase circuits in one conduit, unless specifically noted otherwise, if each circuit is from a different phase (a or b).

3.5 NEUTRAL CONDUCTORS:

- A. LINE-TO-NEUTRAL BRANCH CIRCUITS: Provide a dedicated neutral for each line-to-neutral branch circuit. Size the neutral conductor the same as the phase conductor. In each outlet or junction box containing multiple neutral conductors, tag each neutral to identify which circuit it serves.

3.6 VOLTAGE DROP:

- A. Provide branch circuit conductors in sizes such that voltage drop for branch circuits do not exceed 3 percent at the farthest outlet. Provide service, feeder, and branch circuit conductors so that the voltage drop on the entire electrical system does not exceed 5 percent at the farthest outlet. This shall be strictly followed regardless of the conductor sizes indicated on the electrical drawings. Increase conductor sizes (and conduits where necessary to comply with NEC conduit fill requirements) as necessary to accommodate this requirement. Calculations shall be based on the following:
 - 1. Lighting Branch Circuits: Connected load plus 25% spare.
 - 2. Appliance and Equipment Branch Circuits: Nameplate or NEC required load.
 - 3. 120V Convenience Outlet Branch Circuits: 12 amps minimum, but in no case less than NEC loading requirements. Use the following schedule:

<u>Distance (feet)</u>	<u>Wire Size (AWG)</u>
0-80	#12
81-125	#10
126-200	#8
201-320	#6

- 4. Use the NEC method to calculate voltage drop.

3.7 CONNECTIONS:

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack. Use

pig tails when wiring outlets.

3.8 FIELD QUALITY CONTROL:

- A. Testing: Perform the following field quality-control testing:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect cables for physical damage and proper connection in accordance with the electrical construction documents.
 - b. Test cable mechanical connections to manufacturer's recommended values with a calibrated torque wrench.
 - c. Check cable color coding for compliance with electrical specifications.
 - 2. Electrical Tests:
 - a. Perform insulation resistance test on each conductors for feeders 100 amps and greater with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute.
 - b. Perform continuity test to insure proper cable connection.
 - 3. Test Values:
 - a. Minimum insulation resistance values shall not be less than two megaohms.
- B. Test Reports: Prepare a written report and submit to the Electrical Engineer at the completion of the project. The report shall include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 260120

SECTION 260135 – ELECTRICAL BOXES AND FITTINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to electrical boxes and fittings.

1.2 DESCRIPTION OF WORK:

- A. Extent of electrical boxes and fittings work is indicated by drawings and schedules.
- B. Types of electrical boxes and fittings in this section include the following:
 - 1. Outlet Boxes
 - 2. Junction Boxes
 - 3. Pull Boxes
 - 4. Conduit Bodies
 - 5. Bushings
 - 6. Locknuts
 - 7. Knockout Closures
 - 8. Miscellaneous Boxes and Fittings

1.3 QUALITY ASSURANCE:

- A. Standards: Refer to [Section 260001 – Electrical General Provisions](#) as applicable.
- B. Manufacturers: Firms regularly engaged in the manufacturer of boxes and fittings required, whose products have been in satisfactory service for not less than three years.
- C. Shop Drawings: Submit shop drawings on floor boxes only where required.

PART 2 – PRODUCTS

2.1 INTERIOR OUTLET BOXES:

- A. General: Provide one piece, galvanized or cadmium-plated, flat-rolled, sheet steel interior outlet boxes of types, shapes, and sizes to suit respective location and installation. Construct with stamped knockouts on back and sides and with threaded screw holes. Provide corrosion-resistant screws for securing boxes, covers, and wiring devices. Size all junction boxes in accordance with NEC Table 314.16(A), with a minimum box size of 4" x 4" x 1-1/2". Where three raceway entries are made, provide outlet boxes with a minimum depth of 2-1/8". Where four or more raceway entries are made, provide outlet boxes with a minimum depth of 4-11/16". Gangable boxes shall not be used.
- B. Switch, Telephone, and Receptacle Outlets: Provide outlet boxes not less than 4" square, with

adapting tile or plaster covers where necessary to set flush with finished surfaces. Where three raceway entries are made, provide outlet boxes with a minimum depth of 2-1/8". Gang boxes shall be used where more than one switch or device is located at one point. Sectional Boxes are not acceptable. In masonry walls where tile or plaster ring cannot be used, install a single-gang 3-1/2" deep box minimum, unless otherwise noted. Where four or more raceway entries are made, provide outlet boxes with a minimum depth of 4-11/16".

C. Lighting Outlets:

1. Lay-in Grid: Outlets for recessed fixtures in acoustical tile ceilings shall be located to center on a single tile or at the intersection of four tiles.
2. Surface-mounted: Provide 4" square octagonal outlet boxes for surface-mounted, ceiling fixture outlets. Mount each box independently of the conduit on standard 3/8" stud or approved box hangar where applicable. Include backing and supports as required to carry 200 lbs. Where three or more raceway entrances are made, use a minimum box depth of 2-1/8".

2.2 WEATHERPROOF OUTLET BOXES:

- A. Provide corrosion-resistant, cast-metal weatherproof outlet boxes, of types, shapes, and sizes, with threaded conduit ends, cast metal coverplates with spring-hinged waterproof caps, face plate gaskets, and corrosion-resistant fasteners.

2.3 JUNCTION AND PULL BOXES:

- A. Provide code-gauge sheet steel junction and pull boxes, with removable screw-on covers and welded seams, of types, shapes, and sizes to suit each respective location and installation. Size all junction and pull boxes in accordance with NEC 314.28. Provide stainless steel nuts, bolts, screws, and washer.

2.4 CONDUIT BODIES:

- A. Provide galvanized, cast-metal conduit bodies of type, shapes, and sizes to suit respective locations and installation. Construct with threaded conduit entrance ends and removable covers. Provide corrosion-resistant screws.
- B. Aluminum boxes and fitting shall not be permitted.

2.5 CONDUIT CONNECTIONS:

- A. Box connectors 3/4" and larger shall be insulated, throat-type or equal type plastic bushings. Provide double locknuts and insulating plastic bushings for RMC and IMC terminating at panels and boxes.
- B. Where RMC penetrates building, manholes, or vault walls and floors below grade, provide sealing bushings with external membrane clamps as applicable. Provide segmented internal sealing bushings in all raceways penetrating building walls and slabs below grade, and in all above grade raceway penetrations susceptible to moisture migration into building through raceway. Where RMC terminates in manhole, vault, or pull box, provide insulated grounding bushings. Also see [Section 260135 – Electrical Boxes and Fittings](#).
- C. Install OZ type "B" connectors for all conduits 1" and larger.
- D. Provide cable supports in all vertical risers in accordance with NEC 300-19.

2.6 EXPANSION FITTINGS:

- A. Provide expansion joint fittings in all conduit runs crossing structural expansion joints, whether above-grade, in slab-on-grade, or in suspended slabs. Provide OZ type "AX" or approved equivalent, size to the raceway.

2.7 ACCESSORIES:

- A. Provide all accessories including, but not necessarily limited to, bushings, knockout closures, locknuts, offset connectors, etc. of types, shapes, and sizes to suit respective locations and installation. Construct of corrosion-resistant steel.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install electrical boxes and fittings in accordance with manufacturer's written instruction, applicable requirements of the NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 METHODS:

- A. Where outlet boxes are subject to weather or moisture, install weatherproof outlet boxes.
- B. Remove knockouts only for entering conduits. Provide knockout closures to cap unused knockout holes where blanks are mistakenly removed.
- C. Do not use condulets in place of elbows or junction boxes. Condulets in sizes 2" or larger shall not be used, unless specifically approved by the electrical engineer.
- D. Install boxes and conduit bodies in readily accessible locations. Install recessed boxes with faces of boxes or rings flush with finished surfaces. Seal all openings between outlet box and adjacent surfaces with plaster, grout, or similar suitable material.
- E. For stud construction, install boxes with rigid supports using metal bar hangers, or 2" X 4", 1" X 6" wood bridging between studs with screws. Welding or nailing boxes directly to metal joist and studs is not acceptable. Boxes set opposite in common wall shall have at least 10" of conduit between them. Securely fasten outlet boxes to structural surfaces to which attached.
- F. For concrete or masonry construction, solidly embed electrical boxes in concrete and masonry. Provide box supports as required to keep outlet boxes flush with finished surfaces.
- G. Coordinate location of all outlet boxes with millwork, back splashes, tackboards, etc.
- H. Install junction boxes or condulets in conduit runs as required at 100 foot maximum intervals on long runs. This shall apply to concrete junction boxes in grade and junction boxes within the building.
- I. Provide electrical connections for installed boxes.

3.3 IDENTIFICATION:

A. Mark circuit number on exterior side of junction boxes located in ceilings such that circuit numbers are readily identifiable. For outlet boxes in wall, mark circuit numbers on interior sides of outlet boxes.

B. Identification labels shall be as follows:

Normal Power	Black with White letters
Emergency Power	Red with White Letters
UPS	Orange with White Letters

END OF SECTION 260135

SECTION 260140 – WIRING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to wiring devices.

1.2 DESCRIPTION OF WORK:

- A. Extent of wiring device work is indicated by drawings and schedules.
- B. Types of electrical wiring devices in this section include the following:
 - 1. Toggle Switches
 - 2. Receptacles

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to [Section 260001 – Electrical General Provisions](#) as applicable.
- B. SHOP DRAWINGS:
 - 1. Submit manufacturer's data on all electrical wiring devices.
 - 2. Where occupancy sensors are required, provide scaled drawing showing manufacturer's recommended locations.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. Provide factory-fabricated wiring devices, in types, and electrical ratings for applications indicated and complying with NEMA standards Pub No. WD 1. nylon construction, 20 amp rating minimum.
- B. Provide wiring devices in colors selected by Architect/Engineer. Provide red receptacle outlets and toggle switches where devices are circuited to emergency power. Provide orange receptacle outlets where devices are circuited to UPS power.

2.2 TOGGLE SWITCHES:

- A. Provide toggle switches from one of the following manufacturers (Fed-Spec):

<u>Manufacturer</u>	<u>1-Pole</u>	<u>3-Way</u>	<u>4-Way</u>	<u>W/Pilot</u>
Hubbell	HBL1221	1223	1224	1221-PL

Pass & Seymour	20AC1	20AC3	20AC4	20AC1-RPL
Leviton	1221	1222	1223	1221-PLR
Cooper	2221	2223	2224	2221-PL
Bryant	4901	4903	4904	4901-PL

B. Abbreviations are defined as follows:

1. 1-Pole - Single-Pole Toggle Switch
2. 3-Way - Three-Way Toggle Switch
3. 4-Way - Four-Way Toggle Switch
4. W/Pilo - Single-Pole Toggle Switch with Pilot Light

C. Must be back and side wired, and have color-coded covers, Brass terminal screws, back wire ground clamp, and self-grounding clip.

2.3 RECEPTACLES:

A. Provide duplex receptacles from one of the following manufacturers:

<u>Manufacturer</u>	<u>CO</u>	<u>GFCI</u>	<u>IG</u>
Hubbell	5362	GF5362	5362IG
Pass & Seymour	5362	2091-S	IG6300
Leviton	5362	8899	5362-IG
Cooper	5362	VGF20	IG5362
Bryant	5362	GFR53FT	5362IG

B. Abbreviations are defined as follows:

1. CO- Convenience Outlet Duplex Receptacle
2. GFCI- Ground Fault Circuit Interrupter duplex Receptacle
3. IG- Isolated Ground Duplex Receptacle

C. Must have one-piece Brass back strap and back wire grounding clamp (Does not apply to GCFI or isolated ground).

2.4 COVERPLATES:

A. Wall Plates: Provide coverplates for all wiring devices. In all finished areas, provide nylon or high impact resistant thermoplastic coverplates in colors as selected by Architect. Provide pre-marked coverplates for special purpose outlet indicating voltage, amperages, and phase. Provide raised stamped, galvanized, steel plates in all unfinished areas. Provide weather-proof coverplates for outlets exposed to weather and moisture.

B. Weather-Protecting Device Enclosure: Where required for compliance with NEC 410-67 (receptacles installed outdoors for use other than with portable tools or equipment), provide weather-tight device covers which provide complete protection with the cord and cap inserted into the wiring device. Provide units which mount on either single or double gang devices. Provide device enclosures manufactured by one of the following:

1. Intermatic WP1020 or WP1030
2. Hubbell WP826MP
3. Pass & Seymore

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install wiring devices and accessories in accordance with manufacturer's written instruction, applicable requirements of the NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to insure that products fulfill requirements.

3.2 METHODS:

- A. Install wiring devices only in electrical boxes which are clean and free from excess building materials, dirt, and debris. Do not install wiring devices until painting work is completed.
- B. Replace receptacles and/or coverplates which are damaged, stained, or burned.

3.3 GFCI RECEPTACLES:

- A. Provide separate neutral conductor from panel to each GFCI receptacle circuits.
- B. Install GFCI receptacles for all receptacles installed in restrooms, outdoors, or within six feet of any sink. All receptacles in kitchens shall be GFCI protected.
- C. Do not wire standard receptacles on the load side of GFCI receptacle - Install GFCI receptacles.

3.4 GROUNDING:

- A. Provide electrical continuous, tight, grounding connections for wiring devices.

3.5 TESTING:

- A. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

3.6 IDENTIFICATION:

- A. All devices shall be identified on the coverplate with panelboard name and circuit number.
- B. In each outlet, tag each wire to identify the circuit it serves.
- C. Identification labels shall be as follows:

Normal Power Black with White letters

END OF SECTION 260140

SECTION 260155 – MOTOR STARTERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to motor starters.

1.2 DESCRIPTION OF WORK:

- A. Extent of motor starter work is indicated by drawings and schedules.
- B. Type of motor starters in this section include the following:
 - 1. Fractional Horsepower Manual Starters
 - 2. Integral Horsepower Manual Starters
 - 3. Non-Reversing Magnetic Starters
 - 4. Two-Speed Non-Reversing Magnetic Starters
 - 5. Combination Non-Reversing Magnetic Starters

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to [Section 260001 – Electrical General Provisions](#) as applicable.
- B. SUBMITTALS:
 - 1. Shop Drawings: Submit manufacturer's data and dimensional details on motor starters including voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
 - 2. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. Manufacturers: Subject to compliance with all requirements, provide products of on of the following:
 - 1. Allen Bradley
 - 2. Cutler-Hammer
 - 3. General Electric
 - 4. Siemens
 - 5. Square D

- B. Maintenance, Stock, Fuses: For types and ratings required, furnish additional fuses, amounting to one unit for every 10 installed units, but not less than 3 units of each, for both power and control circuit fuses.

2.2 THERMAL OVERLOAD UNITS:

- A. Provide metal alloy, thermal overload units for all motor starters. Size to actual running full load current, not to motor plate current, after air and water balancing are completed.

2.3 FRACTIONAL HORSEPOWER MANUAL STARTERS:

- A. Provide fractional horsepower manual starters for single-phase fractional horsepower motors up to and including 1 horsepower, equivalent to Square D Class 2510, Type F, of types, sizes, and electrical characteristics required to suit applications or as otherwise indicated on drawings. Provide NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage starter, with thermal overload units, red pilot light, and toggle operator with handle guard/lock-off. Provide ANSI/NEMA ICS 6, Type 1 enclosures, or where subject to weather or moisture, Type 3R.

2.4 INTEGRAL HORSEPOWER MANUAL STARTERS:

- A. Provide integral horsepower manual starters for single-phase and three-phase motors in excess of 1 horsepower, equivalent to Square D Class 2510, Type M, of types, sizes, and electrical characteristics required to suit applications or as otherwise indicated on drawings. Provide NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage starter, with thermal overload units, low voltage protection, red pilot light, and push button with mechanism lock off. Provide ANSI/NEMA ICS 6, Type 1 enclosures, or where subject to weather or moisture, Type 3R.

2.5 NON-REVERSING MAGNETIC STARTERS:

- A. Provide non-reversing magnetic starters equivalent to Square D Class 8536, Type S, of types, sizes, and electrical characteristics as required to suit applications or as otherwise indicated on drawings. Provide NEMA ICS 2, AC general-purpose Class A magnetic starter for induction motors. Provide encapsulated coil with operating voltage compatible with control system (coordinate with Divisions 21, 22, and 23). Provide totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring. Provide straight-through wiring with all terminals clearly marked. Provide NEMA ICS, melting alloy, interchangeable, overload relays with one-piece thermal unit construction and under voltage protection in all phases. Provide replaceable overload relay control circuit contacts. Thermal units shall be required for starter to operate. Provide NEMA ICS 2, 2 each normally open and closed, field convertible, auxiliary contacts in addition to seal-in contact. Provide rotary-type, hand-off-auto and reset switches, recessed pushbutton control. Provide red pilot light. Provide control power transformer in each motor starter with fused primary and secondary. Provide each magnetic starter with integral phase failure protection that will protect against phase loss, phase unbalance, phase reversal, and undervoltage. Provide ANSI/NEMA ICS 6, Type 1 enclosures, or where subject to weather or moisture, Type 3R.

2.6 TWO-SPEED NON-REVERSING MAGNETIC STARTERS:

- A. Provide two-speed, non-reversing magnetic starters equivalent to Square D 8810, of types, sizes, and electrical characteristics as required to suit applications or as otherwise indicated on drawings. Provide non-reversing magnetic starters with features as noted above in the description for "NON-REVERSING MAGNETIC STARTERS" with the following exceptions: Provide high/low pushbutton switches to select motor speed when operating in the hand mode.

Provide green high speed and red low speed pilot lights. Label lights appropriately. Provide separate overload units for high and low speed windings. Provide consequent pole and/or separate winding starters as required to coordinate with motors provided. Coordinate all work with Divisions 21, 22, and 23.

2.7 COMBINATION NON-REVERSING MAGNETIC STARTERS:

- A. Provide combination, non-reversing magnetic starters equivalent to Square D 8538, Type S (non-fusible and fusible disconnect switch type) and Square D 8539, Type S (motor circuit protector type), of types, sizes, and electrical characteristics as required to suit applications or as otherwise indicated on drawings. Provide non-reversing magnetic starters and/or two-speed non-reversing magnetic starters with features as noted above in the descriptions for "NON-REVERSING MAGNETIC STARTERS" and "TWO-SPEED NON-REVERSING MAGNETIC STARTERS".
- B. Where Combination Magnetic Starter/Motor Circuit Protector switches are specified, provide NEMA AB 1, circuit breakers with integral instantaneous magnetic trip in each pole. Provide circuit breakers with externally operable handles that give positive visual indication of ON-OFF positions with red and black color coding.
- C. Where Combination Magnetic Starter/Nonfusible Disconnect Switches are specified, provide NEMA KS 1, enclosed knife switch with externally operable handle and visible blades. Provide disconnects with externally operable handles that give positive visual indication of ON-OFF positions with red and black color coding.
- D. Where Combination Magnetic Starter/Fusible Disconnect Switches are specified, provide NEMA KS 1, enclosed knife switch with externally operable handle and visible blades. Provide switches with Fuse clips to accommodate Class J fuses. Provide fuses in accordance with [Section 260180 – Overcurrent Protective Devices](#). Provide disconnects with externally operable handles that give positive visual indication of ON-OFF positions with red and black color coding.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install motor starters in accordance with manufacturer's written instructions, applicable requirements of the NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices.

3.2 METHODS:

- A. Install overload units so catalog number is visible. Mount chart inside each starter indicating heater type, size, and ampere ratings available.
- B. Where sizes of starters, disconnect, fuses, motor circuit protectors, heaters, etc. are not indicated on drawings, size all equipment in accordance with manufacturer's written instructions.
- C. Submit with the record drawings a record of the motor amperage readings of each electrically-driven unit; show horsepower, full-load amps and service factor.

3.3 IDENTIFICATION:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each starter cabinet. Provide red plastic laminate label for starter supplied by emergency power. Include mechanical equipment designation, horsepower, voltage, full-load amps, and service factor of motor. Mark on interior cover the source of power by indicating the panel and circuit number.

3.4 MOTOR CONNECTIONS:

- A. Each motor shall be connected to the conduit with a length of flexible, seal-tight conduit (minimum of 18"), with proper type fittings. All motor supply circuits shall include a green ground conductor. Check for proper motor rotation on all motors or equipment.

END OF SECTION 260155

SECTION 260160 – PANELBOARDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to panelboards.

1.2 DESCRIPTION OF WORK:

- A. Extent of panelboard work is indicated by drawings and schedules and is specified herein.
- B. Type of panelboards in this section include the following:
 - 1. Power Distribution Panelboards

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to [Section 260001 – Electrical General Provisions](#) as applicable.
- B. SUBMITTALS:
 - 1. Shop Drawings: Submit dimensioned drawings of panelboards and enclosures showing accurately scaled layouts of enclosures. Include schedule of devices, including, but not necessarily limited to, circuit breakers, fusible switches, fuses, ground-fault circuit interrupters, and accessories.
 - 2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

- A. Subject to compliance with all requirements, provide products from one of the follows:
 - 1. Cutler-Hammer, Eaton Corp.
 - 2. General Electric Co.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D Co.

2.2 GENERAL:

- A. Provide panelboards, enclosures, and ancillary components, of types, sizes, and ratings indicated. Provide overcurrent protective devices, etc. as indicated on drawings for a complete installation.

- B. Where "Spaces" or "Blanks" are indicated on panelboard schedules, provide drilled bus and mounting hardware ready to receive breaker or fusible switch of size indicated on panelboard schedule.

2.3 PANELBOARD ENCLOSURES:

- A. Provide Code gauge, galvanized or rust-resistant sheet steel enclosures in sizes and NEMA types to suit respective applications. The size of the wiring gutters and gauge of steel shall be in accordance with the latest NEMA Standards Publication and latest UL standards for panelboards. Flush locks shall not protrude beyond the front of the door. Key all enclosures alike and provide three keys at completion of the project. Fronts shall have adjustable indicating trim clamps, which shall be completely concealed when the doors are closed. Doors shall be mounted by completely concealed steel hinges. A circuit directory frame and card, with clear plastic covering shall be provided on the inside of the door. The directory cards shall be typewritten to identify each circuit service. Provide panel enclosures with doors hinged to enclosures. Provide ANSI-61 painted finish.

2.4 POWER DISTRIBUTION PANELBOARDS:

- A. Provide dead-front, safety-type lighting and appliance panelboards of types and electrical characteristic indicated. Provide wall-mounted or floor-standing power distribution panelboards as indicated. Provide panelboards suitable for use as service equipment where required. Provide copper bus bars, full-sized neutral bus, and ground bus. Provide insulated/isolated ground buses where indicated. Include overcurrent protective devices and switches in quantities, ratings, types, and arrangements shown. See [Section 260180 – Overcurrent Protective Devices](#).
- B. Rate devices, bussing, supports, etc. equal to or greater than the short circuit current rating indicated. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install panelboards in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 IDENTIFICATION:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on both the interior and exterior of each panelboard enclosure indicating name of panelboard. Bolt and nut or rivet labels to enclosure. (Sheet metal screws are not acceptable).

3.3 MOUNTING:

- A. Mount panelboards as indicated, but in no case higher than 6'-6" from finished floor to top of panel. Anchor enclosures firmly to walls and structural surfaces.

3.4 CIRCUIT DIRECTORIES:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering for each load served.

1. Provide red plastic laminate label for emergency loads.
2. If circuits are changed in a panel, type the new circuit designation and glue on existing circuit directory. Do not discard existing panelboard schedule unless all circuits have been changed.

3.5 WIRING METHODS:

- A. Arrange conductors neatly within enclosure, and secure with suitable nylon ties.
- B. Panelboards shall not be used for junction or splicing boxes or as a raceway.

3.6 ARRANGEMENT OF OVERCURRENT PROTECTIVE DEVICES:

- A. The overcurrent protective devices shall be in the same sequence and labeled as the panel schedule on the drawings.

END OF SECTION 260160

SECTION 260170 – DISCONNECT SWITCHES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to disconnect switches.

1.2 DESCRIPTION OF WORK:

- A. Extent of disconnect switch work is indicated by drawings and schedules and is specified herein.
- B. Type of disconnects in this section include the following:
 - 1. General Duty Disconnect Switches
 - 2. Heavy Duty Disconnect Switches
 - 3. Bolted Pressure Switches
 - 4. Fusible Switches

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to [Section 260001 – Electrical General Provisions](#) as applicable.
- B. SUBMITTALS:
 - 1. Product Data: Submit manufacturer's data on disconnect switches including specifications, installation instructions, etc.
 - 2. Shop Drawings: Submit dimensioned drawings of disconnects showing accurately scaled layouts of disconnects and enclosures.
 - 3. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

- A. Subject to compliance with all requirements, provide disconnect switches (fusible and non-fusible) and fusible switches (in power panels) from one of the following:
 - 1. Cutler-Hammer
 - 2. General Electric
 - 3. Siemens
 - 4. Square D

- B. Subject to compliance with all requirements, provide bolted pressure switches from one of the following:
 - 1. Bolt Switch
 - 2. Cutler Hammer
 - 3. General Electric
 - 4. Pringle Switch
 - 5. Siemens
 - 6. Square D

2.2 GENERAL:

- A. Provide fusible and/or non-fusible disconnect switches and ancillary components of types, sizes, ratings, and electrical characteristics as indicated. Provide enclosures in NEMA ratings suitable for applications. Provide fuses as indicated; See [Section 260180 – Overcurrent Protective Devices](#).

2.3 GENERAL DUTY DISCONNECT SWITCHES:

- A. Provide 240 volt rated, general duty switches in sheet steel enclosures as indicated of types, sizes, ratings, and electrical characteristics indicated and as required to suit respective application. Provide general duty switches for circuits rated 240 volts or less. Construct of spring-assisted, quick-make, quick-break mechanisms. Provide solid neutral as required by application. Equip with operating handle capable of being locked in the OFF position. Provide Class R rejection fuse clips for fusible-type switches.

2.4 HEAVY DUTY DISCONNECT SWITCHES:

- A. Provide 600 volt rated, heavy duty switches in sheet steel enclosures as indicated of types, sizes, ratings, and electrical characteristics indicated and as required to suit respective application. Provide heavy duty switches for circuits rated greater than 240 volts, but less than 600 volts. Construct of spring-assisted, quick-make, quick-break mechanisms. Provide solid neutral as required by application. Equip with operating handle capable of being locked in the OFF position. Provide Class R rejection fuse clips for fusible-type switches.

2.5 BOLTED PRESSURE SWITCHES:

- A. Provide factory-assembled, bolted pressure switches as integral components of floor-standing, distribution switchboards of types, sizes, ratings, and electrical characteristics indicated and as required to suit respective application. Provide pressure contacts that clamp at both ends of the switchblade when the blades are fully closed. Provide silver-plated copper for all current-carrying live parts. As standard features, provide quick-make quick-break mechanisms, capacitor trip mechanism, blown main fuse detection, control transformers, full neutral on four wire systems, operating handle capable of being locked in the OFF position, dual fuse door interlock, and external devices indicating status of switch (ON or OFF). Where indicated or as required by codes and/or standards, provide ground fault relays, key interlocks, meters, etc.

2.6 FUSIBLE SWITCHES:

- A. Provide factory-assembled, fusible switch units as integral components of distribution power panels and switchboards of types, sizes, ratings, and electrical characteristics indicated and as required to suit respective application. Provide quick-make quick-break mechanisms and visible blades. Equip with handle capable of being locked in the OFF position. Provide dual fuse door interlocks. Provide switch with Class R rejection fuse clips. Include copper lugs to accommodate conductors specified.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install disconnects in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 IDENTIFICATION:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each disconnect indicating name of disconnect or load served. Bolt labels to enclosure. Mark on interior cover the source of power by indicating the panel and circuit number.
- B. Provide red plastic laminate label for disconnects supplied by emergency power

3.3 MOUNTING:

- A. Mount disconnects as indicated, but in no case higher than 6'-6" from finished floor to top of disconnect. Anchor enclosures firmly to walls and structural surfaces.
- B. Provide 4" high concrete pad under floor-standing disconnects.

END OF SECTION 260170

SECTION 260180 - OVERCURRENT PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 section making reference to overcurrent protective devices.

1.2 DESCRIPTION OF WORK:

- A. Extent of overcurrent protective devices is indicated by drawings and schedules and is specified herein.
- B. Type of overcurrent protective devices in this section include the following:
 - 1. Molded Case Circuit Breakers

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to [Section 260001 - Electrical General Provisions as applicable](#).
- B. SUBMITTALS:
 - 1. SHOP DRAWINGS: Submit manufacturer's data on overcurrent protective devices including specifications, time-current trip characteristics curves, mounting requirements, installation instructions, etc. Submit dimensioned drawings of overcurrent protective devices.
 - 2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. Provide overcurrent protective devices and ancillary components of types, sizes, ratings, and electrical characteristics indicated. Provide enclosures in NEMA ratings as indicated and suitable for applications.

2.2 MOLDED CASE CIRCUIT BREAKERS:

- A. MANUFACTURERS: Subject to compliance with all requirements, provide molded case circuit breakers from one of the following:
 - 1. Cutler-Hammer
 - 2. General Electric

3. Siemens
4. Square D

B. MOLDED CASE CIRCUIT BREAKERS:

1. Provide factory-assembled, molded case circuit breakers as integral components of lighting and appliance panelboards, power panelboards, switchboards, and for individual mounting as indicated. Provide thermal magnetic, molded case circuit breakers of amperages, voltages, types, and short circuit current ratings indicated. Provide bolt-on type breakers only. Construct with quick-break, quick-break mechanism with inverse-time delay and instantaneous trip protection for each pole. Provide breakers rated for ambient temperatures to suit respective applications. Provide mechanical screw type removable copper connector lugs of size to accommodate conductors specified.
2. Provide breakers that have interrupting ratings greater than or equal to the specified fault current. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install overcurrent protective devices in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 IDENTIFICATION:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each disconnect indicating name of disconnect or load served. Bolt labels to enclosure. Mark on interior cover the source of power by indicating the panel and circuit number.
- B. Provide red plastic laminate label for disconnects supplied by emergency power.

3.3 MOUNTING:

- A. Mount disconnects as indicated, but in no case higher than 6'-6" from finished floor to top of disconnect. Anchor enclosures firmly to walls and structural surfaces.
- B. Provide 4" high concrete pad under floor-standing disconnects.

END OF SECTION 260180

SECTION 260182 – SWITCHBOARDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to switchboards.

1.2 DESCRIPTION OF WORK:

- A. Extent of switchboards is indicated by drawings and schedules and is specified herein.

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to [Section 260001 – Electrical General Provisions](#) as applicable.
- B. SUBMITTALS:
 - 1. Shop Drawings: Submit dimensioned drawings of switchboards and enclosures showing accurately scaled layouts of enclosures. Include schedule of devices, including, but not necessarily limited to, circuit breakers, fusible switches, fuses, and accessories.
 - 2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 VENDORS:

- A. Subject to compliance with all requirements, provide products from one of the follows:
 - 1. Cutler-Hammer
 - 2. General Electric
 - 3. Siemens
 - 4. Square D

2.2 GENERAL:

- A. Provide switchboards, enclosures, and ancillary components, of types, sizes, and ratings indicated. Provide overcurrent protective devices, etc. as indicated on drawings for a complete installation. See [Section 260180 – Overcurrent Protective Devices](#).
- B. Rate devices, etc. equal to or greater than the short circuit current rating indicated. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

2.3 AC DEAD-FRONT SWITCHBOARDS:

- A. Provide factory assembled, front accessible, dead-front, floor-standing switchboards in NEMA types to suit respective applications. Construct bus bars of silver-plated copper braced to withstand RMS symmetrical fault current indicated. Provide ground bus in each section. Provide ANSI-61 painted finish.
- B. Lugs shall be copper only.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install switchboards in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 IDENTIFICATION:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on exterior of each enclosure indicating name of switchboard. Bolt labels to enclosure. Mark on enclosure the source of power by indicating the panel and circuit number.
- B. Provide red plastic laminate label for emergency loads.

3.3 MOUNTING:

- A. Provide 4" high concrete pad. Mount switchboard as indicated, but in no case higher than 6'-6" from finished floor to top of switchboard including concrete pad. Bolt switchboard to concrete pad in accordance with [Section 260072 – Electrical Support and Seismic Restraints](#).

3.4 CIRCUIT DIRECTORIES:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering for each load served.
- B. Provide red plastic laminate label for emergency loads.

3.5 WIRING METHODS:

- A. Arrange conductors neatly within enclosure, and secure with suitable nylon ties.

END OF SECTION 260182

SECTION 260289 – SURGE PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes Type 2 Surge Protective Devices for low-voltage power.
- B. Related Sections include the following:
 - 1. [Division 26 Section "Panelboards" for factory-installed SPDs.](#)

1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. VPR: Voltage Protection Rating.
- C. SPD: Surge Protection Device.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.
- B. Product Certificates: For surge protective devices, signed by product manufacturer certifying compliance with the following standards:
 - 1. UL 1283.
 - 2. UL 1449 3rd Edition.
 - 3. UL 281-1 (fuse)
 - 4. CSA 22.2.
 - 5. NEMA LS-1
- C. Manufacturer Seismic Qualification Certification: Submit certification that surge protective devices, accessories, and components will withstand seismic forces defined in [Division 26 Section "Electrical Supports and Seismic Restraints."](#) Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- D. Products Testing: For surge protective devices, provide the following product test data:
1. Provide actual let through voltage test data in the form of oscillograph results for the ANSA/IEEE C62.41 Category C3 & C1 (combination wave) and B3 (ringwave) tested in accordance with ANSI/IEEE C62.45.
 2. Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying the device noise attenuation equal or exceeds 50 db at 100 kHz.
 3. Provide test report in compliance with NEMA LS1 from a recognized independent testing laboratory verifying that surge protection device components can survive published surge current rating on both a per mode and per phase basis using the IEEE C62.41, 8 x 20 microsecond current wave. Note that test data on individual module is not accepted.
- E. Field quality-control test reports, including the following:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Failed test results and corrective action taken to achieve requirements.
- F. Operation and Maintenance Data: For surge protective devices to include in emergency, operation, and maintenance manuals.
- G. Warranties: Special warranties specified in this Section.

1.5 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.
- B. Comply with ANSI/IEEE C62.41.1-2002, "IEEE Guide for Surge Environment in Low Voltage (1000 V and Less) AC Power Circuits," IEEE C62.41.2-2002, "IEEE Recommended Practice on Characterization of Surges in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45-2002, "IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."
- C. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."
- D. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449 2nd Edition, "Surge Protective Devices."
- E. The manufacturer shall be ISO 9000 certified.
- F. Comply with Military Standards MIL-STD220A.
- G. Comply with FIPS Pub 94.
- H. Comply with NEC 2008, Article 285, "Surge Protective Devices."

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

B. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: -40 to 140 deg F.
3. Humidity: 5 to 95 percent, non-condensing.
4. Altitude: Up to 20,000 feet above sea level.

1.7 COORDINATION

- A. Coordinate location of field-mounted surge protection devices to allow adequate clearances for maintenance. Coordinate placement of breakers in electrical panelboards feeding field-mounted surge protection devices so that conductor leads are kept to an absolute minimum.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge protection devices that fail in materials or workmanship within five years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

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

1. Current Technology, Inc.
2. Cutler-Hammer, Inc.; Eaton Corporation.
3. EFI Electronics
4. General Electric Company.
5. LEA International.
6. Leviton Mfg. Company Inc.
7. Liebert Corporation; a division of Emerson.
8. Siemens Energy & Automation, Inc.
9. Square D; Schneider Electric.
10. United Power Corporation.

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

- A. Electrical Requirements:

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall be greater than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge protection device for the service entrance and other distribution level. The system shall not utilize silicon avalanche diodes, selenium cell, air gaps or other components that may crowbar the system voltage leading to system upset or create any

- environmental hazards.
4. Protection Modes – For a wye-configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta-configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).
 5. UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum UL 1449 3rd Edition VPR for the device must not exceed the following:
 - a. 208Y/120 V:
 - 1) L-N; L-G; N-G: 700 V.
 - 2) L-L: 1200 V.
 - b. 480Y/277 V:
 - 1) L-N; L-G; N-G: 1200 V.
 - 2) L-L: 2000 V.
 6. ANSI/IEEE Cat. C3 Let Through Voltage – The let through voltage based on IEEE C62.41 and C62.45 recommended procedures for Category C3 surges (20 kV, 10 kA) shall be less than:
 - a. 208Y/120 V L-N: 560 V.
 - b. 480Y/277 V L-N: 960 V.
 7. ANSI/IEEE Cat. B3 Let Through Voltage – Let through voltage based on IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. B3 ringwave (6 kV, 500 amps) shall be less than:
 - a. 208Y/120 V L-N: 160 V.
 - b. 480Y/277 V L-N: 165 V.

B. SPD Design

1. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating SPD modules shall not be acceptable.
2. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHz using the MIL-STD-220A insertion loss test method. Products not able to demonstrate noise attenuation of 50 dB @ 100 kHz shall be rejected.
3. Extended Range Filter – The Surge Protective Device shall have a High Frequency Extended Range Tracking Filter in each Line to Neutral mode with compliance to UL 1283 and NEMA LS1. The filter shall have published high frequency attenuation rating in the attenuation frequencies:
 - a. Insertion Loss (ratio):
 - 1) 50kHz: 40
 - 2) 100kHz: 316
 - 3) 500kHz: 316
 - 4) 1MHz: 89
 - 5) 10MHz: 200
 - 6) 100MHz: 79
 - b. Insertion Loss (dB):
 - 1) 50kHz: 32
 - 2) 100kHz: 50
 - 3) 500kHz: 50
 - 4) 1MHz: 39
 - 5) 10MHz: 46
 - 6) 100MHz: 38
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.
5. Standard Monitoring Diagnostics – Each SPD shall provide integral monitoring options:

- a. Each unit shall provide a green / red solid state indicator light shall be provided on each phase. The absence of a green light and the presence of a red light shall indicate which phase(s) have been damaged.
 - b. Contacts for Remote Status Monitoring – The SPD device must include form C dry contacts (one NO and one NC) for remote annunciation of unit status. The remote alarm shall change state if any of the three phases detect a fault condition.
6. Overcurrent Protection Fusing: In order to isolate the SPD under any fault condition, the manufacturer shall provide:
- a. Individual Fusing: MOVs shall be individually fused via Copper Fuse Trace. The Copper Fuse shall allow protection during high surge (kA) events. SPD shall safely reach an end-of-life condition when subjected to fault current levels between 0 and 200 kA, including low level fault currents from 5 to 5000 amperes.
 - b. Thermal Protection: MOVs shall be equipped with Thermal Fuse Spring (TFS) technology which allows disconnection of the suppression component at the overheated stage common during temporary over voltage condition. For small fault currents between 100mA to 30Amp, or if the occurrence is over a longer period of time, the TFS will disconnect first. Manufacturers that utilize fuse trace only shall not be approved since there is no fault current protection between 100mA to 30A,
 - c. All overcurrent protection components shall be tested in compliance with UL 1449-Limited Current Test and AIC rating test.
- C. Minimum Repetitive Surge Current Capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 2002:
1. The suppression filter system shall be repetitive surge tested in every mode utilizing a 1.2 x 50 microseconds, 20kV open circuit voltage. 8 x 20 microsecond, 10kA short circuit current Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current. The minimum repetitive surge current capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992 shall be:
 - a. Service Entrance: 5000 impulse per mode.
 - b. Distribution Locations: 5000 impulse per mode.
 - c. Branch Locations: 5000 impulse per mode.

2.3 SYSTEM APPLICATION

- A. Locations – Electrical drawings indicate the location and IEEE Category requirements of all required SPD's.
- B. Surge Current Capacity – The minimum total surge current 8 x 20 microsecond waveform that the device is capable of withstanding shall be as follows:
 1. IEEE Category "C" Locations:
 - a. Per Phase: 250kA.
 - b. Per Mode: 125kA.
 2. IEEE Category "B" Locations:
 - a. Per Phase: 160kA.
 - b. Per Mode: 80kA.
 3. IEEE Category "A" Locations:
 - a. Per Phase: 120kA.
 - b. Per Mode: 60kA.
- C. Lighting and Appliance Panelboard Requirements – Any one of the following options are acceptable:

1. Factory-Installed SPD Option:
 - a. The SPD shall not limit the use of Through-feed lugs, Sub-feed lugs and Sub-feed breaker options.
 - b. The SPD shall be immediately installed on the load side of the main breaker or main lugs.
 - c. The panelboard shall be capable of re-energizing upon removal of the SPD.
 - d. A direct bus bar connection shall be used to mount the SPD component to the panelboard bus bar to reduce the impedance of the shunt path.
 - e. The SPD panelboard shall be constructed using a direct bus bar connection (cable connection between bus bar and SPD device is not acceptable). SPD units that use a cable connection do not meet the intent of this specification. For this option, the breaker shown on the electrical drawings shall be deleted.
 - f. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
 - g. The SPD shall be of the same manufacturer as the panelboard.
 - h. The complete panelboard including the SPD shall be UL67 listed.
 2. Electronic grade Panelboard Extension Option:
 - a. The SPD shall not limit the use of Through-feed lugs, Sub-feed lugs and Sub-feed breaker options.
 - b. The SPD shall be installed in an panelboard extension consisting of a box and trim as follows:
 - 1) Box: The unit's box shall be formed of galvanized and chemically cleansed metal and all breaks in galvanizing shall be painted with metallic paint. Minimum size shall be 16" high and in width and depth to match the panelboard dimensions. It shall have removable top and bottom end-plates to facilitate attachment to the top of bottom of a panelboard (also with removable end-plates) in order to provide a continuous barrier-free volume for routing feeder or branch wiring through the extension box. Collar hardware shall be provided to mate the panelboard and the box.
 - 2) Trim: The unit shall be constructed with gray baked enamel sheet metal trim suitable for attachment to the panelboard. Trim shall be flush- or surface mounted to match panelboard trim requirements. Refer to panelboard schedules.
 - c. Provide a multi-pole circuit breaker in the panelboard in size as recommended by the manufacturer to feed the surge protection device. The size of the breaker shall supersede the size of the breaker shown on the electrical drawings.
 - d. Provide copper conductors in size as recommended by the manufacturer for connecting the phases, neutral, and ground between the surge protection device and the circuit breaker in the panelboard. The size of the conductor shall supersede the size of the conductors shown on the electrical drawings.
 3. Wall-Mounted and/or Retrofit Application Option:
 - a. The SPD shall be wall-mounted immediately adjacent to the panelboard. Conform to all NEC clearance requirements.
 - b. Provide a multi-pole circuit breaker in the panelboard in size as recommended by the manufacturer to feed the surge protection device. The size of the breaker shall supersede the size of the breaker shown on the electrical drawings.
 - c. Provide copper conductors in size as recommended by the manufacturer for connecting the phases, neutral, and ground between the surge protection device and the circuit breaker in the panelboard. The size of the conductor shall supersede the size of the conductors shown on the electrical drawings. Route conductors in conduit sized in accordance with all NEC requirements.
- D. Power Distribution Panelboard, Motor Control Center, and Switchboard Requirements – Any one of the following options are acceptable:

1. Factory-Installed SPD Option:
 - a. The SPD shall be of the same manufacturer as the power distribution panelboard, motor control center, or switchboard.
 - b. The SPD shall be factory installed inside the power distribution panelboard, motor control center, or switchboard at the assembly point by the original equipment manufacturer.
 - c. Locate surge protection device on load side of main disconnect device or main lugs, as close as possible to the phase conductors and ground/neutral bar.
 - d. Provide a disconnect sized in accordance with all manufacturer's recommendations. The disconnect shall be directly integrated to the surge protection device and assembly bus by using bolted bus bar connections. The disconnect is the preferred method. If otherwise recommended by the manufacturer, provide a multi-pole circuit breaker in the panelboard in size as recommended by the manufacturer to feed the surge protection device. The size of the breaker shall supersede the size of the breaker shown on the electrical drawings. Provide copper conductors in size as recommended by the manufacturer for connecting the phases, neutral, and ground between the surge protection device and the circuit breaker in the panelboard. The size of the conductor shall supersede the size of the conductors shown on the electrical drawings.
 - e. The SPD shall be integral to power distribution panelboard, motor control center, or switchboard as factory standardized design.
 - f. All monitoring diagnostics features shall be visible from the front of the equipment.
2. Wall-Mounted and/or Retrofit Applications Option:
 - a. The SPD shall be wall-mounted immediately adjacent to the panelboard. Conform to all NEC clearance requirements.
 - b. Provide a multi-pole circuit breaker in the panelboard in size as recommended by the manufacturer to feed the surge protection device. The size of the breaker shall supersede the size of the breaker shown on the electrical drawings.
 - c. Provide copper conductors in size as recommended by the manufacturer for connecting the phases, neutral, and ground between the surge protection device and the circuit breaker in the panelboard. The size of the conductor shall supersede the size of the conductors shown on the electrical drawings. Route conductors in conduit sized in accordance with all NEC requirements.

2.4 ENCLOSURES

- A. Provide enclosures suitable for locations as indicated on the drawings or as described below:
 1. NEMA 1/3R rainproof enclosures intended for outdoor use primarily to provide protection against rain, sleet and damage from external ice formation.
 2. NEMA 12 dust-tight enclosures intended for indoor use primarily to provide protection against circulating dust, falling dirt and dripping non-corrosive liquids. (Panelboards Only)
 3. NEMA 4 watertight stainless steel intended for indoor or outdoor use primarily to provide protection against windblown dust and rain, splashing rain, hose-directed water, and damage from external ice formation. (Side Mounted Unites Only)

PART 3 – EXECUTION

3.1 INSTALLATION OF SURGE PROTECTION DEVICES

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance

ground.

- B. Install devices for panelboard and auxiliary panels with conductors or buses between surge protection device and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground at SPD.

3.2 PLACING SYSTEM INTO SERVICE

- A. Do not energize or connect electrical equipment to their sources until surge protection devices are installed and connected.

3.3 FIELD QUALITY CONTROL

- A. Testing: Perform the following field tests and inspections and prepare test reports:
 - 1. After installing surge protection devices, but before electrical circuitry has been energized, test for compliance with requirements.
 - 2. Complete startup checks according to manufacturer's written instructions.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
- B. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain surge protective devices. Refer to [Division 1 Section "Closeout Procedures"](#) or ["Demonstration and Training"](#) as may be applicable.

END OF SECTION 260289

SECTION 260420 – SERVICE ENTRANCE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to service entrances.

1.2 DESCRIPTION OF WORK:

- A. Extent of service entrance work is indicated by drawings and schedules and is specified herein.
- B. Work under this section includes the following:
 - 1. Power Company Coordination and Fees
 - 2. Power Company Transformer Pads
 - 3. Raceways and Conductors
 - 4. CT Enclosures
 - 5. Metering
 - 6. Service Entrance Switchboards and/or Panelboards
 - 7. Overcurrent Protective Devices and/or disconnects

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to [Section 260001 – Electrical General Provisions](#) as applicable.
- B. SUBMITTALS:
 - 1. Shop Drawings: Submit manufacturer's data on service entrance equipment and accessories. Submit dimensioned drawings of service entrance equipment.
 - 2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms containing service entrance equipment indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. Provide service entrance equipment and accessories of types, sizes, ratings, and electrical characteristics indicated or as otherwise required to provide a complete system. See other applicable sections.

2.2 POWER COMPANY COORDINATION AND FEES:

- A. Coordinate and comply with all power company requirements. Verify all costs for line extensions (both high voltage and low voltage conductors), underground service fees, etc. with

Power Company prior to bid. Include all costs in bid. Confirm location of point of service before bidding.

2.3 POWER COMPANY TRANSFORMER PADS AND VAULTS:

- A. Provide steel reinforced, concrete transformer pads and/or vaults of sizes and with openings in accordance with the latest standards and requirements of the local power company. Verify all requirements with Power Company prior to installation.

2.4 RACEWAYS AND CONDUCTORS:

- A. Provide service entrance raceways and conductors in accordance with [Section 260110 – Conduit Raceways](#), and [Section 260120 – Conductors and Cables](#).

2.5 CT ENCLOSURES:

- A. Provide CT enclosures complete with meter bases of types and sizes in accordance with all power company requirements. Provide steel reinforced, concrete pads with openings in accordance with same. [Refer to "Concrete Bases" under Section 260001 – Electrical General Provisions](#). Verify and comply with all power company requirements prior to installation.

2.6 METERING:

- A. Meter Bases: Provide meter bases in accordance with all power company requirements. Extend 1" empty conduit from meter bases to secondary compartment of power company transformer. Verify exact location of meter bases prior to installations.
 - 1. Meters:
 - a. Subject to compliance with all requirements, provide metering equipment from one of the following:
 - 1) General Electric
 - 2) Siemens
 - 3) Square D
 - 4) Cutler Hammer
 - B. Power Meters:
 - 1. Provide Square D Power Logic Circuit Monitor, Class 3020, Model CM-3250, or equivalent, integrally mounted in service switchboard, completely wired with current transformers, potential transformers, control power transformer, and fusing.
 - 2. Provide meter with the following features:
 - a. Front panel features:
 - 1) Six-digit LED display
 - 2) Kilo/Mega units LEDs
 - 3) Meter indication LEDs
 - 4) Setup/rest parameters
 - 5) Phase indication LEDs
 - 6) Phase select button
 - 7) Select meter buttons
 - 8) Mode indication LEDs
 - 9) Mode select button
 - 10) Optical communications port
 - b. True RMS Metering
 - c. Accepts standard CT and PT inputs
 - d. 0.2% accuracy, current and voltage

- e. Min/Max displays for metered data
 - f. On-board clock/calendar
 - g. RS-485 Communications standard
 - h. Setpoint controlled alarm/relay functions
 - i. On-board event and data logging
 - j. Waveform capture
 - k. High-speed, triggered 12-cycle event capture
 - l. Downloadable firmware
 - m. Date/time for each Min/Max
 - n. Optional voltage/power module, where required, for direct connection to 480Y/277 V systems.
3. Provide meter with instrumentation to displaying the following information:
- a. Real-time readings:
 - 1) Current (per phase, N, G, 3 phase)
 - 2) Voltage, per phase (L-L, L-N), and 3 phase average.
 - 3) Apparent RMS Current
 - 4) Real power (per phase, 3 phase)
 - 5) Reactive Power (per phase, 3 phase)
 - 6) Apparent power (per phase, 3 phase)
 - 7) Power factor (per phase, 3 phase)
 - 8) Frequency
 - 9) THD (current and voltage)
 - 10) K-factor (per phase)
 - b. Demand Readings:
 - 1) Demand current (per-phase present, peak)
 - 2) Average demand current (per phase present, peak)
 - 3) Peak demand current (per phase)
 - 4) Average power factor (3 phase total)
 - 5) Demand real power (3 phase total)
 - 6) Average demand peak power (3 phase total)
 - 7) Predicted demand real power
 - 8) Peak demand real power
 - 9) Demand apparent power (3 phase total)
 - c. Energy Readings:
 - 1) Accumulated energy, real
 - 2) Accumulated energy, reactive
 - d. Power Analysis Values:
 - 1) Crest factor (per phase)
 - 2) K-factor demand (per phase)
 - 3) Displacement power factor (per phase, 3 phase)
 - 4) Fundamental voltages (per phase)
 - 5) Fundamental currents (per phase)
 - 6) Fundamental real power (per phase)
 - 7) Harmonic power
 - 8) Unbalance (current and voltage)
4. Phase rotation

2.7 SERVICE ENTRANCE SWITCHBOARDS AND/OR PANELBOARDS:

- A. Provide service entrance switchboards and/or panelboards in accordance with [Section 260182 – Switchboards](#), and [Section 260160 – Panelboards](#). Rate all service switchboards and/or panelboards as service entrance equipment.

2.8 OVERCURRENT PROTECTIVE DEVICES AND/OR DISCONNECTS:

- A. Provide overcurrent protective devices and/or disconnects in service switchboards and/or

panelboards in accordance with [Section 260180 – Overcurrent Protective Devices](#), and [Section 260170 – Disconnect Switches](#).

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install service entrance equipment and accessories in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 TRANSFORMER LOCATIONS:

- A. Verify and coordinate exact placement of concrete pad with local power company prior to installation. Strictly maintain sufficient distances from door, window, building walls and overhangs, gas meters, fuel tanks, etc. in accordance with all power company requirements. Field-verify placement of transformer pad in company with the local power company representative.

3.3 COORDINATION:

- A. Coordinate all service entrance work with other trades.
- B. Power Company Coordination: Coordinate installation of service entrance equipment with Power Company and insure that power to building is ready when needed. After the contract has been signed, immediately notify the engineer that the project is underway and indicated when power to the building/project is needed. It is the engineer's responsibility to complete and submit the power company service request form.

END OF SECTION 260420

SECTION 260435 – OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.

- 1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data: For coordination-study specialist.
- D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.

1.4 SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five(5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies of the short-circuit input and output data, where required, shall be provided on CD in PDF format.
- B. For large system studies with more than 200 bus locations, the contractor is required to provide the study project files to the owner in electronic format. In addition, a copy of the computer analysis software viewer program is required to accompany the electronic project files, to allow the owner to review all aspects of the project and print arc flash labels, one-line diagrams, and other items.
- C. The report shall include the following sections:
 - 1. Executive summary
 - 2. Descriptions, purpose, basis, and scope of the study

3. Tabulations of circuit breaker, fuse, and other protective device rating versus calculated short circuit duties
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection
5. Fault current calculations, including a definition of terms and guide for interpretation of the computer printout
6. Details of the incident energy and flash protection boundary calculations
7. Recommendations for system improvements, where needed
8. One-line diagram

D. Arc flash labels shall be provided in hard copy only.

1.5 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. The equipment manufacturer or approved engineering firm shall demonstrate experience with arc flash hazard analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.
- D. The contractor shall furnish an arc flash hazard analysis study, per the requirements set forth in NFPA 70E – Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
- E. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- F. Comply with IEEE 399 for general study procedures.
- G. Comply with 1584 – Guide for Performing Arc-Flash Hazard Calculations.

PART 2 – PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
 1. CGI CYME.
 2. EDSA Micro Corporation.
 3. ESA Inc.
 4. Operation Technology, Inc.

5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 1. Product Data for overcurrent protective devices specified in other Division 26 sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Impedance of utility service entrance.
 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 1. Switchgear and switchboard bus.
 2. Medium-voltage controller.
 3. Motor-control center.
 4. Distribution panelboard.
 5. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with **[IEEE 141]** **[IEEE 241]** and IEEE 242.
 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.
 2. Medium-Voltage Circuit Breakers: IEEE C37.010.
 3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 4. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-**[and high-]**voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with **[IEEE 141] [IEEE 241] [IEEE 242]** recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup

- values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 - 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
 - G. Completed data sheets for setting of overcurrent protective devices.
- 3.5 ARC FLASH HAZARD ANALYSIS
- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
 - B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway, and splitters) where work could be performed on energized parts.
 - C. The arc flash hazard analysis shall include all significant locations to 240 volt and 209 volt systems fed from transformers equal to, or greater than, 125 kVA , where work could be performed on energized parts.
 - D. Safe working distances shall be based upon the calculated arc flash boundary, considering an incident energy of 1.2 cal/cm².
 - E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
 - F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into considering the parallel operation of synchronous generators with the electric utility, where applicable.
 - G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows.

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- I. When performing incident energy calculations on the line side of a main breaker, as required above, the line side and load side contributions must be included in the fault calculation.
- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds, based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

3.6 ARC FLASH WARNING LABELS

- A. The contractor of the arc flash hazard analysis shall provide a 3.5 inch x 5 inch thermal transfer-type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device setting and will be provided after the results of the analysis have been presented to the owner, and after any system changes, upgrades, or modifications have been incorporated in the system.
- C. The label shall included the following information, at a minimum:
1. Location designation
 2. Nominal voltage
 3. Flash protection boundary
 4. Hazard risk category
 5. Incident energy
 6. Working distance
 7. Engineering report number, revision number, and issue date
- D. Labels shall be machine-printing, with no field markings.
- E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
1. For each 600, 480, and applicable 208 volt panelboard, one arc flash label shall be provided.
 2. For each motor control center, one arc flash label shall be provided.
 3. For each low-voltage switchboard, one arc flash label shall be provided.
 4. For each switchgear, on flash label shall be provided.
 5. For medium voltage switches, one arc flash label shall be provided.
- F. Labels shall be field-installed by the engineering service division of the equipment manufacturer

under the Startup and Acceptance Testing contract portion.

3.7 ARC FLASH TRAINING

- A. The contractor of the arc flash hazard analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET), or equivalent.

END OF SECTION 260435

SECTION 260452 – GROUNDING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to grounding.

1.2 DESCRIPTION OF WORK:

- A. Extent of grounding work is indicated by drawings and schedules and is specified herein.
- B. Ground the complete electrical installation including the system neutral, metallic conduits and raceways, boxes, fittings, devices, cabinets, equipment, and separately derived systems in accordance with the NEC and all other applicable codes to provide a permanent, continuous, low impedance, grounding system.
- C. Provide grounding system such that the resistance from the service entrance ground bus, through the grounding electrode to earth is not greater than 5 ohms.

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to [Section 260001 – Electrical General Provisions](#) as applicable.
- B. TESTING: Submit results of ground resistance testing as specified in this section. Include name of testing agency with report. Include test results in operation and maintenance manuals.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. Provide grounding equipment and accessories of types, sizes, ratings, and electrical characteristics indicated or as otherwise required to provide a complete system.

2.2 GROUNDING CONDUCTORS:

- A. Unless noted otherwise, provide grounding conductors with stranding and insulation types to match phase conductors. Provide conductors with green insulation if possible; otherwise wrap with green tape. Size ground conductors as indicated on drawings. Do not size ground conductors smaller than that allowable by NEC.

2.3 GROUND RODS:

- A. Provide copper clad, steel, 3/4" diameter by 10' long, ground rods (Weaver, Cadweld, or equivalent).

2.4 TEST WELLS:

- A. Provide precast concrete box 9-1/2" W. x 16" L. x 18" D. with light duty concrete cover for non-traffic areas or rated steel plate for traffic areas. Provide covers with lifting holes. Engrave cover with "Ground Rod".

2.5 CONCRETE ENCASED GROUNDING ELECTRODE (UFER GROUND):

- A. Provide a bare copper conductor encased along the bottom of concrete foundation or footing that is in direct contact with the earth and where there is no impervious water-proofing membrane between the footing and the soil. Size UFER ground conductor in accordance with the NEC. Extend conductor through a horizontal length of 30' minimum and encase with not less than 2 nor more than 5 inches of concrete separating it from surrounding soils.

2.6 INSULATED GROUNDING BUSHINGS:

- A. Provide plated malleable iron body with 150 degree Centigrade molded plastic insulating throat, lay-in grounding lug with hardened stainless steel fasteners (OZ Gedney BLG or equivalent).

2.7 CONNECTION TO PIPES:

- A. Provide heavy duty, cast bronze, ground clamp systems with silicon bronze bolts and nuts (OZ Gedney G Series - B or equivalent).

2.8 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES:

- A. Provide exothermic welds. (Cadweld or equivalent)

2.9 BONDING JUMPERS:

- A. Provide bonding jumpers with hot dip galvanized malleable or ductile iron clamps, hot dip galvanized steel U-bolts, and tinned copper braids (OZ Gedney BJ Series or equivalent).

2.10 GROUND BUS:

- A. Provide 1/4" x 4", copper ground bus complete with insulators and brackets in lengths and at mounting heights as indicated on drawings. Furnish complete with drilled holes and lugs to accommodate grounding conductors.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install grounding systems in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 CLEANING:

- A. Thoroughly clean all metal contact surfaces prior to installation of clamp-on connectors.

3.3 SEPARATELY DERIVED SYSTEMS:

- A. Ground each separately derived system in accordance with NEC Section 250-16 unless otherwise indicated on drawings.

3.4 SERVICE ENTRANCE GROUNDING:

- A. Connect the following items using NEC sized copper grounding conductors (in NEC sized, conduits if concealment is required) to lugs on the service ground bus:
 1. Conductor from the UFER ground.
 2. Conductor from two ground rods driven exterior to building at not less than 10' apart.
 3. Conductor from main incoming cold water piping system.
 4. Conductor from building structural steel.
 5. Conductor from separately derived systems.
 6. Conductor from insulated ground bushings on service entrance conduits.
 7. Additional ground rods as required to achieve resistance value specified.
 8. Additional items indicated on drawings.

3.5 EQUIPMENT BONDING AND GROUNDING:

- A. Provide an NEC sized conductor, whether indicated or not on the drawings, in raceways as follows:
 1. Non-metallic conduits and ducts.
 2. Distribution feeders.
 3. Motor and equipment branch circuits.
 4. Device and lighting branch circuits.
 5. Full length of all multi-outlet assemblies and other surface wireways.

3.6 ADDITIONAL GROUNDING INSTALLATION REQUIREMENTS:

- A. Provide grounding bushings on all service conduit and conduits installed in concentric/eccentric knock-outs or reducing washer at panelboards, cabinets, and gutters.
- B. Provide bonding jumpers across expansion and deflection couplings in conduit runs, across pipe connections at water meters, and across dielectric couplings in metallic cold water piping system. Connection to water piping system shall be made electrically continuous by connecting to the street side of the water main valve and/or installing additional bonding jumpers across the meter, valves or service unions that might be disconnected.
- C. Provide bonding wire in all flexible conduits.
- D. Isolated Ground Circuits: Circuits used for isolated ground outlets shall be run in separate raceways or shall have a separate green insulated ground conductor installed and tagged for identification at all outlet and junction boxes.

3.7 TEST WELLS:

- A. All ground rods shall be driven external to building and shall be located in ground well boxes. Locate in landscaped areas where possible.

3.8 TESTING:

- A. Obtain and record ground resistance measurements both from service entrance ground bus to the ground electrode and from the ground electrode to earth. Install additional bonding and grounding electrodes as required to comply with resistance limits specified under this Section.

Use independent testing agency for all testing.

END OF SECTION 260452

SECTION 260510 – INTERIOR AND EXTERIOR BUILDING LIGHTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to interior and exterior building lighting.

1.2 DESCRIPTION OF WORK:

- A. Extent of interior and exterior building lighting work is indicated by drawings and schedules and is specified herein.
- B. Type of lighting fixtures in this section include the following:
 - 1. Fluorescent
 - 2. High intensity discharge

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to [Section 260001 - Electrical General Provisions](#) as applicable. Provide fluorescent-lamp ballasts which comply with Certified Ballast Manufacturer's Association standards and carry the CBM label.
- B. SHOP DRAWINGS: Submit manufacturer's data on interior and exterior building lighting fixtures. Submit dimensioned drawings of all lighting fixtures. Identify light fixtures by type and submit in alphabetical order.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. Provide light fixtures of types as indicated on drawings or as approved by addenda. Provide light fixtures complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, starters, wiring, etc. Provide all light fixtures with safety latches where applicable.
- B. Provide all detachable fixture parts, luminous ceiling accessories, louvers, diffusers, lenses, and reflectors with locking catches, screws, safety chains, or safety cables.
- C. Provide all exterior fixtures with damp or wet location labels as required by application.
- D. Provide all light fixtures and support accessories as required for a complete system.
- E. Consult architectural drawings for louvers (if any) to be provided by Division 26.

2.2 FLUORESCENT LIGHT FIXTURES:

A. FLUORESCENT BALLASTS:

1. Electronic:
 - a. Manufacturers: Provide electronic ballasts from manufacturers specified as an integral part of light fixtures on the light fixture schedule. Where "generic" electronic ballasts are specified, provide products of one of the following for each fixture type:
 - 1) Advance Transformer
 - 2) Magnetek
 - 3) Motorola
 - 4) Osram Sylvania
 - b. Electronic Ballasts: Whether specified specifically or generically, provide electronic, fluorescent lamp ballasts for each type of fluorescent fixture capable of operating lamps indicated. Provide power factor (as indicated on drawings, Class P, sound-rated A, and internally thermally protected ballasts. Provide ballasts with input third harmonic content not exceeding 10% for 120V ballasts and less than 15% for 277V ballasts, average lamp current crest factor of 1.7, frequency of operation 20 KHz or greater, and non-PCB capacitors. Unless specifically noted otherwise, provide all interior light fixtures, with full light output electronic ballasts. Equip all exterior light fixtures with low temperature starting ballasts. Comply with all manufacturer's written recommendations for all lamp-ballast combinations.
 - c. Programmed Start Electronic Ballasts: Electronic ballasts shall be programmed start for maximum lamp life on shorter start cycles. Filament voltage shall be applied prior to the application of open circuit voltage to allow adequate heating of the filaments and then open circuit voltage is applied to start the lamps. Ballasts shall provide for a minimum lamp starting temperature of 0 Degrees F.
 - d. End-of-Life Circuitry: Ballasts for lamps of T5 and smaller including T5, T4, and T2 diameter shall contain end-of-life sensing circuitry to prevent lamp bulb, lamp base, or socket damage at lamp end-of-life.

B. FLUORESCENT LAMPS:

1. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
 - a. General Electric
 - b. Phillips
 - c. Osram Sylvania
2. Lamps: Provide fluorescent lamps in types, wattages, and sizes as indicated on fixture schedule. Unless specifically noted otherwise, equip interior light fixtures with full light output, energy-conserving, fluorescent lamps.
3. T-8 Lamps: Where T-8 lamps are specified, provide General Electric "Trimline", Sylvania "Optron", or Phillips only with initial lumens outputs of 3100.
4. Provide TCLP-compliant lamps where available from the manufacturer.

C. DIFFUSERS: Where acrylic diffusers are specified, provide 100 percent virgin acrylic compound with minimum thickness of .125 inches.

2.3 HIGH INTENSITY DISCHARGE (HID) LIGHT FIXTURES:

A. HID BALLASTS:

1. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
 - a. Advance Transformer
 - b. General Electric

- c. Universal
 - 2. Ballasts: Provide electromagnetic, constant wattage, HID lamp ballasts for each type of HID fixture capable of operating lamps indicated. Provide high power factor (90% of greater) ballasts. Provide HID ballasts for each HID fixture with features in accordance with all manufacturer's written recommendations. Equip all exterior light fixtures with low temperature (-10 degree F.) starting ballasts. Comply with all manufacturer's written recommendations for all lamp-ballast combinations.
- B. HID LAMPS:
- 1. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
 - a. General Electric
 - b. Phillips
 - c. Osram Sylvania
 - d. Venture
 - 2. Lamps: Provide HID lamps in types, wattages, and sizes as indicated on fixture schedule.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install interior and exterior light fixtures in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 SUPPORT REQUIREMENTS:

- A. SURFACE MOUNTED LIGHT FIXTURES: Support all surface mounted fixtures from a 4" square octagonal outlet box connected to a standard 3/8" stud or box hangar where applicable. Include backing and supports as required to support weight of light fixture.
- B. PENDANT AND STEM MOUNTED LIGHT FIXTURES: Provide pendants, rigid conduit stems, and flexible ball joint hangers for all pendant and stem hung fixtures.

3.3 PROTECTION AND CLEANING:

- A. Protect installed and non-installed fixtures from damage during construction period.
- B. Thoroughly clean all interior and exterior light fixtures. Do not mar or scar reflectors or diffusers. Repair all nicks and scratches to appearance of original finish. Remove protective plastic coverings on light fixtures at completion of project.

3.4 WIRING METHODS:

- A. Route a minimum of 36" of 3/8" flexible conduit to each lay-in light fixture directly from an outlet box. Unless specified otherwise, flexible conduit shall not exceed 72" in length. Do not loop flexible conduit from fixture to fixture.
- B. Grounding: Provide equipment grounding connections for each lighting fixture.

3.5 COORDINATION:

- A. Refer to architectural reflected ceiling drawings for exact location and quantities of light fixtures, and ceiling types. Where conflicts occur between the architectural and electrical drawings, or where fixtures types do not coordinate with ceiling systems, notify architect/engineer prior to bid. After bid and award of contract, provide all light fixtures as required to meet the intent of the construction documents. Coordinate fixture layouts and installations with ceiling installer prior to submitting shop drawings and during construction. Fluorescent light fixtures shall be not less than 1/2" from combustible materials.

3.6 SPARE PARTS:

- A. LAMPS: Provide 15% spare lamps, but in no case less than one, of each type, wattage, and size used for the project.
- B. ACRYLIC DIFFUSERS: Provide a spare acrylic diffusers and/or glass for each light fixture type and one for each additional unit for each ten fixtures. The quantity of any single type need not exceed 10.
- C. ELECTRONIC BALLASTS: Provide 2% spare electronic ballasts.

3.7 WARRANTY:

- A. LAMPS: Warranty incandescent and fluorescent lamps for a period of two months from substantial completion.
- B. ELECTRONIC BALLASTS: Warranty electronic ballasts for parts and labor for complete replacement for a period of five years. Warranty shall include an allowance for nominal replacement labor and replacement of defective product.

END OF SECTION 260510

SECTION 260551 – EXTERIOR AREA LIGHTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to exterior area lighting.

1.2 DESCRIPTION OF WORK:

- A. Extent of exterior area lighting work is indicated by drawings and schedules and is specified herein.

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to [Section 260001 - Electrical General Provisions](#) and other sections as applicable.
- B. SHOP DRAWINGS: Submit manufacturer's data on exterior area lighting items including but not necessarily limited to poles, brackets, light fixtures, fuse, fuseblocks, etc. Submit dimensioned drawings of all pole and lighting fixtures. Include information with interior and exterior building lighting fixtures.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. Provide exterior lighting fixtures of types as indicated on drawings or as approved by addenda.

2.2 LIGHT FIXTURES:

- A. Refer to [Section 260510 - Interior and Exterior Building Lighting](#) for requirements for exterior light fixtures, lamps, ballasts, etc.

2.3 POLES:

- A. Provide poles and all accessories including but not necessarily limited to anchor bolts, templates for anchor bolt pattern, brackets, bolts, etc. Provide handhole and cover at base of each pole. Provide poles which have been primed and painted at the factory. Provide poles, anchor bolts, etc. in sizes as recommended by manufacturer to withstand windloadings.

2.4 CONCRETE BASES:

- A. Provide 3000 psi class concrete, forms, steel reinforcement, tie wires, etc. as required. See drawings for details.

2.5 GROUND RODS:

- A. See [Section 260452 – Grounding](#) for ground rod requirements.

2.6 FUSEHOLDER, FUSES, AND BREAK-A-WAY RECEPTACLES:

- A. Provide fuseholders with break-a-way receptacles equivalent to Bussmann Tron Waterproof Fuseholders and Break-A-Way Receptacles in the base for all phase conductors and materials. Neutral fuse holder will use a shorting fuse insert. Provide Bussmann KTK-R fuses in ratings to suit respective applications and sized in accordance with all manufacturer's recommendations.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install exterior area lighting in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 INSTALLATION METHODS:

- A. Set all poles plumb. Use belt slings or ropes to raise and set poles to protect finish. Repair nicks and scratches to match original surface.
- B. Locate fuseholder at handhole. Provide fuse blanks in all neutral conductors.
- C. Grounding: Provide one ground rod for each light pole. Connect ground rod to pole by means of an NEC-sized grounding conductor and all additional grounding as required.

3.3 CONCRETE BASES:

- A. Provide concrete bases for light poles in accordance with details on drawings. Grout and hand-rub all concrete to a uniform smooth finish.

3.4 SPARE PARTS:

- A. FUSES: Provide three spare fuses for each type and size used.

3.5 WIRING METHODS:

- A. No common neutral multi-wire circuits will be used to feed area lighting. Provide dedicated neutral wire for each circuit indicated.

END OF SECTION 260551

SECTION 260923 - LIGHTING CONTROL RELAY PANEL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Lighting control relay panel systems

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Interconnection diagrams showing field-installed wiring.
 - 2. Include diagrams for power, signal, and control wiring.
 - 3. Programming channels and assigned relay schedules

1.4 INFORMATIONAL SUBMITTALS

- A. Commissioning report, indicating compliance with commissioning requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of device include, operation, and maintenance manuals including part numbers.
- B. Commissioning tests and inspections: Provide proof of satisfactory completion of commissioning, include all test and result reports.
- C. Owner Training Video: Provide a video tape of the Owner training in digital form on video DVD's.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements of the drawings and specifications herein, provide a lighting control relay system by one of the following:
 - 1. GE

2. Nexlight
3. Hubbell
4. Wattstopper
5. LC&D
6. Marlin
7. Douglas
8. Additional manufacturers must submit for prior approval in writing a minimum of 2 weeks prior to bid opening in order to be considered.

- B. Basis-of-Design Product: Where a specific manufacturer is noted on the drawings it shall be used as the basis-of-design product and all other systems shall be subject to providing a complete system comparable to the basis of design. The A/E shall have sole discretion in determining and confirming the submitted system is “comparable” to the basis-of design product.

2.2 LIGHTING CONTROL RELAY PANELS

A. General Description:

1. Relay panels shall be UL listed.
2. Enclosures: Shall be NEMA 1, surface mount, and sized appropriately to house the specified quantity of relays and other equipment required for a complete relay control panel system. Cover shall have captive screws and a hinged, lockable door.
3. Power Supplies: Provide dual rated 120/277 VAC transformers with internal overcurrent protection and automatic reset metal oxide varistor surge protection. Power supply shall provide control power for the lighting control panel system and ancillary low voltage devices connected to the lighting control panel system. Size power supplies to handle the full load of all devices and equipment connected to the power supplies plus a minimum of 50% spare capacity.
4. Provide integral DIN rail mounting bar for mounting of other system components.
5. Provide on/off switches for both the panel and the dataline power.
6. Provide channels as indicated on the drawings with a minimum of 2 spare channels and in no case less than 8 total channels. Each channel shall include shall include a manual on/off switch and a terminal block for separate dry contact inputs.
7. The panel shall be configured such that any relay can be assigned to each channel with overlapping allowed. Channels shall be setup without the use of hand held programmers or remote keypads. Each channel shall include visible indication of channel state by use of LED lights that indicate the channel is on or off state.
8. The system shall be capable of future upgrades on site without removal of the panel.
9. Where indicated on the drawings, low voltage exterior photocells shall be provided and shall be connected to the lighting control relay system. Photocell shall be rated for outdoor use and shall be capable of monitoring light levels between 1-10 footcandles. provide input . Photocell shall be located facing north with an unobstructed view and be programmed with a 60 second delay to prevent false operation.

B. Relays:

1. Manufactureres: subject compliance with requirements of the drawings and specifications herein, provide relays by one of the following:
 - a. Allen-Bradley
 - b. ASCO Power Technologies
 - c. Eaton Corporation
 - d. General Electric Company
 - e. Square D
2. Shall be momentary pulsed, mechanically latching contactors, combination of single and 2-pole as indicated on drawings, sizes as indicated on drawings, rated to combination of voltages as indicated on drawings.

3. Each relay shall have a status indication LED light next to it indicating on/off state.

C. General Features:

1. Each channel button's dry control contact input terminal shall accept either 2 or 3-wire, maintained or momentary inputs. They shall also accept a 2-wire toggling input.
2. Each channel shall also have an associated 1 amp, 30 VDC isolated contact which may be used for status feedback or pilot light control.
3. The Relay Panel shall use an EEPROM to record the channel softwiring assignments and the current status of all relays, thus insuring a 40-year backup of information in the event of a power failure. Systems that require a chargeable battery with less than 10 year's life shall not be allowed.
4. The unit shall provide LED status indication of the power supply status. Access to 24VAC and 24V rectified power for accessory devices shall be provided within the panel.
5. Where multiple panels are indicated on the drawings, a single dataline shall be used for transferring control and status between relay panels. A primary panel shall serve as the main control panel with the other panel(s) setup as slave panels that are controlled and monitored from the primary control panel. The dataline shall also be capable of connecting timeclocks, switch modules, and other devices mounted within the interior of the primary or slave control panels. The dataline shall be capable of running up to 1,500 feet using #18 conductors.
6. Once the system parameters have been programmed, system shall allow any user-definable feature (schedules, relay groups, switch assignments) to be easily field modified by the Owner.
7. System shall include a Windows based configuration software for system commissioning, programming, monitoring, and control of the lighting control relay system.

2.3 SOFTWARED DATALINE SWITCHES

A. Description

1. To allow individual overrides, dataline switches shall be terminated to each panel's 4 wire "Local Dataline". Switches shall be available in either single, dual, quad, or octal (1 button, 2 button, 4 button, or 8 button) designs. The single, dual, and quad devices mount in a standard single gang box, while the octal version mounts in a two gang box. Button quantity shall be as indicated on the drawings.
2. Each button in a switch module can be individually programmed. Programming is done by a "Softwiring Sequence" rather than with a handheld keypad or laptop. Each button can be assigned to any one of the following four functions:
 - a. Control any individual relay in any single panel
 - b. Control any group of relays in any single panel
 - c. Control any of the eight channels (A-H) in a single panel
 - d. Control the same channel letter (A-H) in any chosen group of panels in the system.
3. For applications that require pattern switching, any button can perform its function using an "ON/OFF/Not Controlled" pattern of relays instead of the normal All ON/All OFF.
4. Each switch module shall use a bi-color LED pilot light for the individual buttons to indicate status of the controlled relay or group of relays. LED indications are Red for All ON, Green for Mixed State (some relays in the group ON and others OFF), and No LED for All OFF.
5. Switch shall also include a locator light.
6. Individual buttons shall have a removable clear cover to allow standard 3/8 inch tape to use for labeling the controlled loads. Each load shall be labeled.
7. The dual, quad, and octal switches shall all include a single master button that will override all relays controlled by the individual buttons OFF, or Restore them to their original state. Each switch unit's master button function can be configured to perform a "Master On/Off", "OFF Only", or "Disabled" function if desired.

8. Dip switches on the back of the module shall allow switch units to be designated for "Cleaning Crew" Control. This prevents the switch from turning off the occupant's lights accidentally.
9. Where the operation of a button on the switch overrides the lights into an "ON" state where they would normally be off, the system shall maintain the lights in the "ON" state for a period of 2 hours at which time they will return to their standard programming state.
10. Where indicated on the drawings provide switch modules in a Smart Keylock version. Once a key is inserted, the individual buttons will function for five minutes.

2.4 SOFTWIRED CLOCK

A. Description

1. Using the same dataline as mentioned above, provide a softwired timeclock. From any plug-in point on the dataline, timeclock can be used to:
 - a. Schedule any of the channel groups in the relay panel network
 - b. Program softwired dataline switches. Schedules are defined using "Occupied vs. Unoccupied" times to simplify data entry.
2. Timeclock shall include user-selectable intelligent scenarios to handle standard lighting control functions for each channel independently. Selectable scenarios shall include:
 - a. Scheduled ON / Scheduled OFF
 - b. Manual ON / Scheduled OFF
 - c. Astronomical ON / Astronomical OFF (with optional offset)
 - d. Astronomical ON / Scheduled OFF (with optional offset)
3. Each channel can be assigned a standard time delay from 1-256 minutes. During "Occupied" hours, the time delays do not take effect. During "Unoccupied" hours, the time delays will ensure that overridden lights are automatically turned off.
4. Each channel can be assigned an automatic "blinking" of the lights before they are turned off to allow occupants the opportunity to enter an override without being put in the dark. The time interval between the blink warn and "off" operation shall be user configurable between 1 and 15 minutes.
5. The timeclock will provide a clear multi-line, multi-character display and a simple user interface.
6. Timeclock to take into account leap year, daylight savings dates, holidays, and be certified as "Year 2000 Approved".

PART 3 - EXECUTION

3.1 IDENTIFICATION

- A. Identify components and power and control wiring using permanent engraved labels and schedules located on interior of lighting control panels."
 1. Identify controlled circuits in lighting relay panel
 2. Identify channels and channel control
 3. Identify relays associated with each channel
 4. Identify what loads are controlled by each low voltage switch button
- B. Label time switches and relays with a unique designation

3.2 COMMISSIONING

- A. Testing Agency: Contractor shall provide a factory trained and authorized representative for programming, inspection, testing, training, and fine tuning of the lighting relay control system.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing test each relay panel installation, relay, channel, timeclock system, remote switches, and daylight harvesting controls to confirm proper unit operation.
 - a. Relay panel: visually verify the system is installed correctly wired correctly, and contains all the correct components (including timeclock, daylight harvesting photocell control module, relays, processor, etc.).
 - b. Relays: test the manual on/off operation as well as the automatic operation by forcing the relay on through the programming system; visually verify each relay controls the proper light fixtures.
 - c. Channels: test the channels by confirming they have been programmed as indicated on the drawings and by forcing the channel on through the programming of the system; visually verify each channel controls the proper relays/lights.
 - d. Timeclock: test the operation of the timeclock by forcing the programming to turn the lights on and off. Visually verify that the timeclock programmed settings have been set properly.
 - e. Remote switches: test each remote switch by manually operating each button and visually verifying it turns the proper lights on and off. Verify that each button has a unique description label identifying the load it serves.
 - f. Daylight harvesting controls:
 - 1) Test the general operation of the daylight harvesting system by simulating high and low light levels situations.
 - a) Place a high intensity flash light directly into the photocell, confirm the proper lights are turned off
 - b) Cover the photocell so that no light reaches the photocell, confirm the proper lights are turned on
 - 2) Test the time delay of the system to confirm the proper delay specified herein is programmed prior to the switching of the lights on/off when high and low light levels were simulated.
 - 3) Test the specific operation of the daylight harvesting system by utilizing a footcandle meter to tune the daylight system footcandle setpoints, time delay, and deadband so that the light levels indicated on the drawings are maintained. Include the Owner in this initial tuning and make adjustments to ensure the system is providing light levels that are adequate for the Owner in each individual setpoint levels.
 - 2. Where any of the operational tests result in unsatisfactory results, make the required corrections and/or adjustments and re-test utilizing the same operational test. This process shall continue until satisfactory results are achieved.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Provide written record of operational test results indicating compliance and satisfactory results with the O&M manuals
- D. Provide written approval from the Owner and Commissioning agent indicated final approval of the lighting control relay system operation.
- E. Lighting control devices will be considered defective if they do not pass tests and inspections.

3.3 FINE TUNING AND ADJUSTING

- A. Within 6 months of Owner occupancy, the contractor shall provide fine tuning and adjustment of the lighting relay control system as directed by the Owner. The visit shall be scheduled upon request of the Owner within 2 weeks of written request. Fine tuning shall include on-site assistance.
 - 1. For daylighting controls, adjust set points, time delay, and deadband controls to suit Owner's operations.
 - 2. For channels, adjust settings, times, and operational control to suit Owner's operations.
 - 3. For relays, adjust channel operation of relays to suit Owner's operations.
 - 4. For remote switches, adjust programming of each button and relays controlled by each button to suit Owner's operations.
 - 5. For timeclock, adjust settings of timeclock to suit Owner's operations.

3.4 OWNER TRAINING & DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the lighting control panel system.
 - 1. Training shall be a minimum of 4 hours.
 - 2. Training shall include hands on training including adjustment, operation, and maintenance for the equipment.
 - 3. Training shall include a question and answer session.
 - 4. Training shall be videotaped, copies of the training shall be provided within the O&M manual submittal.

END OF SECTION 260923

DIVISION 31 - EARTHWORK

TABLE OF CONTENTS

SECTION	ITEM
311100	Site Clearing
312000	Earthwork
312500	Erosion and Sediment Control (APWA)

SITE CLEARING – SECTION 311100

NOTE – Red text was changed or ~~deleted~~ during bidding.

PART 1 - GENERAL

1.1 SUMMARY

- A. Scope of Work: This work shall consist of clearing, grubbing, removing, and disposing of trees noted, woody plant material, and debris as well as stripping of topsoil within the contract line specified by the plans and specifications. This work shall also include the preservation from injury or defacement of all trees, vegetation, and objects other than those designated for clearing.
- B. This work includes the following:
 - 1. Protecting existing trees, shrubs, groundcovers, plants, and grass to remain.
 - 2. Removing existing trees, shrubs, groundcovers, plants, and grass as indicated on demolition plan.
 - 3. Clearing and Grubbing
 - 4. Stripping and Stockpiling topsoil.
 - 5. Removing above- and below-grade site improvements.

1.2 RELATED DOCUMENTS:

- A. Related Sections include the following:
 - 1. Section 312000 Earthwork
 - 2. Section 329119 Fine Grading and Soil Preparation
 - 3. Section 312500 Erosion and Sediment Control

1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; free of subsoil and weeds, roots, toxic materials, or other non-soil materials.
- B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain, cleared materials shall become Contractor's property and shall be removed from project site.

1.5 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings,

adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

1.6 JOB CONDITIONS

- A. Traffic: Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.
- B. Protection of Existing Improvements: Provide protection necessary to prevent damage to existing improvements indicated to remain in place. Protect improvements on adjoining properties and on Owner's property.
- C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- E. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 – PRODUCTS

2.1 CONSTRUCTION FENCE

- A. Construction fence shall be 6' tall Chain Link Barrier Fencing as required to insure safe construction site.

2.2 METAL T POSTS

- A. Fence posts for mesh construction fencing shall be a 6' tall metal T Post.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Install construction fencing in areas indicated on the drawings and in accordance with the General Conditions
 - 1. Posts for Construction Fencing shall be spaced as required to support the fence.
- D. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to the owner.

3.2 EROSION AND SEDIMENTATION CONTROL

- A. Provide erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to Specification Section 312500 "Erosion and Sediment Control" and the requirements of authorities having jurisdiction. Erosion and sedimentation control measures shall comply with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever, is more stringent.
- B. Inspect, repair, and maintain erosion and sedimentation control during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 UTILITIES

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner's Authorized Representative not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions with Owner's Authorized Representative's written permission.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, stumps, roots, shrubs, concrete, asphalt, culverts, and other objectionable materials to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or be relocated.
 - 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 - 3. Grind Stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
 - 4. Use only hand methods for grubbing within tree protection zones.
 - 5. Remove tree branches and dispose of off-site.
- B. The contract limit line will establish clearing lines between which the ground shall be cleared of all materials as indicated above. No debris may be buried on the site.
- C. The Contractor shall dispose of all trees, stumps, roots, brush, concrete, asphalt, etc., from the premises in a manner satisfactory to the Owner's Authorized Representative.
- D. The Contractor shall thoroughly moisten all graded surfaces to lay the dust to rest before proceeding with other operations of the contract. He shall also make certain that the ground surface drains properly so as to avoid un-necessary puddling and standing water.

- E. Water truck shall be used to maintain reasonable dust control during clearing, grubbing, and grading operations.
- F. Clearing, grubbing, grading, and earth moving operations shall not continue during windy periods.
- G. During clearing and grubbing operations, the Contractor shall take care not to strip any topsoil except as specified.
- H. If any utility lines not shown on the plans are discovered during the clearing and grubbing operations, the Owner's Authorized Representative shall be notified immediately.
- I. Fill depression caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

- A. Remove woody plant material prior to stripping topsoil. Sod, grass, weeds, and herbaceous plant material only needs to be removed prior to stripping topsoil if herbaceous material is thick and dense and will not break up as part of stripping activities. The stripped topsoil shall be fine, clean topsoil free of large sod chunks or other plant material as determined by the Landscape Architect.
- B. **Stripping of topsoil is only required for quantities needed for planting soil mix and topsoil in accordance with the Planting Plan and specification section 329119 Soil Preparation and Fine Grading.** Strip topsoil in areas as needed to meet required quantities in accordance with the following priority areas:
 - 1. Areas requiring removal of topsoil for proper base preparation such as drives, parking lots, structures, paving, and sports courts
 - 2. Earthwork areas where cuts are expected to be deeper than topsoil depths
 - 3. Areas of significant fill where existing topsoil would be covered
 - 4. Other areas as approved
 - 5. Last resort for stripping of topsoil will be the future sports field areas at east end of property.
 - 6. **Contractor is responsible to verify adequate quantity of existing topsoil is stripped and stockpiled. If contractor does not strip and stockpile adequate quantities as required, contractor shall provide imported topsoil at no additional cost to the owner).**
- C. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
- D. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. **Location of topsoil stockpiles shall be approved by the Landscape Architect and Owner's Authorized Representative.** Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within tree protection zones.
3. Excess topsoil shall remain on-site.
4. Stockpile surplus topsoil on-site in location approved by Owner's Authorized Representative.

3.6 SITE IMPROVEMENTS

- A. Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction. Refer to project plans for improvements to be abandoned in place. Store and protect any improvements indicated for reuse in the project.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 1. Unless existing full-depth joints coincide with line of demolitions, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
 2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.7 DISPOSAL

- A. Disposal: Remove unsuitable topsoil, ~~fill material~~, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
 1. The Contractor shall remove all debris and materials from the premises weekly to prevent large accumulations and the potential of unhealthy conditions. Burning on-site will not be permitted.
 2. **Excess earthwork material that is suitable to for use as topsoil or fill material can be stockpiled on site. See drawings for proposed location of topsoil and earthwork stockpiles. All other materials shall be removed from the site and legally disposed.**

END OF SECTION 311100

EARTHWORK - SECTION 312000

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The General Documents, as listed on the Table of Contents, and applicable parts of Division 1, GENERAL REQUIREMENTS, shall be included in and made a part of this Section.
- B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SUMMARY

- A. Provide all equipment and materials, and do all work necessary to complete the earthwork which includes, but is not necessarily limited to the following:
 - 1. Unclassified excavation.
 - 2. Common trench excavation for piping and structures.
 - 3. Rock excavation.
 - 4. Fill materials, fill and compaction.
 - 5. Trench backfill.
 - 6. Drainage and dewatering as necessary to perform work in the dry.
 - 7. Rough grading.
 - 8. Removal of surplus or unsuitable excavated materials.
 - 9. Dust control.
 - 10. Preparation of subgrade for slabs, pavements, and landscaping.

1.3 RELATED WORK UNDER OTHER SECTIONS

- A. The following items of related work are specified and included in other Sections of the Specifications:
 - 1. Section 312500 - Erosion and Sediment Control
 - 2. Section 329119 - Soil Preparation and Fine Grading

1.4 REFERENCES

- A. The following standards shall apply to the work of this Section.
 - 1. Associated General Contractors of America, Inc. (AGC): Manual of Accident Prevention in Construction
 - 2. American Society for Testing and Materials (ASTM):
 - a. C 33 Concrete Aggregates
 - b. C 136 Sieve Analysis of Fine and Coarse Aggregates
 - c. D 422 Particle-Size Analysis of Soils
 - d. D 448 Classifications for Sizes of Aggregate for Road and Bridge Construction
 - e. D 698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 - f. D 1556 Density of Soil In-Place by the Sand Cone Method
 - g. Compaction Standard: Modified Proctor Density ASTM D1557
 - h. D 2167 Density and Unit Weight of Soil In-Place by the Rubber Balloon Method
 - i. D 2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - j. D 2922 Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
 - k. D 2937 Density of Soil In-Place by the Drive-Cylinder Method

- I. D 2940 Specification for Graded Aggregate Material For bases or Sub-bases for Highways or Airports
 - m. D 3017 Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
 - n. D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 - o. D 4491 Test Methods for Water Permeability of Geotextiles by Permittivity
 - p. D 4632 Test Method for Grab Breaking Load and Elongation of Geotextiles
 - q. D 4751 Test Method for Determining the Apparent Opening Size of a Geotextile
 - r. D 4759 Practice for Determining the Specification Conformance of Geosynthetics
 3. American Association of State Highway and Transportation Officials (AASHTO)
 4. American Public Works Association (APWA) Manual of Standard Specifications and Standard Plans, 2007 Edition.

1.5 SUBMITTALS

- A. Soil Samples: A 70 lb. (31.85 kg) sample of each off-site material proposed for use, and of any on-site material when so requested by the Owner's Authorized Representative or testing laboratory, shall be submitted for approval.
 1. Samples shall be delivered to the office of the Landscape Architect or testing laboratory, as directed.
 2. Samples required in connection with compaction tests will be taken by and transported to the testing laboratory.
- B. Product Data: Submit product data for the following:
 1. Filter fabric.
- C. Material Samples: Submit samples of the following:
 1. 12 in. x 12 in. sample of filter fabric.
- D. Test Reports: In addition to test reports required under the Paragraph, Quality Control Testing Requirements of Part 1, submit the following:
 1. Mechanical gradation (sieve analysis) of each soil material proposed for fill and backfill from on-site materials and off-site borrow sources. Mechanical gradation shall be performed on off-site sources of fill and backfill materials using the same sieves as the materials specified. Mechanical gradation shall be performed on on-site fill and backfill materials using the same sieves or testing procedures as would be required for off-site borrow materials for which the on-site materials are proposed to replace.
 2. One optimum moisture-maximum density curve for each soil material.

1.6 QUALITY CONTROL TESTING REQUIREMENTS

The Owner will provide Quality Control Testing through an independent testing agency and shall conform to the following:

- A. Field in-place density tests shall be performed according to ASTM D 6938, ASTM D 1556, ASTM D 2167, or ASTM D 2937, as applicable. Testing laboratory shall submit test results directly to the Owner's Authorized Representative for review and acceptance.
 1. Paved Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 10,000 sq. ft. or less of paved area, but in no case fewer than three tests as directed by the Owner's Authorized Representative.

2. Fills and Embankments: For each 500 cubic yards or fraction thereof per shift, perform at least one field in-place density test as directed by the Owner's Authorized Representative.

B. When subgrade, fills or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained.

C. Testing of soils shall be in accordance with the following:

<u>Property</u>	<u>ASTM Test Method</u>
Particle - Size Analysis	D 422
Liquid Limit	D 4318
Plasticity Index	D 4318

D. The Owner reserves the right to modify or waive testing laboratory services.

1.7 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.

B. Comply with applicable requirements of NFPA 495.

C. Pre-installation Conference: Before commencing earthwork, meet with representatives of the governing authorities, Owner, Landscape Architect, consultants, geotechnical engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least three working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

D. Compliance: Comply with local safety regulations and with provisions of "Accident Prevention in Construction" published by the Associated General Contractors of America, Inc.

1.8 EXAMINATION OF EXISTING CONDITIONS

A. The Contractor shall become thoroughly familiar with the existing conditions of the site, consult records and drawings of adjacent structures and of existing utilities and their connections, and note all conditions which may influence the work of this Section.

- Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Owner's Authorized Representative and then only after acceptable temporary utility services have been provided.
- Provide a minimum 48-hours' notice to the Owner's Authorized Representative and receive written notice to proceed before interrupting any utility.

B. The Contractor may, at his own expense, conduct additional subsurface testing as required for his own information.

1.9 INFORMATION NOT GUARANTEED

A. Information on the Drawings and in the Specifications relating to subsurface conditions, natural phenomena, and existing utilities and structures is from the best sources presently available. Such information is furnished only for the information and convenience of the Contractor, and the accuracy or completeness of this information is not guaranteed.

B. Plans, surveys, measurements, and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the

bidding period, as no additional compensation will be made for errors and inaccuracies that may be found therein.

1.10 PERMITS, CODES, AND SAFETY REQUIREMENTS

- A. Comply with all rules, regulations, laws and ordinances of the City or County or State, and all other authorities having jurisdiction over the project site. All labor, materials, equipment and services necessary to make the work comply with such requirements shall be provided by the Contractor without additional cost to the Owner.
- B. Comply with the provisions of the Manual for Accident Prevention in Construction of the Associated General Contractors of America, Inc., and the requirements of the Occupational Safety and Health Administration, United States Department of Labor.
- C. The Contractor shall procure and pay for all permits and licenses required for the complete work specified herein and shown on the Drawings.
- D. The Contractor shall not close or obstruct any street, sidewalk, or passageway without written permission from authorities having jurisdiction. The Contractor shall so conduct his operations as to interfere as little as possible with the use ordinarily made of roads, driveways, or other facilities near enough to the work to be affected thereby.
- E. The Contractor shall secure a Blue Stakes permit number for the project to certify notification of gas, electrical and telephone utilities. All other affected utilities shall be contacted by the Contractor, who shall secure notification. Contractor shall not commence work until Blue Stakes has responded. The work shall then be performed in such a manner, and with reasonable precaution taken to avoid damage to utilities under the surface in said areas of the work.

1.11 LAYOUT AND GRADES

- A. Benchmarks: The Contractor shall establish, maintain and/or reestablish benchmarks and survey monuments necessary for the work of these Contract Documents and as shown on the Drawings or found to exist on the site to provide a base reference for the construction. Replace any which may become destroyed or disturbed. The Contractor shall employ and pay all costs for a registered Civil Engineer or Surveyor who is licensed within the jurisdiction of the project site to lay out all lines and grades in accordance with the Drawings and Specifications, and as necessary or required for the construction. The selection of the registered Civil Engineer or Surveyor shall be subject to the Owner's Authorized Representative's approval.

1.12 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

- A. Observe all rules and regulations governing the respective utilities in executing work under this Section. The work shall be executed in such manner as to prevent any damage to adjacent property and any other property and existing improvements such as, but not limited to: streets, curbs, paving, utility lines and structures, monuments, bench marks and other public and private property. Protect existing structures and foundations from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. In case of any damage or injury caused in the performance of the work, the Contractor shall, at his own expense, make good such damage or injury to the satisfaction of, and without cost to the Owner. Existing roads, sidewalks, and curbs damaged during the project work shall be repaired or replaced to their original condition at the completion of operations. The Contractor shall replace, at his own cost, existing bench marks, monuments, and other reference points which are disturbed or destroyed.

- C. Buried structures, utility lines, etc., including those which project less than 18 in. above grade, which are subject to damage from construction equipment shall be clearly marked to indicate the hazard. Markers shall indicate limits of danger areas, by means which will be clearly visible to operators of trucks and other construction equipment, and shall be maintained at all times until completion of Project.
- D. Locate and mark underground utilities to remain in service before beginning the work. Protect all existing utilities to remain during operations. Do not interrupt existing utilities except when authorized in writing by authorities having jurisdiction.
- E. When an active utility line is exposed during construction, its location and elevation shall be plotted on the Record Drawing by the Contractor and both the Owner's Authorized Representative and the Utility Owner shall be notified in writing.
- F. Provide barricades, fences, lights, signs, and all other safety devices required for the protection of the public.

1.13 DEFINITIONS

- A. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.
- B. Drainage Fill: Course of washed granular material supporting slab-on-grade placed to cut off upward capillary flow of pore water.
- C. Embankment: Any area on the site where the Contractor is required to raise grades to proposed subgrade elevations. Embankments are placed in layers to a predetermined elevation and cross section.
- D. Excavation: The removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.
- E. Finish Grade: Final grade elevations indicated on the Drawings. Spot elevations shall govern over proposed contours. Where not otherwise indicated, project site areas shall be given uniform slope between points for which finished grades are indicated or between such points and existing established grades. Spot elevations shall govern over proposed contours. No ponding of surfaces shall be allowed due to lack of improper pitches across surfaces that will not allow proper drainage to occur.
- F. Rock: A sound and solid mass, layer, or ledge of mineral matter in place of such hardness and texture that it:
 - 1. Mechanical Definition of Rock: Cannot be effectively loosened or broken down by ripping in a single pass with a late model tractor-mounted hydraulic ripper equipped with one digging point of standard manufacturer's design adequately sized for use with and propelled by a crawler type tractor rated between 210- and 240-net flywheel horsepower, operating in low gear, or
 - 2. Manual Definition of Rock: In areas where the use of the ripper described above is impracticable, rock defined as sound material of such hardness and texture that it cannot be loosened or broken by a 6 lb. (2.7 kg) drifting pick. The drifting pick shall have a handle not less than 34 in. (0.86 m) in length.
- G. Base Course: The layer placed between the subgrade and surface pavement in a paving system.
- H. Rough grade: The top surface of subbase or base courses such as gravel, crushed stone, ordinary fill, etc., ready to receive the final surface material application. Unless stated otherwise, all rough grades shall represent compacted material depths, as specified herein.

- I. Soil: All earth materials, organic or inorganic, which have resulted from natural processes such as weathering, decay, and chemical action of *in situ* rock or the deposition of unconsolidated material in which more than 35 percent by weight will pass a No. 200 sieve.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.
- K. Subbase Course: The layer placed between the subgrade and base course in a paving system or the layer placed between the subgrade and surface of a pavement or walk.
- L. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below road base, drainage fill, or topsoil materials.
- M. Topsoil: The upper layer of the soil profile which is supporting the growth of vegetation as evidenced by the existence therein of numerous roots and other organic matter.
- N. Unauthorized excavation: Removing materials beyond indicated subgrade elevations or dimensions without direction by the Owner's Authorized Representative. Unauthorized excavation, as well as remedial work directed by the Owner's Authorized Representative, shall be at the Contractor's expense.
- O. Unsuitable Material: Material which is classified as "unsuitable" shall be material having at least one of the following properties:
 - 1. Material with a maximum unit dry weight per cubic foot less than 90 lb. (40.9 kg) as determined by ASTM D 1557.
 - 2. Material containing visible organic matter, topsoil, organic silt, peat, construction debris, roots, and stumps.
 - 3. Material which has a Liquid Limit greater than 55 when tested in accordance with ASTM D 4318.
 - 4. Material designated in the field by the Owner's Authorized Representative or the testing laboratory.
- P. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.
- Q. Utility Trench Backfill: The area bounded by the proposed finished subgrade and the cover material over the respective pipe or conduit. This material shall conform with applicable requirements for embankment or structural backfill depending on the area or zone into which the utility is installed.

1.14 COORDINATION

- A. Prior to start of earthwork the Contractor shall arrange an on-site meeting with the Owner's Authorized Representative for the purpose of establishing Contractor's schedule of operations and scheduling inspection procedures and requirements.
- B. As construction proceeds, the Contractor shall be responsible for notifying the Owner's Authorized Representative prior to start of earthwork operations requiring inspection and/or testing.
- C. In the event that the Contractor does not notify the Owner's Authorized Representative prior to the start of earthwork operations and inspections and tests are not made or performed by the Owner's testing agents, the Owner's Authorized Representative may require the Contractor to remove all earthwork performed without the necessary inspections and replaced under the required supervision, review, inspections or tests at no additional cost to the Owner.

- D. The Contractor shall be responsible for obtaining test samples of soil materials proposed to be used and transporting them to the site sufficiently in advance of time planned for use of these materials for testing of materials to be completed. Use of these proposed materials by the Contractor prior to testing and approval or rejection, shall be at the Contractor's risk.

1.15 RECORD DRAWINGS

- A. The Contractor shall submit to the Owner a set of as-built drawings for work covered under these Specifications. The drawings shall be prepared upon reproducible copies of the Contract Documents supplied by the Owner. As-built drawings shall record all changes made during construction with respect to materials, layout, grading contours and spot elevations, all as compared to the original Contract Drawings.

1.16 WARRANTY

- A. Fill and Backfill: Correct settlement in backfill, fill, and in structures built over backfill or fill, which may occur within one year correction period. Restore structures damaged by settlement to original condition at no additional cost to the owner.

PART 2 PRODUCTS

2.0 GEOTECHNICAL REPORT

- A. **A Geotechnical Report has been provided for the site and is included in the Appendix to these Technical Specifications. The Geotechnical Report provides specific recommendations related to the earthwork for the site. The recommendations from the Geotechnical Report shall supersede any requirements outlined in this specification. Any work that is not covered or addressed by the Geotechnical Report shall conform to this specification. If any conflicts or discrepancies arise, the more stringent of the two shall apply.**

2.1 SOURCE OF MATERIALS

- A. Material shall be obtained from required on-site excavation, to the extent that suitable material is available, and from off-site sources, to the extent that suitable material is not available from on-site excavation.

2.2 SOIL MATERIALS

- A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations. Gradation requirements shall be determined by AASHTO T11 and T27.
 - 1. Borrow material that shall come from on-site or off-site sources shall contain salt levels less than 1.0 milliohms/com as measured by electrical conductivity (EC2) of a 1:2 soil-water suspension (Test minus sieve #4 material).
- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 in. (50 mm) in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
- D. Backfill and Fill Materials: Satisfactory soil materials as described above. On-site material for use in compacted backfill shall be natural, inorganic, granular soil, taken from areas of

excavation after stripping of topsoil and removal of unsatisfactory soil materials as described above.

- E. Use only backfill materials meeting the requirements of satisfactory soil materials that are free from rocks greater than 4 in. (200 mm) in diameter or length, that have largest dimension no greater than 3/4 lift thickness, or are no greater than 1/2 ft.3 in volume. Do not use any foreign matter, such as construction debris, trash, wood, roots, leaves, sod, organic matter, or soft clay and silt. Sound pieces of building stone, masonry, and concrete from on-site sources subject to the same size limitations as stone, may be employed in backfill. Individual pieces shall be mixed into general backfill material, leaving no voids between pieces. Backfill shall be clean, non-organic material, of non-swelling character, capable of being readily compacted to form a solid, stable embankment. Materials containing ice or frozen lumps shall not be employed.
- F. All soil material shall conform to the Geotechnical Report (provided as an appendix to the project manual).

2.3 FILL AND BACKFILL MATERIAL

- A. Uses of Fill Materials: Fill materials listed above or as specified in APWA Section 321123 Crushed Aggregate Base and shall be utilized as follows and as otherwise indicated on the Drawings, specified or directed (and as specified in the Geotechnical Report).

1. TYPE A:

Type A material may be used under concrete sidewalks, with a maximum uncompressed layer depth of 6” and a minimum relative compaction of 95%. Type A material shall be a clean gravel-sand mixture free from organic matter and shall conform to the following gradation:

<u>U.S. standard sieve size</u>	<u>Percent by weight passing</u>
1-inch	100
3/4-inch	90-100
No. 4	35-65
No. 16	15-40
No. 200	2-10

2. TYPE B:

Type B material may be used for bedding pipe, initial and subsequent pipeline backfill, with a maximum uncompressed layer depth of 8” and a minimum relative compaction of 95%. Type B material shall be a select granular material free from organic matter and of such size and gradation that the specified compaction can be readily attained. Material shall have a sand equivalent value of not less than 30 and shall conform to the following gradation:

<u>U.S. standard sieve size</u>	<u>Percent by weight passing</u>
3/8-inch	100
No. 4	90-100
No. 50	10-40
No. 100	3-15
No. 200	0-7

3. TYPE C:

Type C material may be used as site fill, embankments, dikes, initial and subsequent pipeline backfill, with a maximum uncompressed layer depth of 8” and a minimum relative compaction of 95%. Type C material shall be unclassified material and may be obtained from excavation on site. The material shall be free from peat, wood, roots, bark, debris, garbage, rubbish or other extraneous materials. The maximum size of stone shall not exceed 6 inches.

4. TYPE D:

Type D material may be used as fill under slabs and structures, with a maximum uncompressed layer depth of 8” and a minimum relative compaction of 95%. Type D material shall be crushed rock commonly known as drain rock and shall conform to the following gradation:

<u>U.S. standard sieve size</u>	<u>Percent by weight passing</u>
1-1/2-inch	100
3/4-inch	30-75
1/2-inch	15-55
1/4-inch	0-5
No. 200	0-2

Type D material shall be composed of hard, durable, sound pieces having a specific gravity of not less than 2.65.

5. TYPE E:

Type E material may be used as structural fill, fill under concrete sidewalks, with a maximum uncompressed layer depth of 12” and a minimum relative compaction of 95%. Type E material shall be crushed rock and shall conform to the following gradation:

<u>U.S. standard sieve size</u>	<u>Percent by weight passing</u>
1-1/2-inch	100
3/4-inch	81-91
1/2-inch	67-77
No. 4	43-53
No. 16	23-29
No. 200	6-10

Type E material shall be composed of hard, durable, sound pieces having a specific gravity of not less than 2.65.

- B. Fill material shall be placed in horizontal layers and compacted with power operated tampers, rollers, idlers, or vibratory equipment. Unless otherwise specified, fill classes shall be used where specified as noted above under general application. Compaction of layers shall be accomplished in two passes of equipment with complete coverage across the width of the field.

2.4 CLASSIFICATION OF FILL

- A. Fill material shall be placed in horizontal layers and compacted with power operated tampers, rollers, idlers, or vibratory equipment. Material type, maximum layer depth, relative compaction, and general application are specified in Table A. Unless otherwise specified, fill classes shall be used where specified in Table A under general application.

Table A, Fill Classifications

Material Type	Maximum Uncompressed Layer Depth, Inches	Minimum Relative Compaction, Percent	General Application
A	6	95	Under concrete sidewalks
B	8	95	Bedding for pipe, initial and subsequent pipeline backfill
C	8	95	Site fill, embankments, dikes, initial and subsequent pipeline backfill.
D	8	95	Fill under slabs and structures
E	12	95	Structural fill, fill under concrete walkways

Compaction of layers shall be accomplished in two passes of equipment with complete coverage across the width of the field.

2.5 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility.
- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 in. (760 mm) deep.
 - 1. Tape Colors: Provide tape colors to utilities as follows:
 - a. Red: Electric.
 - b. Yellow: Gas, oil, steam, and dangerous materials.
 - c. Orange: Telephone and other communications.
 - d. Blue: Water systems.
 - e. Green: Sewer systems.
- C. Filter Fabric: Manufacturer's standard non-woven pervious geotextile fabric of polypropylene, nylon or polyester fibers, or a combination.
 - 1. Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D 4759 and the referenced standard test method in parentheses:
 - a. Grab Tensile Strength (ASTM D 4632): 100 lb.
 - b. Apparent Opening Size (ASTM D 4751): No. 100 U.S. Standard sieve.

- c. Permeability (ASTM D 4491): 150 gallons per minute per sq. ft.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site Visit: Visit and inspect site; take into consideration known and reasonably inferable conditions affecting work. Failure to visit site will not relieve Contractor of furnishing materials and performing work required.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect subgrade and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways in accordance with the provisions of Section 312500, Erosion and Sedimentation Control.

3.2 GRADES AND ELEVATIONS

- A. The Drawings indicate, in general, alignments, grade elevations and invert elevations. Establish the lines and grades in conformity with the Drawings. The Landscape Architect, however, may make such adjustments in the field in grades and alignments as are found necessary in order to avoid interference with any special conditions encountered.
- B. Spot elevations shall govern over proposed contours. Where not otherwise indicated, project site areas shall be given uniform slopes between points for which finished grades are indicated or between such points and existing established grades.
- C. Establish and maintain suitable stakes over all areas to be graded as directed, specified or required, and/or noted on the drawings. Maintain sufficient reference points at all times during construction to properly perform the contract installation

3.3 UNCLASSIFIED EXCAVATION

- A. The work of excavation shall be conducted at such locations, at such rates of progress and in such a manner as will ensure the continued progress of the work, with a minimum inconvenience to the general public.
- B. All material encountered during excavation shall be unclassified excavation and shall include the removal of boulders up to 3 cubic yards, earth, rock, concrete, covered pavements, abandoned utilities, abandoned foundations and all material encountered as required for excavation. Boulders and rock over 3 cubic yards shall be covered under "Rock Excavation" in this Section. The sequence of all excavation operations shall be such as to ensure the most efficient reuse of acceptable excavated borrow materials for particular improvement application. Acceptable materials shall be used or stockpiled for later use in backfill and subgrade preparation.
- C. Excavate all materials to the elevations, dimensions and form as shown on the Drawings and as specified for the construction of drainage structures, utilities, lawn and site improvements necessary for the completion of the utilities and site work. Excavate to elevations indicated or

required within a tolerance of plus or minus 0.10 foot and as will allow footings to rest on firm, undisturbed earth or rock, free of loose materials, and as will permit rough grades to be at indicated or specified depths. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction, and for inspections.

- D. Trench Excavation: If the Contractor encounters unsuitable soils materials at the specified depths during trench excavation, he shall contact the Owner's Authorized Representative and request instructions from the Geotechnical Engineer before proceeding further.
1. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
 - a. Clearance: 12 inches each side of pipe or conduit, unless otherwise noted or specified.
 2. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to avoid point loading.
 - a. For pipes or conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - b. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 - c. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches below invert elevation to receive bedding course.
- E. Hand Excavation: In general, machine excavation will be permitted with the exception of work in the vicinity of trees to remain, existing utilities and excavation of pipe bells which will be hand work. Excavate to 6 inches below the bottom of pipe or as shown on Drawings. Excavation to final grade shall be made in such a manner as to maintain the undisturbed bearing character of the soil exposed at the excavation level.
- F. Inspection: After completion of the excavation and prior to commencement of foundation footings, pavements and concrete slab construction, the excavation will be inspected by the Owner's Representative to ensure that foundation elevations have been reached.
- G. Stockpiling: No excavation shall be deposited or stockpiled at any time so as to endanger portions of the new construction or layout, either by direct pressure or indirectly by overloading banks contiguous to the operation. Stockpile soil materials away from edge of excavations. Material, if stockpiled, shall be stored so as not to interfere with the established sequence of the construction. If there is not sufficient area available for stockpiling within the limits of the project, the Contractor will be required to furnish his own area for stockpiling, and for moving the material back and forth from the storage area, at no additional cost to the Owner. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind-blown dust.
- H. Compliance: Comply with local safety regulations and with provisions of "Accident Prevention in Construction," published by the Associated General Contractors of America, Inc.

3.4 ROCK EXCAVATION

- A. Rock excavation includes removal and disposal of rock material and obstructions encountered that cannot be removed by the following heavy-duty rock excavating equipment without systematic drilling, blasting, or ripping.

1. Rock excavating equipment for footings, trenches, and pits shall be equivalent to Caterpillar Model No. 215D LC track-mounted hydraulic excavator, equipped with a 42-inch-wide short-tip radius rock bucket, rated at not less than 120-hp flywheel power with bucket-curling force of not less than 25,000 pounds and stick-crowd force of not less than 18,700 pounds measured according to SAE Standard J1179.
2. Rock-excavating equipment for open excavations shall be equivalent to Caterpillar Model No. 973, heavy-duty, track-mounted loader, rated at not less than 210-hp flywheel power and developing minimum of 45,000-lb breakout force, measured according to SAE Standard J732c-69.
 - a. Excavations more than 10 feet in width and pits more than 30 feet in either length or width are defined as open excavations.

B. Measurements:

1. When, during the process of excavation, rock or boulders larger than 3 cubic yards in volume and rock in beds, ledges, unstratified masses, and conglomerate deposits is encountered, such material shall be uncovered and exposed, and Owner's Authorized Representative shall be notified by the Contractor, before proceeding further. The areas in question shall be cross-sectioned as specified in this Section. * (To the best of the Landscape Architect's knowledge there should be no rock encountered.) * Rock excavation and removal of rock or boulders over 3cubic yards in size shall be paid for as a Unit Price under Part 1 of this Section.
2. Failure on the part of the Contractor to uncover such material and to notify the Owner's Authorized Representative, and proceeding by the Contractor with the excavation before cross-sections are taken, will forfeit the Contractor's right to any credits.
3. The Contractor shall employ and pay for an approved registered Civil Engineer or Land Surveyor to take cross-sections of rock before removal and to make computations of rock quantities. Cross-sections shall be taken in the presence of the Testing Laboratory. The Owner has the option to perform independent cross-sections and computations of rock quantities.
4. Where removal of boulder or ledge is required outside the established payment lines, the extent of this removal and basis of payments shall be determined by the Owner's Authorized Representative.

3.5 CONTAMINATED MATERIAL

- A. If, during the course of excavation or other performance of the Work, materials on the project are encountered which may be contaminated or hazardous, stop work immediately and notify the Owner within one hour of the discovery. Follow up telephone conversation with written correspondence hand delivered within 24 hours of discovery.

3.6 FILLING, BACKFILLING AND COMPACTION

A. Placing Fills and Compacting:

1. Preparation: All areas to be filled or backfilled shall be free of vegetation, topsoil, wet materials, unsatisfactory soil materials, obstructions, deleterious materials, construction debris, refuse, compressible or decayable materials and standing water from ground surface prior to placing fills. Do not place fill when fill materials or material below it are frozen. No fill materials containing ice or frozen lumps shall be used.
 - a. Plow, furrow, till or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.
 - b. Distribute material to avoid formation of lenses or layers of material differing substantially from surrounding work.
2. Remove all concrete formwork, temporary shoring, bracing, and sheeting prior to inspection by the Owner.

3. The Contractor shall notify the Owner when excavation is ready for formal inspection. Filling and backfilling shall not be started until conditions have been approved by the Owner's Authorized Representative.
4. At the completion of excavation and before placing any fills, proof-roll compact subgrades to the same compaction levels required for placed fills as required hereinafter
 - a. Notify Owner's Authorized Representative when excavations have reached required subgrade.
 - b. When test results determine that unforeseen unsatisfactory soil is present, stop excavation work immediately and contact the Owner's Authorized Representative to determine whether or not to continue excavation and replace the unsatisfactory soil with compacted backfill or fill material as directed by the Owner's Authorized Representative.
5. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in work.
6. Reconstruct subgrade damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Owner's Authorized Representative.
7. Subgrade compaction shall be tested by the testing laboratory before proceeding further.
8. All fill is to be placed "in-the-dry", to which end dewatering may be required. Spreading and drying of each layer may also be required. Dewatering, as necessary, shall be a part of the work of this Section and shall be done at no additional cost to the Owner.
9. Conversely, if the testing laboratory determines that the fill is too dry for proper compaction, water shall be added, as necessary, to provide the specified optimum moisture content for proper compaction.
10. Compaction of each lift shall be as specified herein and as determined by ASTM Test, Designation D6938. Fill shall be placed in successive horizontal lifts no thicker than 6 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Compact fill to the required density as specified in this Section. Maximum dry density shall be determined in accordance with ASTM D1557, Method D. The following percentages of maximum dry densities shall be achieved for fill materials or prepared subgrades.
11. Under structures, footings, paved surfaces, drainage piping, utilities and other improvements:
 - a. All fills - 95%
 - b. Top twelve inches of subgrades in cut - 95%
 - c. Fills within lawn and planting areas to within eighteen inches of finished subgrade – 85%
 - d. Fills within lawn and planting areas in top eighteen inches of finished grade – 85%
12. Place and compact backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.
13. In the case of lawn and planting areas, compaction requirements for subgrades and fills shall be considered minimums and maximums within the density percentages called for, and any over-compaction of subgrades or fills which would be detrimental to lawn or planting objectives shall be corrected by loosening subgrades or fills through tilling or other means and re-compacting to specified compaction limits.
14. The Contractor shall notify the Owner's Authorized Representative 3 days in advance when the rough grades are established and ready for formal inspection. No loam shall be placed on rough grades before inspection by the Owner's Authorized Representative.

3.7 BACKFILLING OF TRENCHES AND STRUCTURES

- A. All requirements for description, placement, compaction and spreading of fill materials as specified in this Section shall be applicable to backfilling operations for trenches and structures. If the Contractor encounters unsuitable soils materials at the specified depths during trench excavation, he shall contact the Owner's Authorized Representative and request instructions before proceeding further.

- B. Backfill materials as specified in this Section shall be used as bedding and backfill around drainage pipes, around structures and for other uses as shown on the Drawings.
- C. Approvals Prior to Backfilling: Do not commence backfilling operations for trenches and structures until all piping, etc., has been installed, tested and approved, and the locations of all pipe and appurtenances have been recorded.
- D. Placement in Trenches: Bedding materials as specified shall be placed to the full width of the trench as indicated on the Drawings. Place and compact bedding course on rock and other unyielding bearing surfaces. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. After a pipe is bedded, the trench shall be filled to the centerline of the pipe with additional bedding material as specified except at the joint. After the joint is inspected, that portion shall be filled in. Material under and around the pipe shall be carefully and thoroughly compacted to the densities specified in this Section.
- E. From the centerline of the pipe to a point 12 inches above the top of the pipe place additional bedding material as backfill by hand and compact with mechanical tampers to not less than 95% of maximum density at optimum moisture content of the material. Above this point, backfill shall be placed by machine or by hand in layers 6 inches deep and compacted to the densities specified in this Section. This backfill shall be extended as shown on the Detail Drawings. Backfill simultaneously on all sides of pipe or structure. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- F. Coordinate backfilling with utilities testing.
- G. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
- H. Place and compact final backfill of satisfactory soil material to final subgrade.
- I. Compaction requirements: Compact each layer by methods acceptable to Geotechnical Engineer with +/- 2 percent of optimum moisture content to minimum of following relative Proctor densities as determined by ASTM D1557.
- J. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.
- K. Once subgrade is compacted the Contractor shall place the geotextile/filter fabric in locations as shown on the Contract Drawings. The fabric shall overlap at seams by 6 inches and shall be laid flat prior to having gravel base material placed over the fabric. Fabric shall be placed in accordance with Manufacturer's instructions and recommendations.

3.8 STABILITY OF EXCAVATIONS

- A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.

3.9 ROUGH GRADING

- A. Rough grading shall include the shaping, trimming, rolling, and refinishing of all surfaces of the subbase and base courses, shoulders, and earth slopes in preparation for final, finish grading of pavements, loams and site improvements as shown on the Drawings. The rough grading of shoulders and sloped areas may be done by machine methods. All ruts shall be eliminated. Traffic of men and equipment across soil subgrade areas shall be prohibited following excavation to the required lines and grades.
 - 1. Shape subbase and base courses to required crown elevations and cross-slope grades.

2. When thickness of compacted subbase or base course is 6 inches or less, place materials in a single layer.
 3. When thickness of compacted subbase or base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.
- B. If, during the progress of the Work, any pipe, drain or other construction is damaged due to operations under this Contract, the Contractor shall repair all damage at no additional cost to the Owner and restore damaged areas to their original conditions.
- C. Do all other cutting, filling and grading to the lines and grades indicated on the Drawings. Grade evenly to within the dimensions required for grades shown on Drawings and as specified herein. No stones larger than 3 inches in largest dimension shall be placed in upper 6 inches of the subgrade. Fill shall be left in a compacted state at the end of the workday and sloped to drain.
- D. Slope grades to direct water away from buildings and to prevent ponding. Rough grade to required elevations within the following tolerances:
1. Lawn or Unpaved Areas: Plus or minus 0.10 foot.
 2. Paved Areas: Plus or minus 0.05 foot.
- E. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders at least 12 inches wide of acceptable soil materials and compact simultaneously with each subbase course and base course layer.
- F. The Contractor shall bring all areas to grades as shown on the Drawings and in the details. The Landscape Architect, however, may make such adjustments in grades and alignments as are found necessary to avoid special conditions encountered.
- G. No rubbish of any description shall be allowed to enter fill material. Such material shall be removed from the site.
- H. Wherever streets, lawns, or sidewalks or other items contained within or outside the Limit of Contract lines have been excavated in fulfilling the work required under this Contract, the Contractor shall furnish and install all materials necessary to bring finish surfaces level with the existing adjacent surfaces. All work shall be installed to match the existing conditions in accordance with the governing authority. Notify the proper authorities prior to restoring surfaces outside the Contract Limit Lines.
- I. Fill materials that become contaminated shall be removed and replaced, as directed by the Owner's Authorized Representative.
- J. Contractor shall clean the subgrade of all stones greater than 2 inches and all debris and rubbish.

3.10 REMOVAL OF SURPLUS AND UNSUITABLE MATERIALS

- A. Any surplus of excavated suitable fill material or topsoil shall not be removed from the site. Surplus off-site borrow materials not required to complete site construction and unsuitable excavated materials shall, unless directed otherwise by the Owner's Authorized Representative, become the property of the Contractor who shall remove such materials from the site and legally dispose of it at no additional cost to the Owner.

3.11 DRAINAGE, DEWATERING

- A. The Contractor shall control the grading in areas under construction on the site so that the surface of the ground will properly slope to prevent accumulation of water in excavated areas and adjacent properties. Prevent surface water and subsurface or ground water from entering

excavations, from ponding on prepared subgrade, and from flooding Project site and surrounding area. The Contractor shall grade and ditch the site as necessary to direct surface runoff away from open excavations and subgrade surfaces. Positive drainage (minimum 1.0 percent slope) shall be maintained at all times.

- B. Protect subgrade and foundation soils from softening and damage by rain or water accumulation.
- C. Should surface water, rain, or groundwater be encountered during the operations, the Contractor shall furnish and operate pumps or other equipment, and provide all necessary piping to keep all excavation clear of water at all times and shall be responsible for any damage to work or adjacent properties from such water. All piping exposed above surface for this use shall be properly covered to allow foot traffic and vehicles to pass without obstruction.
- D. Water from trenches and excavations shall be disposed of in such a manner as will not cause injury to public health nor to public or private property, nor to existing work, nor to the work completed or in progress, nor to the surface of roads, walks, and streets, nor cause any interference with the use of the same by the public. Methods of disposal of pumped effluent shall not cause erosion or siltation. Comply with Section 312500, Erosion and Sediment Control.
- E. There shall be sufficient pumping equipment, in good working order, available at all times to remove water.
- F. Presence of ground water in soil will not constitute a condition for which an increase in the Contract price may be made.
- G. Under no circumstances place fills, pour concrete, or install piping and appurtenances in excavations containing free water.
- H. Where, in the opinion of the Owner's Authorized Representative, pumping of excavations is not effective in maintaining a dry, firm subgrade, provide other dewatering methods acceptable to the Owner's Authorized Representative.

3.12 FROST PROTECTION

- A. Do not excavate to full indicated depth when freezing temperatures may be expected, unless footings or slabs can be poured immediately after the excavation has been completed. Protect the excavation from frost if placing of concrete is delayed.
- B. Completed foundations that have not been backfilled shall be protected from freezing by temporary additional earth cover, insulating blankets, heaters, or other methods acceptable to the Owner's Authorized Representative.
- C. Frozen material shall not be placed as fill or backfill.
- D. No work shall be installed on frozen ground.

3.13 DUST CONTROL

- A. During the construction period, the Contractor shall take special measures including, but not limited to, wetting down to control dust on site, in order to prevent annoyance/and or damage to adjacent property, whether public or private. Calcium chloride or any other chemical material may not be used on subgrades of areas to be seeded or planted.
- B. The Contractor shall take all necessary measures to keep streets, over which equipment and service for project travel, clean and free from dirt, dust, mud and debris resulting from

construction operations. The actions taken shall meet the requirements of all parties having jurisdiction.

3.14 FINISH GRADING

- A. General: Cut and fill are areas to elevations and tolerances specified. Leave graded surface clean, free from rubbish and large clods and reasonably smooth.
- B. Contaminated Material: Do not use earth that has been rendered unfit to receive planting due to concrete water, mortar or lime water dumped on it at areas to receive plantings.
- C. Subgrade under sidewalk, curb, gutter, and slabs-on-grade: Finish grade to bearing surface. Tolerance: ± 0.05 foot.
- D. Subgrade under paving: Finish grade to bottom elevation of aggregate base course. Tolerance: ± 0.05 foot.
- E. Subgrade under sodded areas: Finish grade to elevations allowing for 1-1/2 inches of sod, maintaining top of sod at elevations indicated. Tolerance: ± 0.1 foot.

3.15 UNSUITABLE BEARING MATERIAL

- A. Moisture Sensitive (collapsible) soils are known to exist on site (See attached Geotechnical Report included in appendix). All proposed structures, buildings, walls, and playground equipment shall be supported on undisturbed non-moisture sensitive soils or properly compacted structural fill extending down to suitable material (over-excavation). Contractor shall refer to the attached Geotechnical Report to determine depths and locations for areas that may require over-excavation.
- B. In proposed areas of concrete flat work and pavement, moisture sensitive soils are allowed to remain if the following conditions are met as per the Geotechnical Report Recommendations:
 - 1. Upper 12 inches is scarified
 - 2. Moisture content is adjusted to optimum moisture content
 - 3. Soil is compacted to at least 90 Percent of modified Proctor value.

3.16 CLEANUP

- A. At the end of all excavation, filling and grading operations and before acceptance of the work, the Contractor shall remove all debris, rubbish, etc., from the site in a legal manner. The premises shall be left clean, presentable, and satisfactory.

END OF SECTION 312000

DIVISION 32 – EXTERIOR IMPROVEMENTS

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HOT-MIX ASPHALT PAVING - SECTION 321216

PART 1 GENERAL

1.1 SUMMARY

- A. The work of this Section consists of providing all equipment and materials to construct the asphalt concrete pavement, as indicated on the Drawings and as specified herein.
- B. Related Sections. Other specification sections which directly relate to the work of this Section include, but are not limited to, the following:
 - 1. General and Supplementary Conditions and Division 1 Specification Sections
 - 2. Section 312000, Earthwork
 - 3. Section 321723, Pavement Marking Paint

1.2 REFERENCES

- A. The following standards shall apply to the work of this Section.
 - 1. Standard specifications for hot-mix asphalt paving for state and local Department of Transportation.
 - 2. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M 20 Penetration Graded Asphalt Cement
 - b. M 82 Cut-Back Asphalt (Medium Curing Type)
 - c. M 140 Emulsified Asphalt
 - 3. American Society for Testing and Materials (ASTM):

D 1557 Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb. (4.54-kg) Rammer and 18-in. (475-mm) Drop
 - 4. Utah Department of Transportation (UDOT) Metric Standard Specifications for Road and Bridge Construction

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be a paving-mix manufacturer registered with and approved by authorities having jurisdiction or the Utah Department of Transportation.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.
- C. Regulatory Requirements: Comply with applicable standards of owner and/or governing agency for asphalt paving work.
- D. Asphalt-Paving Publication: Comply with AIMS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

- E. Unless otherwise specified, work and materials shall conform to APWA Specification section 321123, Crushed Aggregate Base for untreated base course.
- F. All paving and base course work shall be done only after excavation and construction work that might damage them has been completed.
- G. Pavement base course shall not be placed on a wet, excessively damp, muddy, or frozen subgrade. Pavement courses shall not be placed on frozen or contaminated base course or binder course.
- H. Do not apply asphalt materials if the following conditions are not met:
 - 1. Prime and Tack Coats: Minimum surface temperature of 60 deg F (15.5 deg C)
 - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F (4 deg C) and rising at the time of placement.
 - 3. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.5 deg C) at time of placement.
- I. Existing pavement under state or local jurisdiction shall, if damaged during the course of this project, shall be repaired or replaced under this section of the specification. Materials and construction shall match local or state paving standards and cross sections, which ever is most stringent.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
 - 1. Job Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
 - 2. Job Mix Designs: For each job mix proposed for the Work.
- B. Qualification Data: for qualified manufacturer.
- C. Material Certificates: For each paving material, from manufacturer.
- D. Material Test Reports: For each paving material.

1.5 TESTING AND INSPECTION

- A. Testing Agency: The Owner will engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D979 or AASHTO T168.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt paving mixture delivered daily to the site, prepared according to ASTM D2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D2726. Cores will also be measured for compacted thickness. The owner and Landscape Architect may also direct additional cores to be taken at locations of their choosing to verify final pavement thickness.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field Density of in-place compacted pavement may also be determined by nuclear method according to ASTM D2950 and correlated with ASTM D 1188 or ASTM D 2726.
 - c. Coordinate the time and location of all holes so that cores may be filled.
- E. The contractor will replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

PART 2 PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D 692, sound, angular crushed stone, crushed gravel, or properly cured, crushed blast furnace slag.
- C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of total aggregate mass.
- D. Untreated Base Course Material shall conform to APWA Specification Section 321123, "Crushed Aggregate Base."
- E. Mineral Filler: ASTM D 242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO MP 1, to match County standards.

- B. Asphalt Cement: AC 20 per ASTM D 3381 for viscosity-graded material and ASTM D 946 for penetration-graded material.
- C. Tack Coat: ASTM D 977 or AASHTO M140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- D. Prime Coat: Not required if paving is done within 48 hours of final compaction. Asphalt emulsion prime complying with Salt Lake County Requirements.
- E. Water: Potable

2.3 AUXILIARY MATERIALS

- A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide granular, liquid, or wettable powder form.
- B. Sand: ASTM D 1073 or AASHTO M 29, Grade Nos. 2 or 3.
- C. Joint Sealant: ASTM D 6690 or AASHTO M 324, Type 1, Type II or III, or Type IV, hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

- A. Hot-mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and meeting APWA AC-20; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and other Hot-Mix Types," and complying with the following requirements:
 - 1. Provide mixes with a history of satisfactory performance in geographical area where project is located. Provide mix with the following characteristics:
 - a. Total Compacted Pavement Thickness: As indicated on the Drawings.
 - b. Number of compaction blows each end of specimen: 50.
 - c. Satiability based on ASTM D5581: 1200 minimum.
 - d. Flow in 0.01 inch units per ASTM D5581: 10-18.
 - e. Voids in mineral aggregate VMA: 14.
 - f. The percentage of bituminous material by weight added to aggregate will be between 4% and 7% of the weight of the bituminous mixture.
 - 2. Surface Course: Minimum compacted thickness as indicated on the Drawings with aggregate meeting the DM-1/2 APWA Master Grading Band.

DM-1/2 APWA Master Grading Band

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1/2"	100
#4	60-80
#16	28-42
#50	11-23
#200	3-7

- B. Complete job mix formula, listing quantities and pertinent ingredient properties, shall be submitted to and approved by Owner's Authorized Representative at least two weeks before work is scheduled to begin.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
 - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
 - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 ton or other vehicle with similar axle weight.
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner's Authorized Representative, and replace with compacted backfill or fill as directed.
 - 4. Verify that base course has been properly compacted and graded to the correct line, grade, and slope.
 - 5. Verify that the base course thickness is as indicated on the project plans.
 - 6. Verify that sufficient depth at curbs, walks, lips and other vertical edges is available to place the required thickness of compacted asphalt.
 - 7. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 GRADING

- A. Areas to be paved will be compacted and brought approximately to subgrade elevation under Section 312000, Earthwork before work of this section is performed. Final fine grading, filling, and compaction of subgrade to receive paving, as required to form a firm, uniform, accurate, and unyielding subgrade at required elevations and to required lines, shall be done under this Section.
- B. Proof-roll subgrade using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction. Existing subgrade material which will not readily compact as required shall be removed and replaced with satisfactory materials. Additional materials needed to bring subgrade to required line and grade and to replace unsuitable material removed shall be material conforming to this Section.
- C. Subgrade of areas to be paved shall be recompacted as required to bring top 8 in. (200 mm) of material immediately below gravel base course to a compaction of at least 95% of maximum density, as determined by ASTM D 1557, Method D. Subgrade compaction shall extend for a distance of at least 12 inches (300 mm) beyond pavement edge.
- D. Excavation required in pavement subgrade shall be completed before fine grading and final compaction of subgrade are performed. Where excavation must be performed in completed subgrade or subbase subsequent backfill and compaction shall be performed as directed by the Owner's Authorized Representative as specified in Section 312000, Earthwork Completed subgrade after filling such areas shall be uniformly and properly graded.

- E. Areas being graded or compacted shall be kept shaped and drained during construction. Ruts greater than or equal to 2 in. (50 mm) deep in subgrade, shall be graded out, reshaped as required, and recompact before placing pavement.
- F. Materials shall not be stored or stockpiled on subgrade.
- G. Disposal of debris and other material excavated and/or stripped under this section, and material unsuitable for or in excess of requirements for completing work of this Section shall be legally disposed of off-site.
- H. Proceed with paving only after unsatisfactory conditions have been corrected. Subgrade shall be approved by the Owner's Authorized Representative before installation of paving base course.

3.3 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
 - 1. Sweep loose granular particles from surface of unbound-aggregate base course. DO not dislodge or disturb aggregate embedded in compacted surface of base course.
- B. Herbicide Treatment: Spot treat subgrade with high potency herbicide if asphalt path passes within 30' of existing trees. Application shall be per manufacturer's specifications.
- C. Prime Coat: Not used if paving takes place not more than 24 hours after final compaction and grading of base course. Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m). Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure for 72 hours minimum.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.
- D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings.
 - 3. Remove and replace items damaged by overspray or clean affected surfaces as directed by Owner's Authorized Representative at no additional cost to the owner.

3.4 AGGREGATE BASE COURSE

- A. Aggregate base course for paving and the spreading, grading, and compaction methods employed shall conform to standard requirements for usual base course of this type for first class road work, and the following:

1. APWA Specification section 321123, Crushed Aggregate Base.
- B. Compaction of aggregate base course shall be to 95% of maximum density as determined by ASTM D 1557, Method D. Stone greater than 2 inches (64 mm) shall be excluded from course.
- C. Width of base course shall be greater than or equal to the width of pavement surface, if continuous lateral support is provided during rolling, and shall extend a distance of at least twice the base thickness beyond edge of the course above, if not so supported.
- D. Aggregate material shall be applied in lifts less than or equal to 6 in. (150 mm) thick, compacted measure. Each lift shall be separately compacted to specified density.
 1. Material shall be placed adjacent to wall, manhole, catch basin, and other structures only after they have been set to required grade and level.
 2. Rolling shall begin at sides and progress to center of crowned areas, and shall begin on low side and progress toward high side of sloped areas. Rolling shall continue until material does not creep or wave ahead of roller wheels.
 3. Surface irregularities which exceed 1/2 in. (12 mm) measured by means of a 10 ft. (3 m) long straightedge shall be replaced and properly compacted.
- E. Subgrade and base course shall be kept clean and uncontaminated. Less select materials shall not be permitted to become mixed with gravel. Materials spilled outside pavement lines shall be removed and area repaired.

3.5 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 1. Spread mix at minimum temperature of 250 deg F (121 deg C).
 2. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
 3. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.
 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix, use suitable hand tools to smooth surface.

3.6 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
 3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
 4. Construct transverse joints as described in A1 MS-22, "Construction of Hot Mix Asphalt Pavements."
 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct lay down and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent nor greater than 100 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Place asphalt so that final compacted asphalt is even with lip of gutter on curbs that drain away from the curb and gutter (open face or depressed curb and gutter). Place asphalt so that final compacted asphalt is 1/4-inch above lip of gutter on curbs that carry water (slope of parking lot is towards the curb). In transition areas, use extra care to make sure that no ponds, bird baths, or depressions are left after paving.
- G. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- H. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

- I. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 1. Base Course: Plus or minus ½ inch (13 mm).
 2. Surface Course: Plus ¼ inch (6 mm), no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
 1. Base Course: ¼ inch (6 mm).
 2. Surface Course: 1/8 inch (3 mm).
 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3.9 PAVEMENT MARKING

- A. Apply pavement-marking in accordance with Specification Section 321723 "Pavement Marking".
- B. Allow paving to age for 30 days before starting pavement marking.

3.10 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site, and legally dispose of them in an EPA-approved landfill.
 1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 321216

SECTION 321313 – SITE CONCRETE

PART 1 GENERAL

1.0 DESCRIPTION

- A. The work to be performed under this section shall consist of furnishing all labor, materials, and equipment to form, pour, finish, and cure concrete walks, drives and roadways, flat work, retaining walls, footings, mowstrips, as per the plans and specifications. The work may include but not be limited to excavation, forming, pouring, finishing, jointing, curing, protecting, removing forms, restoring earth or sod around the edges, and guaranteeing the work.

1.1 RELATED SECTIONS AND REQUIREMENTS

- A. Section 312000 – Earthwork: Preparation of site for paving and base and preparation of subsoil.
- B. Section 321723 – Pavement Markings.

1.2 REFERENCES

- A. American Public Works Association (APWA) Specifications:
 - 1. Section 321123: Crushed Aggregate Base.
 - 2. Section 312326: Compaction.
 - 3. Section 033004: Concrete.
 - 4. Section 032000: Concrete Reinforcing.
 - 5. Section 033900: Concrete Curing.

1.3 SUBMITTALS

- A. See section 013000 – Administrative Requirements, for submittal procedures.
- B. Installer Qualifications and ACI Certification for Supervisor/Foreman
- C.
- D. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, installation details, weather, test results or other circumstances warrant adjustments.
- E. Product Data: For each type of product indicated. Submit manufacturer's product data, installation instructions. Product data will include limitations and recommendations for each material.
- F. Test and Performance Data: Submit independent test data substantiating compliance with ASTM C 1116 as specified.
- G. Field quality-control test reports.
- H. Integral Colored Concrete Samples: At location on Project selected by Landscape Architect, place and finish 2' x 2' mockup samples for each of the three colors listed as well as mock up samples for each color using 50% of the color additive, for a total of 6 samples. These samples will be used for approval of colored concrete color. Mock up

samples shall also demonstrate methods of obtaining consistent visual appearance, including materials, workmanship, and curing method to be used throughout Project.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. ACI Publications: Comply with ACI 301, "Specifications for Structural Concrete," unless modified by requirements in the Contract Documents.

1.5 SAMPLING AND TESTING

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. All concrete shall be sampled and tested in accordance with AASHTO Designation T-141 for air entrainment, slump, and strength. The Contractor shall have the test made at the appropriate times and places. All test results shall be sent to the project Owner's Authorized Representative by the testing laboratory at the Contractor's expense.
 - 1. Slump Test: Slump tests shall be made in accordance with AASHTO Designation T-119. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. If a slump test does not meet the specifications, a second slump test shall be made immediately on the same load. The load will be accepted or rejected from the site by the inspector depending on the results of the second test. Perform one slump test for each set of test cylinders taken.
 - 2. Air Entrainment: Air entrainment tests shall be made in accordance with AASHTO Designations T-152. One test for each truck. If an air entrainment test does not meet the specification, a second test shall be taken immediately on the same load. The load will be accepted or rejected from the site by the Inspector depending on the results of the second test.
 - 3. Temperature: One test for every truck. Maximum temperature allowed is 90 degrees Fahrenheit.
 - 4. Compression Tests: Making, curing, and determining compressive strength of concrete cylinders shall be in accordance with AASHTO Designation T-22 and T23. For each test, mold and cure one set of four (4) standard cylinders for every 100 cubic yards placed or 5000 sq. ft. or fraction thereof of each concrete mix place each day. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are use. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete represents.
 - a. Compressive Strength Tests: 1 specimen at 7 days and 2 specimens at 28 days. 1 Specimen held in reserve for additional testing if required.
 - b. Compressive strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days. Cylinders for strength tests shall be taken by the testing laboratory, which will also inspect the batching procedure to ascertain compliance with the

- mix design.
- c. If any individual strength test is below 4,000 PSI, the concrete may be accepted by the project Owner's Authorized Representative after reviewing the circumstances. The price the Owner shall pay for the concrete will be reduced in accordance with the following schedule:

<u>PSI Below Specified Strength Specification</u>	<u>Pay Factor (Percent)</u>
1-100	98
101-200	94
200-300	88
301-400	80

5. Proctor Tests: Compaction of the natural or imported base shall be tested in accordance with AASHTO Designation T-191. All testing procedures and any additional tests which may be required shall follow those specified in the most recent edition of State of Utah Standard Specifications for Road and Bridge Construction.
- C. All costs incurred in sampling and re-sampling, testing and retesting shall be paid by the Contractor.
- D. All batching and mixing procedures shall be followed based upon the Salt Lake County Public Works Specifications as administered by the Salt Lake County Public Works Department as related to the most recent edition of the State of Utah Standard Specifications for Road and Bridge Construction

1.6 PROJECT CONDITIONS

- A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.
- B. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 MATERIALS

2.0 CONCRETE MATERIALS

- A. Cement: The cement shall be Portland Type II cement meeting current AASHTO Designation M-85 Specifications. The supplier and type of cement shall not be changed during the complete concrete phase of the project. Supplement with the following:
1. Fly Ash: ASTM C 618, Class F, Sourced from Bridger Power Plant, Wyoming, or Navajo Power Plant, Arizona
- B. Aggregate: The aggregate shall be well graded from fine to coarse. The fine aggregate shall be uniformly graded meeting the requirements of AASHTO Designation ASTM-C33. The coarse aggregate shall be 1" to #4 conforming to the requirements of AASHTO Designation M-92.
- C. Water: All water used in mixing the concrete shall be as per ASTM C94/C 94M.

- D. Fill and Back Fill: The entire area beneath the concrete shall be excavated to the proper depth to allow for the specified thickness of untreated base course compacted to minimum 95% or as indicated in Geotechnical Report, as measured by a Procter test.
1. All excavated material shall be either re-used on the site or hauled away as specified on the plans.
 2. Where untreated base course (free drainage material) is specified, the contractor shall import the required quantities from a local supplier. The contractor shall submit samples of the material to be used to the Inspector 3 days prior to use on the site. The untreated base course shall meet the requirements of Section 301 of the most recent edition of State of Utah Standard Specifications for Road and Bridge Construction. This refers to AASHTO Designations I-90, T-27, T-11, T-19 for mineral aggregate requirements. The gradation shall be for 3/4 or 1" maximum passing through the sieves in the percentages and with the tolerances shown on page 108, section 301.03 of the State Standard Specifications referred to above. (Base material shall be installed 6" wider than concrete walk width, both sides.)
- E. Air Entrainment Admixture: ASTM C260.
- F. Chemical Admixtures: ASTM C494/C 494M, of type suitable for application, certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

2.1 COLOR ADDITIVES FOR INTEGRALLY COLORED CONCRETE

- A. Color Additives for Integrally Colored Concrete:
1. Manufacturer: Unless specified otherwise on Product and Materials schedule, Davis Colors, phone 800.356.4848, or approved equal
 2. Materials: Color additives shall contain pure, concentrated mineral pigments specially processed for mixing into concrete and complying with ASTM C979. Color additives containing carbon black are not acceptable.
 3. Colors for Stamped Concrete Faux Bridge Area: Basis of Design Color(s) as listed on product and materials schedule on drawings is listed to convey design intent. Contractor to submit color chart to Landscape Architect for selection of 3 colors based on Basis of Design color. Contractor to provide colored concrete mockups for 3 colors selected as required above for the listed colors as well as the mockups for each color using 50% of the specified color additive for a total of 6 color mockups.
 4. Colors for Oval Plaza Area and Restroom Plaza: Basis of Design Color(s) as listed on product and materials schedule on drawings is listed to convey design intent. Contractor to submit color chart to Landscape Architect for selection of 3 colors based on Basis of Design color. Contractor to provide colored concrete mockups for 3 colors selected as required above for the listed colors as well as the mockups for each color using 50% of the specified color additive for a total of 6 color mockups.
- B. Curing Compound for Colored Concrete: Curing compound shall comply with ASTM C309 and be approved by color additive manufacturer for use with colored concrete.
- C. Dosage rate for color additive shall not exceed 10 percent of weight of cementitious materials in mix.

- 2.2 FORMS: Forms shall be of suitable materials such as wood, plastic, metal, or combinations thereof. Forms shall be of the shape and dimensions shown on the plans and true to line and grades specified. All forms shall be free from knotholes, loose knots, cracks, splints, warps, or other defects affecting the strength or appearance of the finished product. All forms shall be free of bulges and warping. They shall be cleaned thoroughly before they are used on this project. There shall be no split holes, bolts, or nuts on the final concrete surface when the forms are removed.
- A. If at any stage of work, during or after placing the concrete, the forms sag or bulge the affected concrete shall be removed. Exceptions may be considered by the Inspector if the concrete is going to be covered with earth.

2.3 METAL REINFORCEMENT

- A. Steel reinforcing bars: shall conform to ASTM A 615.
1. Bars employed as reinforcement shall be deformed type.
 2. Bars employed as dowels shall be hot-rolled plain rounds.
 3. Unless otherwise indicated on the Drawings, reinforcing bars shall be Grade 60.
- B. Steel expansion dowels: conform to AASHTO M31.
1. Hot-rolled plain steel rounds.
 2. Grade 60 - 1/2 inch by 24 inches (610 mm) smooth steel dowel and compatible waxed tube sleeve, 12 inches in length.
 3. Dowels and sleeves shall be as furnished by U.S. Steel Corp., or approved equal.
 4. Bars employed as dowels shall be hot-rolled plain rounds.
 5. Dowels shall be epoxy coated.

2.4 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:
1. All concrete shall be Class AA (AE) Type II.
 2. Compressive Strength (28 days): 4,000 P.S.I.
 3. 6.5 bag cement mix shall be used, with adjustments made as necessary due to the use of fly ash.
 4. Fly Ash Content: Maximum 15% of cementitious materials by weight, subject to mix design verification.
 5. Water-Cement Ratio: .45 maximum water/cement ratio at point of placement, or as little water content as practicable.
 6. Air Content: 6%, with a plus or minus variable of 1%.
 7. Slump Limit: 4 inch maximum.
 8. The supplier and mix of concrete shall not be changed during the complete concrete phase of the project.
- C. Color Additives: Mix color additives into concrete mixture according to manufacturer's written instructions.

2.5 FIBER REINFORCEMENT

- A. Fiber Reinforcement: Provide concrete admixture complying with the following requirements:

1. Fiber Reinforcement **shall only be used for construction of Concrete Slide.** Fiber Reinforcement **shall not** be used for any other concrete work on the project.
 2. Fibers: 1/2 inch or 3/4 inch polypropylene fibers, maximum 3 denier, complying with ASTM C 1116, Type III, Par. 4.1.3 and applicable building code requirements.
 3. Approved Monofilament Fibers are as follows:
 - a. Axim Concrete Technologies; Fibrasol IIP.
 - b. Euclid Chemical Company (The); Fiberstrand 100.
 - c. FORTA Corporation; Forta Mono.
 - d. Grace, W. R. & Co.--Conn.; Grace MicroFiber.
 - e. Metalcrete Industries; Polystrand 1000.
 - f. SI Concrete Systems; Fibermix Stealth.
 - g. Or engineer approved equal.
 4. Approved Fibrillated Fibers are as follows:
 - a. Axim Concrete Technologies; Fibrasol F.
 - b. FORTA Corporation; Forta FORTA Corporation; Forta Mono.
 - c. Euclid Chemical Company (The); Fiberstrand F.
 - d. Grace, W. R. & Co.--Conn.; Grace Fibers.
 - e. SI Concrete Systems; Fibermesh.
 - f. Or engineer approved equal.
1. Mix in truck a minimum of 20 minutes after fiber addition for uniform distribution
 2. Fibers per pound: not less than 50 million individual fibers.
 3. Fibers will be supplied in cellulose Concrete Ready Bags® which disperse during mixing.
 - a. Application Rate: one 1-1/2 pound per cubic yard of concrete.
 - b. Add fibers at the batch plant to ensure proper mixing.
 - c. Mix in truck a minimum of 20 minutes after fiber addition for uniform distribution.

2.6 SEALANT

- A. Sealant as specified below, or approved equal:

Sikaflex polyurethane based sealant: Manufacturer: Sika Corporation, 1-800-933-SIKA, for sealing control joints and expansion joints in concrete.

 1. Expansion joints: Sikaflex 1a
 2. Color of sealant: Limestone
 3. Use primer recommended by the manufacturer for the use intended.

2.7 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

- E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating
- F. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

2.8 RELATED MATERIALS

- A. Expansion Joint Filler: ASTM D 1751, 1/2" thick, asphalt-saturated cellulosic fiber.
- B. Pavement Marking Paint: See specification section 321723-Pavement Marking.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted base course is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.2 PREPARATION

- A. Construct subgrades to plan elevations following Division 31 Earthwork specification sections.
- B. Place and compact fill material and untreated base course in accordance with Division 31 Earthwork specification sections.
- C. Moisten base to minimize absorption of water from fresh concrete.
- D. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.
- E. Notify architect minimum 24 hours prior to commencement of concreting operations.

3.3 PLACEMENT (Supervisor/Foreman must have A.C.I. Training): All debris shall be removed from the inside of the forms prior to placement of any concrete. The Contractor shall take all necessary measures to protect the concrete after placement to prevent rain, graffiti, or other damage to the surface.

- A. Concrete mix trucks shall be routed to each pour over areas where the least possible damage will occur to the existing sprinkler irrigation system, utilities, lawn, or plant materials. The Contractor shall be responsible for repair of damage done by the concrete mix trucks and any other vehicles involved in these operations.
- B. The concrete shall be spread in horizontal layers insofar as practical and only of the thickness that can be satisfactorily hand worked or compacted with vibrators and other such equipment.
- C. The concrete shall be deposited as near the final resting place as possible so as to minimize working it and to prevent separating the ingredients.
- D. The concrete slope shall be a minimum 1" per 10' or 1% in the direction of the natural grade or as indicated on the plans. Flat work will have not more than an 1/8" difference in

a 20' radius.

3.4 COLD AND HOT WEATHER CONCRETING

- A. Follow recommendations of ACI 305R when concreting during hot weather.
- B. Follow recommendations of ACI 306R when concreting during cold weather.
 - 1. Winter Concrete: When outside temperatures reach 35 degrees Fahrenheit, a 7-1/2 bag mix shall be used; heated water shall be used in the concrete mix. Heaters shall be used to heat the aggregate to a temperature of 70-150 degrees Fahrenheit. The aggregates shall be uniformly heated and the development of "hot spots" shall be avoided. The temperature of the mixed concrete shall be 60-90 degrees Fahrenheit. A straw blanket shall be used on all surfaces. Concrete shall not be poured on frozen ground and shall meet A.C.I. 305 and 306 requirements for hot and cold weather precautions. Concrete temperature must be maintained at 50 degrees Fahrenheit or greater but never more than 90 degrees Fahrenheit for 7 days.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.6 STEEL REINFORCEMENT

- A. Reinforcing for reinforced concrete shall be thoroughly cleaned of loose mill and rust scale, dirt, ice, and other foreign material which may reduce the bond between the concrete and reinforcing. Where there is delay in placing concrete after reinforcement is in place, bars shall be re-inspected and cleaned when necessary.
- B. Reinforcing Steel: After forms have been coated with form release agent, but before concrete is placed, reinforcing steel anchors shall be securely wired in the exact position called for, and shall be maintained in that position until concrete is placed and compacted.
 - 1. Any bar showing cracks after bending shall be discarded.
 - 2. Chair bars and supports shall be provided in a number and arrangement satisfactory to the Landscape Architect.
- C. Unless otherwise indicated on the Drawings, reinforcing shall extend to within two (2) inches of formwork and expansion joints.
 - 1. Reinforcing shall continue through control joints.
- D. The Owner may do core testing to make sure that reinforcement is in the proper position. If testing shows otherwise, concrete will be rejected and the Contractor shall remove all rejected slabs and re-pour new slabs at no additional cost. Contractor shall repair cored holes as directed by the Landscape Architect.

3.7 FINISH

- A. Unless specified on the plans, the finish for all concrete flat work shall be a non-skid surface by medium brooming, perpendicular to direction of travel with troweled and radius edges 1/2" radius.
- B. Formed Surfaces: Allow concrete to cure not more than 72 hours before commencing surface finish operations, unless otherwise approved. Revise the finishes as needed to secure approval.

1. As-Cast Form Finish – Smooth: Patch tie holes and defects and remove fins completely.
 - a. When surface texture is impaired and form joints misaligned, grind, brush hammer, or correct affected concrete.
 - b. Slurry grout areas evidencing minor mortar leakage to match adjacent concrete
 - c. Repair major mortar leakage as a defective area.
 - d. When workmanship is less than acceptable standard, provide one of APWA rubbed finishes at no additional cost to the owner.

- C. Stamped Concrete Finish: Stamped concrete pattern shall be as specified on Product and Materials schedule and shall be installed in accordance with manufacturer's instructions. Stamped concrete areas shall receive 2 coats of UV protective concrete sealant.

3.8 JOINTING

- A. Joints shall be placed in the concrete by the Contractor so as to control and minimize cracking. Normally the Contractor shall follow the jointing patterns shown on the plans or submit a drawing showing recommended changes for approval by the project Owner's Authorized Representative or Landscape Architect.
 1. Wall Joints: Shall be as noted and detailed on the drawings.
 2. Control Joints: Sidewalk joints shall be in linear feet equal to the width of the walk (for example, a 6-foot wide walk shall be scored every 6 linear feet.) unless otherwise noted on the plans Slab work shall be jointed a maximum in feet of 2 -1/2 times the thickness of the concrete in inches (for example, the joints would be less than 15 feet apart for a slab 6 inches thick) and never more than 15 feet apart - for a 4" slab, between 8 - 10 feet.
 - e. The control joints shall be a depth of 1/4 the thickness of the slab. Control joints shall be made before shrinkage cracking occurs. All control joints shall be continuous across the concrete except where interrupted by a post, wall, joint, or other obstacle.
 - f. Saw cutting control joints will not be allowed except where specifically called for in the drawings.
 2. Construction Joints: Shall be created longitudinally by the edges of paving or transversely at the end of each days work. A key way shall be formed by fastening a key of wood, plastic, or PVC to the form of the first slab. The thickness of the key way shall be 1/5 of the thickness of the slab. The edges shall be rounded 1/4" radius, never on slabs less than 6" thick. Use a release agent on wood formed key ways.
 3. Doweled joints: should be installed as detailed at all intersecting walks, where new concrete ties into existing concrete and at expansion joints in the concrete drive and parking paving.
 4. Expansion Joints: Shall be created at junctions of new and existing pavement, at buildings, or other abutting objects, between gutter and concrete drive and parking paving and where shown on the drawings. Expansion joints shall not be spaced greater than 50' apart. An 1/2" expansion joint material (full depth) shall be placed against the existing object to prevent bonding.

- a. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - b. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - c. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - d. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
5. Sealing Joints: Expansion joints in concrete walkways shall be sealed with a polyurethane joint sealant 3/8" depth.

3.9 CARE AND CURING

- A. All concrete shall be cured for a minimum of 7 days before heavy loads may be placed upon it. Care shall be taken by the Supplier and the Contractor to prevent too rapid curing and the improper aging of the concrete. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these methods.
- E. After pouring and during the curing process, the Contractor shall see that no initials or other unnecessary marks are made into the surface. The Contractor shall replace any section containing permanent marks at the completion of the project. Prior to that time, the Contractor may grind the surface or take measures to erase any permanent marks in a section if approved by the Inspector or Owner's Authorized Representative.

3.10 FORM REMOVAL

- A. After the concrete is cured, all forms, stakes, and fastening materials shall be removed from the concrete. Care shall be taken to protect the edges from chipping and to prevent damage to the concrete during removal.

All forming materials shall be taken from the site as soon as possible after removal. The area taken up by the forms shall be filled with approved backfill, if needed, and compacted so that top soil shall be placed on top to meet finished grade. If the area is in existing lawn, the sod shall be removed back from the edges of the concrete the standard width of new commercial sod. Then new commercial sod shall be laid full width along the edges of the new concrete until all areas are repaired. The finish grade against the concrete shall be 1 to 2" below the top of the concrete.

3.11 CONCRETE RETAINING WALLS

- A. Retaining Wall Reinforcing steel:
1. Detailing, fabrication and placement of reinforcing bars (unless otherwise noted) must follow the A.C.I. Manual of Standard Practice for detailing reinforced concrete structures, A.C.I. 315 – Latest Edition.
 2. All reinforcing bars for retaining walls shall conform to the standard specification for deformed billet-steel bars for concrete reinforcement, ASTM A615-85: grade 60 except #3 re-bars shall be grade 40.
 3. Lap all splices in concrete as “Class B” splices minimum, as per the IBC, referenced addition, unless otherwise shown.
 4. Reinforcing steel shall have a minimum concrete cover as tabulated below unless otherwise noted.
 - a. Footings and walls cast against earth – 3 inches
 - b. Walls exposed to weather or soil – 2 inches
 5. Where continuous bars are called out, provide contact splices (as required) in accordance with A.4 above.
 6. Bottom of steel of slabs, footings, and grade beams shall be supported off of the earth or forms by precast concrete blocks wire tied to the reinforcement.
- B. Retaining Wall Concrete
1. All reinforcing bars, anchor bolts and inserts shall be well secured prior to placing concrete.
 2. Concrete compressive design strength at 28 days shall be as specified above. Concrete shall have been tested and have reached minimum strength psi prior to backfilling walls.
 3. All exposed concrete edges shall have ¼” chamfer.
 4. Construction requirements shall conform to ACI 301 and ACI 318 Latest Edition.
 5. Concrete work shall conform to the requirements of Chapter 19 of the IBC, reference edition.
- B. Retaining Wall Earthwork
1. Retaining wall backwall backfill shall be free from frozen lumps, rocks larger than 4 inches in the largest dimension, and other deleterious material.
 2. Structural fill placed beneath footings shall be placed in maximum 9 inch thick loose lifts compacted to at least 95 percent of maximum dry density with a moisture content within 2 percent of optimum moisture content in accordance with ASTM D-1557
 3. All other backfill shall be placed and compacted to at least 90 percent of maximum dry density with a moisture content within 2 percent of optimum moisture content in accordance with ASTM D-1557.
 4. Excavation shall be braced and supported to prevent ground adjacent to the excavation from sliding or settling.

3.12 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
1. Elevation: 1/4 inch.
 2. Thickness: minus ¼ inch.
 3. Surface: Gap below 10-foot long, unleveled strait edge not to exceed ¼ inch.
 4. Joint Spacing: 3 inches.
 5. Contraction Joint Depth: Plus ¼”, no minus.
 6. Joint width: Plus 1/8”, no minus.

- B. Minor variations in appearance of colored concrete, which are similar to natural variations in color and appearance of uncolored concrete, are acceptable.

3.13 PAVEMENT AND CURB MARKING

- A. See specification section 321723-Pavement Marking

3.14 CLEAN-UP

- A. Upon completion of the concrete work, the entire affected area shall be cleaned up by the Contractor. All wood, forms, stakes, rocks, sod, and other extraneous material shall be removed from the premises.

3.15 PROTECTION, GUARANTEE AND REPLACEMENT

- A. The Contractor shall guarantee all concrete materials, labor, and workmanship for 1 year following final approval of the contract as per the general County Specifications. Sections containing cracks deemed to be unacceptable by Owner's Authorized Representative shall be replaced at no expense to the Owner.
- B. Protect concrete from damage, Exclude traffic from pavement for at least 14 days after placement.
- C. Maintain concrete free of stains, discolorations, dirt, and other foreign material. Sweep concrete pavement not more than two days before dated scheduled for Substantial Completions inspection.

END OF SECTION 321313

SECTION 321613 - CURBS, GUTTERS, DRIVEWAYS, AND ADA RAMPS

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Materials and procedures for constructing curbs, gutter transitions, ADA pedestrian ramps, and plowable end sections.

1.2 RELATED SECTIONS

- A. Section 321313 – Concrete Paving

1.3 REFERENCES

- A. American Public Works Association (APWA) Specifications:
 - 1. Section 321123: Crushed Aggregate Base.
 - 2. Section 312326: Compaction.
 - 3. Section 033004: Concrete.
 - 4. Section 032000: Concrete Reinforcing.
 - 5. Section 033900: Concrete Curing.

PART 2 PRODUCTS

2.1 CONCRETE MIX

- A. Cast-in-place: Class 4000, Refer to APWA Section 033004.
- B. Maximum slump per mix design.

2.2 EXPANSION JOINT FILLER

- A. Preformed material. ASTM D 1751, 1/2" thick, asphalt-saturated cellulosic fiber.

2.3 UNTREATED BASE COURSE

- A. Refer to APWA Section 321123, Part 2, and paragraph: Untreated Base Course.

2.4 REINFORCEMENT

- A. Reinforcing Steel: Grade 60 ksi galvanized or epoxy coated steel. Refer to APWA Section 032000.

2.5 DETECTABLE WARNING PLATES FOR ADA RAMPS

- A. Cast In Place Detectable Warning Plates: Accessible truncated-dome detectable warning tiles configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
 - 1. Material: Cast-fiber-reinforced polymer concrete tile

2. Color: As specified on the drawings and as approved by County representative.
3. Dome spacing and configuration: Manufacturer's standard compliant spacing in square pattern.
4. Mounting: Permanently embedded detectable warning tile wet-set into freshly poured concrete.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Construct subgrade to plan elevations following APWA Section 320510, Backfilling Roadways.
- B. Place and compact fill material and untreated base course. Follow APWA Section 312326, Compaction.
- C. May use a slip form curb and gutter machine.
- D. Dampen the untreated base course before placing concrete.
- E. Curbs and Gutters: Refer to Construction Details.
- F. ADA Pedestrian Access: Refer to Construction Details.
- G. Detectable Warning Plates: Embed in concrete in accordance with Manufacturer's installation instructions in locations indicated and detailed on the drawings.
- G. Forms: Refer to APWA Section 031100.

3.2 PLACING CONCRETE

- A. Furnish materials and construct concrete following APWA Section 033010, Concrete Placement.
- B. Make sure base course is uniformly damp at time of concrete placement
- C. Place concrete so time between end of placement and beginning of finishing is less than 15 minutes.
- D. Do not use mechanical vibrators.
- E. Hand tamp forms to eliminate honeycomb.
- F. Deposit concrete continuously when using a slip form machine.
- G. Use dowels as shown on the plans when placing curb next to existing pavement.

3.3 FINISHING CONCRETE

- A. Finish concrete following APWA Section 033500, Concrete Finishing.

- B. Round edges to a 1/2 inch radius.
- C. Use a float to finish the top and front face of the curb and the top of the gutter.
- D. Apply broom finish longitudinal to curb and gutter flow line.
- E. Finish the traveled portion of the driveway with a broom finish.
- F. Remove form marks or irregularities from finish surfaces.
- G. Install detectable warning strips on disabled pedestrian ramps as shown.

3.4 CONTRACTION JOINTS

- A. Tooled Joints Depth = $T/4$ where T is depth of the concrete slab in inches.
- B. Saw Cut Joints: Saw cut joints before uncontrolled shrinkage cracking occurs. Do not tear or ravel concrete during sawing.
- C. Joints for curbs, gutters, and waterways at intervals not exceeding 12 feet.
- D. At curb radius and walk returns make the joints radial.
- E. Where integral curb and gutter is adjacent to concrete pavement, align joints with the pavement joints where practical.

3.5 EXPANSION JOINTS

- A. Geometrics: 1/2 inch wide full depth filler that is flush with concrete surface. Do not Place seal over top of filler.
- B. Place expansion joints between sidewalks and the back of curb returns and between the sidewalk and sidewalk ramps.
- C. Do not place expansion joints in sidewalk ramp surfaces.
- D. Do not place longitudinal joints in drain gutter flow-line.
- E. Where drain gutter transitions extend beyond the curb return, place expansion joints at the ends of the drain gutter transition.
- F. Place expansion joints at the beginning of curb radius and end of curb radius.

3.6 CONCRETE CURING

- A. Cure the surface. Refer to APWA Section 033900.
- B. Type ID Class A (clear with fugitive dye) membrane forming compound. Apply total coverage in 2 directions after texturing.

- B. Eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete slab.

3.7 PROTECTION AND REPAIRS

- A. General: All expenses are at no cost to Owner.
- B. Protection: APWA Section 033010.
 - 1. Protect concrete work from deicing chemicals during 28 day cure period.
 - 2. Immediately after placement, protect concrete from graffiti or other types of mechanical injury.
- C. Repairs: APWA Section 033010.
 - 1. Correct all humps or depressions.

END OF SECTION 321613

SECTION 321723 - PAVEMENT AND CURB MARKINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish traffic paint meeting Federal Specification TT-P-1952.
- B. Apply to asphaltic or concrete pavement and curbs as edge lines, centerlines, skip lines, guidelines, symbols, and other related markings.
- C. Remove pavement markings.

1.2 RELATED SECTIONS

- A. Section 321216 – Hot Mix Asphalt Paving
- B. Section 321313 – Concrete Paving.
- C. Section 321613 - Curbs, Gutters, Driveways, and ADA Ramps.

1.3 REFERENCES

- A. Miscellaneous:
 - 1. Federal Standards 595B, 37875, 33538, 11105.
 - 2. TT-P-345: Federal Standard Color Number.
 - 3. TT-P-410: Federal Standard Color Number.
 - 4. TT-P-445.
- B. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M 247: Glass Beads Used in Traffic Paint.
- C. American Society for Testing and Materials (ASTM):
 - 1. ASTM D 476: Titanium Dioxide Pigments.
 - 2. ASTM D 600: Liquid Paint Dryers.
 - 3. ASTM D 603: Aluminum Silicate Pigments (Hydrous).
 - 4. ASTM D 605: Magnesium Silicate Pigment (Talc).
 - 5. ASTM D 711: No-Pick-Up Time of Traffic Paint.
 - 7. ASTM D 740: Methyl Ethyl Ketone.
 - 8. ASTM D 1155: Roundness of Glass Spheres.
 - 9. ASTM D 1214: Sieve Analysis of Glass Spheres.
 - 10. ASTM D 2243: Freeze-Thaw Resistance of Water-Borne Coatings.
 - 11. ASTM D 1199: Calcium Carbonate Pigments.
 - 12. ASTM D 1214: Sieve Analysis of Glass Spheres.
 - 13. ASTM D 2635: Methyl Isobutyl Carbinol.

1.4 SUBMITTALS

- A. Furnish for approval all Manufacturers' specifications for all items listed in this Section
- B. Shop Drawings: The contractor shall submit Shop Drawings for review and acceptance prior to product fabrication or delivery to the site. Shop Drawings shall be complete with respect to

quantities, dimensions, specified performance and design criteria, materials, color, and similar data to enable an adequate review of the information required.

- C. Color Samples: Provide color samples for approval of pavement and curb marking paint colors.

PART 2 PRODUCTS

2.1 PAVEMENT AND CURB MARKING PAINT

- A. Pavement and Curb Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS tt-p-1952.
- B. Color:
 - 1. Yellow: Parking stalls
 - 2. White: Pedestrian Crossings & Traffic Arrows & Striping
 - 3. Red: Fire Lane Painted Curbs
- C. Paint and reflective media shall be in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, formulation number and directions, all of which shall be plainly legible at time of use.
 - A. Paint shall be homogeneous, easily mixed to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of six months.

2.2 GLASS BEADS

- A. Required gradation: ASTM D 1214.

Sieve Size	Percent Passing
µm	
600	100
300	40-70
212	15-35
150	0-10

- B. Minimum of 75 Percent (by weight) true spheres. ASTM D 1155.
- C. Required characteristics:
 - 1. Colorless.
 - 2. Free of dark spots, milkiness, and air inclusions.
 - 3. Silane coated.
 - 4. Minimum index of refraction of 1.50 when tested by liquid immersion at 25 degrees C. AASHTO M 247.

2.3 PAVEMENT MARKING EQUIPMENT

- A. Use equipment manufactured specifically for applying paint and only by workers experienced in operating such equipment.
- B. The equipment for applying paint to pavements shall be self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 5 mph (8.05 km/hour), and shall be capable of applying the stripe widths indicated, at the paint

coverage rate specified in paragraph "Application", below, and of even uniform thickness with clear-cut edges. Equipment used for marking streets and highways shall be capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines or a combination of solid and intermittent lines using a maximum of three different colors of paint as specified. The paint applicator shall have paint reservoirs with tanks of sufficient capacity and suitable gages to apply paint in accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gages in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to insure freedom from residue and foreign matter that may cause malfunction of the spray guns. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

- C. Push-type machines of a type commonly used for application of paint to pavement surfaces shall be acceptable for marking roadway and parking areas. Applicator machine shall have the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.
- D. Provide sandblasting equipment as required for cleaning surfaces to be painted.
- E. Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required. Compressor shall be capable of furnishing not less than 150 cfm (4.2 m³/minute) of air at a pressure of not less than 90 psi (620.5 kPa) at the nozzle for each nozzle used.
- F. Locate glass bead applicator directly behind and synchronized with marking applicator.
- G. Shield devices properly to avoid applying marking or losing beads outside designated area.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

- A. New pavement and curb surfaces shall be allowed to cure for a period of not less than 30 days before application of marking materials
- B. Where oil or grease is present on old pavements to be marked, affected areas shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint.
- C. Sweep and clean surface to eliminate loose material and dust.

3.2 PAVEMENT MARKING APPLICATION

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Owner's Authorized Representative.
- B. Apply no later than 24 hours after receiving written order from the Owner's Authorized Representative.
- B. Apply marking materials to clean, dry surfaces in accordance with the requirements of UDOT Specification Section 02765 Supplemental.
- C. Apply paint pneumatically with approved equipment.

- D. Revise rate for reflectorized paint.
- E. Apply pavement marking materials evenly to the pavement surface to be coated at the rate recommended by manufacturer.
- F. Use guidelines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols.
- G. Edges of markings shall be sharply outlined.
- H. Maximum drying time requirements of the paint manufacturer shall be enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by vehicle tires.
- I. If markings require more drying time than stated by the paint manufacturer, painting operations shall be discontinued until cause of the slow drying is determined and corrected.
 - 1. Apply paint during the following conditions:
 - a. When pavement surface is dry, clean, and free of oil.
 - b. When pavement and air temperatures are at least 40 degrees F (4 degrees C).
 - c. During daylight hours.
 - 2. Apply paint and glass beads for parking lot striping, letters, arrows, railroad crossing markings, crosswalks, and stop bars:
 - a. With well defined outside edges and uniform thickness.
 - b. At recommended rate to provide a minimum wet film thickness of 15 mils (0.4mm).
 - c. Apply glass beads uniformly into wet pavement markings at a rate of 6 lb./gal (72 Kg/L) of paint.
 - 3. Operate equipment in the direction of the normal flow of traffic.

3.3 PROTECTION OF MARKINGS

- A. Markings shall remain protected in accordance with UDOT Specifications.

3.4 ACCEPTANCE STANDARDS

- A. The following acceptance standards shall be applied to this Contract. These standards are considered superior to typical industry standards. Any portion of the pavement markings that does not come up to these required acceptance standards will be removed at the direction of the Owner's Authorized Representative. Sandblast or otherwise remove unacceptable pavement markings as required by the Owner's Authorized Representative and replace with new pavement markings that meet the requirements of this Section.
 - 1. Puddles and thick accretions at the ends of lines of pavement markings.
 - 2. Pavement markings that diverge from alignment.
 - 3. Solid line pavement markings that show kinks, bends, bumps, or other deformities from true alignment.

END OF SECTION 321723

SECTION 321800 – PLAYGROUND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes supply and installation of playground equipment.
- B. Related Sections include the following:
 - 1. Division 1 – General Requirements
 - 2. Section 321313 – Site Concrete
 - 3. Section 323100 – Site Improvements
 - 4. Section 321816 – Playground Protective Surfacing

1.3 REFERENCES

- A. US Consumer Product Safety Commission (CPSC) Handbook for Playground Safety, current version.

1.4 QUALITY ASSURANCE

- A. Structural Integrity Requirements for Playground Equipment: Playground equipment shall comply with structural integrity requirements for playground equipment, as tested under ASTM F1487.
- B. American Standards for Testing and Materials (ASTM): Playground equipment shall comply with relevant ASTM standards for playground equipment, components, and materials.
- C. Consumer Products Safety Commission (CPSC): Playground equipment shall comply with the requirements of the Consumer Products Safety Commission (CPSC), latest version.
- D. Manufacturer's Experience: Playground equipment shall be furnished by a manufacturer with a minimum of ten (10) years' experience in the design, fabrication, and assembly of integrated playground equipment.
- E. Installer's Experience: Playground equipment shall be installed by a contractor with a minimum of five (5) years' experience in the assembly and installation of playground equipment and shall be an experienced and certified installer who has completed work with similar equipment, materials, and design, and to the extent similar with this project and whose work has resulted in construction with a record of successful in-service performance. Contractor to provide a list of all subcontractors and their appropriate qualification. Installer shall follow manufacturer's instructions and installation documentation for all equipment.

1.5 SUBMITTALS

- A. General: Submit in compliance with Division 1 Section “Submittals.”
- B. Test Results: Test results shall be certified and submitted on independent testing laboratory letterhead indicating compliance with the tests noted above, as follows:
 - 1. ASTM “Structural Integrity Requirements for Playground Equipment”
- C. Certification: Certification shall be submitted indicating compliance with:
 - 1. Consumer Products Safety Commission (CPSC) guidelines.
- D. Notice of Defects: Copies of any public notices or private correspondence to purchasers informing same of any defects or potential defects within the past five (5) years.
- E. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work. Indicate capacity and number of play activities.
- F. Coordination Drawings: Drawn to scale and coordinating playground equipment installation with other site improvements and playground surfacing systems. Show playground equipment locations and extent of playground surfacing systems.
 - 1. Show equipment use zones and fall heights as defined in ASTM F 1487.
 - 2. Show Critical Height of playground surfacing systems as defined in CPSC No. 325.
- G. Maintenance instructions and data.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store delivered play equipment items under this Section in a manner to prevent wracking or stress of components, and to prevent mechanical damage or damage by the elements.
- B. Protect all stored materials and items from weather, careless handling and vandalism.
- C. Items, which become rusted or damaged because of non-compliance with these conditions, will be rejected and will be replaced without additional cost to the Owner.

1.7 COORDINATION

- A. Installation of play equipment shall be coordinated with all necessary trades to insure proper layout, installation, and minimize disturbance or damage to other areas of work. Installation of play equipment shall be closely coordinated with installation of Playground Protective Safety Surfacing to minimize to the greatest extent possible, the timeframe in which play equipment is installed without protective surfacing in place. If play equipment is installed prior to safety surfacing, play equipment installer shall take necessary measure to prevent use of equipment until safety surfacing is in place.

1.8 SUBSTITUTIONS

- A. Any proposed product substitutions shall be in accordance with the General Conditions; shall meet or exceed specified warranty; shall be equivalent in specific features and qualities such as

performance, weight, size, durability, visual effect; shall be compatible with the rest of the work; and shall not require any changes or revisions to the Construction Documents.

1.9 JOB CONDITIONS

- A. Examine areas to receive play equipment or play components. Verify dimensions are as indicated on the plans and are of a size to accommodate play equipment and play component use zones.
 - 1. Do not proceed with play equipment installation until area dimensions have been verified.
- B. Proceed with and complete the work as rapidly as portions of the site become available.

1.10 WARRANTY/GUARANTEE PERIOD

- A. Contractor will furnish and deliver standard written manufacturer's guarantee in Owner's name covering all materials and workmanship provided or installed by contractor under this Division 32 Section, Playground Equipment, in addition to, and not in lieu of, guarantee requirements set forth under Division 1, General Requirements, and other liabilities which the Contractor may have by law or other provisions of the Contract Documents.
- B. Pay for repairs of any damage to any part of the project, or caused by defects in his work and for any repair to the materials or equipment caused by replacement. Complete all repairs to the satisfaction of the Owner's Representative.
- C. Replace any part of the work installed under this contract requiring excessive maintenance. Work of this nature will be considered defective. Replace at no cost to the Owner upon notification during the one-year guarantee period.

1.11 INSPECTIONS

- A. The contractor shall request a site inspection with the Landscape Architect and Owner's Representative at the time of Substantial Completion and again at the end of the warranty period. Inspections will verify compliance to the drawings and specifications. Any items not complying with the drawings and specifications shall be adjusted and/or repaired prior to issuing Substantial Completion or Final Acceptance.
 - 1. The Landscape Architect shall be given a minimum of 7 days notice prior to the site inspections.
- B. A manufacturer's authorized services representative(s) shall be present at the punch list review of the playground equipment. Others present at the punch list review will be the Owner's Representative, the Contractor, and, if applicable, the playground installer subcontractor. Manufacturer's authorized service representative shall not review the equipment without these other parties present.
 - 1. Manufacturer's authorized service representative shall note any items which are not in conformance with the playground equipment's specifications or instructions for installation, and which must be corrected before the playground equipment can be safely used, or which must be corrected in order for the manufacturer's warranties to be in effect.
- C. Contractor(s)/Owner's Vendor Installer(s) responsible for installing playground equipment, elements, or components shall be responsible to verify equipment and installation meets

applicable CPSC and ASTM Playground Safety Guidelines and shall have installation inspected by a Certified Playground Safety Inspector. This includes manufactured, off-the-shelf equipment and custom play features.

PART 2 - PRODUCTS

2.1 OWNER PROVIDED & OWNER VENDOR INSTALLED EQUIPMENT

- A. Playground Equipment: Owner provided as specified in products and materials schedule including the items listed below. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor and installer for delivery and installation at proper time for construction sequencing to keep the project on schedule.
1. Contractor will also be responsible for layout and preparation of playground areas including sub-grading, installation of walls and hardscape/paving features installation.
 2. Contractor shall be responsible to provide staking and layout points as needed for Owner's equipment installer to properly locate their equipment. **Special Care shall be taken by contractor to verify layout and construction of surrounding playground area improvements to provide proper space for required fall zones as shown on the drawings.**
 3. Owner's Vendor Installer will be responsible for equipment installation and any associated footings, including excavation for footings.
 4. Owner Provide Play Equipment includes the following:
 - a. Oodle Swing
 - b. Swing 1 – 8' Tall (with Expression Swing)
 - c. Cozy Dome
 - d. Fossil Dig
 - e. Forest Shop
 - f. Omnispin Spinner
 - g. Cozy Cocoon
 - h. Weevos (2-5 play structure)
 - i. 30" Tunnel Slide
 - j. Harp
 - k. Lilypad Cymbals
 - l. Contrabass Chimes
 - m. Manta Ray instrument
 - n. Tuned Drums
 - o. Speedway 85' Zipline
 - p. Zipkrooz Assisted Zipline
 - q. Swing 2 – 7' Tall (with tire swing)
 - r. Global Motion
 - s. TT-OLA Balance Beam
 - t. Single Hill Loops
 - u. Wavy 4 Rail Climber
 - v. 12' Play Odyssey Tower (5-12 play structure)
 - w. Erosion Boulder
 - x. Crab Trap (5-12 play structure)
 - y. 64" Wiggle Ladder
 - z. Double Embankment Slide
 - aa. Optigear Play Panel

- bb. Ball Maze Play Panel
- cc. Match 4 Play Panel

2.2 OWNER PROVIDED/CONTRACTOR INSTALLED EQUIPMENT

- A. Concrete Dished Sand Sphere & Concrete Sand Table – As specified in Section 323100 Site Improvements. Concrete Dished Sphere and Concrete Sand Table is intended to be a play component and shall also meet the criteria of this specification section.

2.3 CONTRACTOR PROVIDED & CONTRACTOR INSTALLED EQUIPMENT/IMPROVEMENTS

- A. Crawl Tube in mound: As specified in Specification Section 323100 Site Improvements.
 - 1. Crawl Tube in mound is intended to be a play component and shall meet the criteria of this specification sections.
- B. Play Mound: Contractor responsible to shape subgrade and base course per play mound as detailed in preparation for Owner's Vendor to install play surfacing.
- C. Climbing Wall Grips (to be attached to concrete wall): To be provided as specified in the products and materials schedule in locations shown on the drawings. Layout and spacing of climbing wall grips shall be reviewed on-site by the Landscape Architect.
- D. Embankment Slide: Provide as detailed in location shown on the drawings. Contractor shall reference the latest edition of CPSC Public Playground Safety Handbook, section 5.3.6.3.1 Embankment Slides, and take care to install embankment slide in accordance with outlined requirements and guidelines.
- E. Metal Play Ladder: Provide as detailed in location shown on the drawings. Contractor shall reference the latest edition of CPSC Public Playground Safety Handbook, , and take care to install in accordance with outlined requirements and guidelines.

2.4 EARTHWORK MATERIALS

- A. All backfill materials, including base and sub base materials, ordinary borrow, drainage fill and structural fill will be as specified under the Division 31 Section, Earthwork, of this Specification, and provided, delivered and paid for under the work of this Division 32 Section, Playground Equipment. Contractor is responsible, in accordance with specification 312000 Earthwork and the Geotechnical Report (attached in appendix), to over-excavate unsuitable soils, if required, so building is supported on undisturbed non-moisture sensitive soils or properly compacted structural fill extending down to suitable material.

2.5 CONCRETE

- A. As per specification section 321313 – Site Concrete.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. All excavation, filling, compacting and grading of backfill materials, including base and sub base materials, ordinary borrow, drainage fill and structural associated with and used in the installation of the items of this Division 32 Section, Site Improvements, will be as specified under the Division 31 Section, Earthwork, and performed and paid for under the work of this Division 32 Section, Playground Equipment..

3.2 CONCRETE

- A. Concrete footing placement, protection and formwork will be as specified under the Division 32 Section Site Concrete, of this Specification and installed and paid for under the work of this Division 32 Section, Playground Equipment. Concrete footings will be to the sizes required as per manufacturer's installation instructions or as detailed in the drawings..

3.3 INSTALLATION

- A. Do not begin installation before final grading required for placing protective surfacing is completed.
- B. Anchor playground equipment securely, positioned at locations and elevations indicated on Shop Drawings.
- C. Post and Footing Excavation: Hand-excavate holes for posts and footings in firm, undisturbed or compacted subgrade soil. Level bearing surfaces with drainage fill to required elevation.
- D. Post Setting: Set main-frame equipment posts in concrete footing. Protect portion of posts above footing from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Verify that posts are set plumb or at the correct angle and are aligned and at the correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
 - 1. Concrete Footings: Smooth top, and shape to shed water.
- E. Adjust movable playground equipment components to operate smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range.
- F. Verify equipment is installed at proper elevation to allow for safety heights and

END OF SECTION 321800

SECTION 321816 – PLAYGROUND PROTECTIVE SURFACING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes supply and installation of playground protective surfacing.
- B. Related Sections include the following:
 - 1. Division 1 – General Requirements
 - 2. Section 321313 – Site Concrete
 - 3. Section 321800 – Playground Equipment
 - 4. Section 323100 – Site Improvements

1.3 REFERENCES

- A. ASTM F1015 (2003; R 2009) Relative Abrasiveness of Synthetic Turf Playing Surfaces
- B. ASTM F1292 (2009) Impact Attenuation of Surface Systems Under and Around Playground Equipment
- C. ASTM F1487 Playground Equipment for Public Use, latest version.
- D. CPSC Pub No 325 Handbook for Public Playground Safety, latest version.

1.4 DEFINITIONS

- A. Critical Height: The fall height at which the protective surfacing meets the requirements of ASTM F1292.
- B. Designated Play Surface: Any elevated surface for standing, walking, sitting, or climbing; or a flat surface a minimum 50 mm 2 inches wide having up to a maximum 30 degree angle from horizontal. In some play events the platform surface will be the same as the designated play surface. However, the terms should not be interchanged as they do not define the same point of measurement according to ASTM F1487.
- C. Head Injury Criteria (HIC): A measure of impact severity that considers the duration over which the most critical section of the deceleration pulse persists as well as the peak level of that deceleration. Head impact injuries are not believed to be life threatening if the HIC does not exceed a value of 1,000.
- D. Impact Attenuation: The ability of protective surfacing to reduce and dissipate the energy of an impacting body.

- E. Loose Fill: Consisting of small independent movable components such as sand, gravel, or wood chip. The percent of fine material in the loose fill affects its compression properties from rainfall.
- F. Maximum Equipment Height: The highest point on the equipment (i.e.: roof ridge, top of support pole).
- G. Play Event: A piece of manufactured playground equipment that supports one or more play activities.

1.5 SYSTEM DESCRIPTION

- A. Measure the perimeters of the play event use zone in accordance with the requirements of Section 311800 PLAYGROUND EQUIPMENT.
- B. Child Safety: Meet or exceed the impact attenuating performance requirements of synthetic surfacing and loose-fill surfacing systems, installed in the use zones, as follows. The surfacing critical height value shall yield up to both a maximum 200 G's peak deceleration, and a maximum 1,000 Head Injury Criteria (HIC) value for a head-first fall from the play event in accordance with CPSC Pub No 325 and ASTM F1292. The protective surfacing should have a minimum critical height value equal to the height of the highest designated play surface. Sand, gravel, and wood products shall not be installed over a concrete or bituminous subsurface in accordance with CPSC Pub No 325.
- C. QUALITY ASSURANCE
- D. American Standards for Testing and Materials (ASTM): Playground protective safety surfacing shall comply with relevant ASTM standards for specified playground protective safety surfacing materials.
- E. Consumer Products Safety Commission (CPSC): Playground protective safety surfacing shall comply with the requirements of the Consumer Products Safety Commission (CPSC), latest version.
- F. Manufacturer's Experience: Playground protective surfacing shall be furnished by a manufacturer with a minimum of five (5) years' experience in the design, fabrication, and assembly of specified playground protective surfacing.
- G. Installer's Experience: Company specializing in outdoor resilient surfaces in the USA for at least 5 years. The applicator shall be approved and trained, with a minimum of three years' documented experience. Conditions of all surface substrates with respect to structural performance shall be evaluated and approved by the surface installer prior to application of surface system. Installer shall have experience that includes Protective surfacing installation in a minimum 10 sites and been in successful service for a minimum 5 year calendar period. The manufacturer shall provide a Certificate of Insurance as required by Salt Lake County.

1.6 SUBMITTALS

- A. General: Submit in compliance with Division 1 Section "Submittals."
- B. Shop Drawings: Include plans, sections, and details indicating location of specified protective surfacing types and any special attachment or installation details that may deviate from those detailed in the drawings.

- C. Product Data for each product specified
- D. Manufacturer's Qualifications
- E. Installer's Qualifications
- F. Samples: Color samples for review and approval for all materials specified.
- G. Certificates: for each type of protecting surfacing product specified indicating compliance with specification requirements, compliance with CPSC and ASTM standards.
- H. Operation and Maintenance Data: Maintenance instructions to include supplier and installer information, procedures for repair, required maintenance for warranty, and other maintenance considerations and recommendations for each type of product specified.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store delivered materials under this Section in a manner to prevent damage by the elements.
- B. Protect all stored materials and items from weather, careless handling and vandalism.
- C. Items, which become damaged because of non-compliance with these conditions, will be rejected and will be replaced without additional cost to the Owner.

1.8 COORDINATION

- A. Installation of playground protective surfacing shall be coordinated with all necessary trades to insure proper layout, installation, and minimize disturbance or damage to other areas of work. Installation of playground protective surfacing shall be closely coordinated with installation of Playground Equipment to minimize to the greatest extent possible, the timeframe in which play equipment is installed without protective surfacing in place.

1.9 SUBSTITUTIONS

- A. Any proposed product substitutions shall be in accordance with the General Conditions; shall meet or exceed specified warranty; shall be equivalent in specific features and qualities such as performance, weight, size, durability, visual effect; shall be compatible with the rest of the work; and shall not require any changes or revisions to the Construction Documents.

1.10 JOB CONDITIONS

- A. Examine the subgrades, verify that elevations vary no more than 2" above or below subgrade elevation taking into account the elevation allowance needed to accommodate surfacing depths. Observe the conditions under which work is to be performed, and notify the Landscape Architect of unsatisfactory conditions.
- B. Proceed with and complete the work as rapidly as portions of the site become available.

1.11 WARRANTY/GUARANTEE PERIOD

- A. Protective Surfacing Supplier/Installer shall furnish and deliver standard written manufacturer's guarantee in Owner's name covering all materials and workmanship provided or installed by installer under this Division 32 Section, Playground Protective Surfacing, in addition to, and not in lieu of, guarantee requirements set forth under Division 1, General Requirements, and other liabilities which the Contractor may have by law or other provisions of the Contract Documents.
- B. Pay for repairs of any damage to any part of the project, or caused by defects in his work and for any repair to the materials or equipment caused by replacement. Complete all repairs to the satisfaction of the Owner's Representative.
- C. Replace any part of the work installed under this contract requiring excessive maintenance. Work of this nature will be considered defective. Replace at no cost to the Owner upon notification during the one-year guarantee period.

1.12 INSPECTIONS

- A. The installer(s) shall request a site inspection with the Landscape Architect and Owner's Representative at the time of Substantial Completion and again at the end of the warranty period. Inspections will verify compliance to the drawings and specifications. Any items not complying with the drawings and specifications shall be adjusted and/or repaired prior to issuing Substantial Completion or Final Acceptance.
 - 1. The Landscape Architect shall be given a minimum of 7 days notice prior to the site inspections.
- B. A manufacturer's authorized services representative(s) shall be present at the punch list review of the playground protective surfacing. Others present at the punch list review will be the Owner's Representative, the Contractor, and, if applicable, the playground installer subcontractor. Manufacturer's authorized service representative shall not review the protective surfacing without these other parties present.
 - 1. Manufacturer's authorized service representative shall note any items which are not in conformance with the manufacturer's specifications or instructions for installation, and which must be corrected before the playground equipment can be safely used, or which must be corrected in order for the manufacturer's warranties to be in effect.
- C. Contractor(s)/Owner's Vendor Installer(s) responsible for installing playground equipment, elements, or components shall be responsible to verify playground protective surfacing installation meets applicable CPSC and ASTM Playground Safety Guidelines and shall have installation inspected by a Certified Playground Safety Inspector.

PART 2 - PRODUCTS

2.1 OWNER PROVIDED & OWNER VENDOR INSTALLED EQUIPMENT

- A. Playground Surfacing: Owner provided as specified in products and materials schedule including the items listed below. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor and installer for delivery and installation at proper time for construction sequencing to keep the project on schedule.

1. Contractor shall be responsible for preparation of the area including sub-grading and layout of surfacing areas for Owner's Installer, and shaping of subgrade and placement of drainage.
2. Owner's Installer will be responsible for base course and base course compaction for surfacing.
3. Playground Surfacing Includes:
 - a. Rubber Tiles
 - b. Engineered Wood Chips
 - c. Synthetic Turf
 - d. Swing mats

2.2 RUBBER TILES

- A. Shall be as specified in safety surfacing products and materials schedule on the drawings.

2.3 POURED-IN-PLACE RUBBER SURFACING

- A. Shall be as specified in safety surfacing products and materials schedule on the drawings.

2.4 ENGINEERED WOOD CHIPS

- A. As specified in products and materials schedule and meeting the following: Engineered wood fiber manufactured for the purpose of protective surfacing shall consist of particles varying from a minimum 1/8 inch wide to a maximum 1/2 inch thick; and a minimum 1 inch wide to a maximum 3 inches long.

2.5 SYNTHETIC TURF SAFETY SURFACING

- A. Shall be as specified in safety surfacing products and materials schedule.

2.6 AGGREGATE BASE COURSE

- A. Provide Untreated Base Course material conforming to Section 313200 Earthwork.

2.7 CONTAINMENT AND FASTENING EDGES

- A. Containment and fastening edges or curbs include the following: treated wood, concrete, recycled plastic, or recycled plastic molded as lumber. Containment edges shall provide a smooth and hazard-free transition from the protective surfacing to the adjacent surfaces and shall be free of sharp vertical edges, protruding elements and trip hazards. Edges shall be as detailed and as recommended by the manufacturer.

2.8 EARTHWORK MATERIALS

- A. All backfill materials, including base and sub base materials, ordinary borrow, drainage fill and structural fill will be as specified under the Division 31 Section, Earthwork, of this Specification, and provided, delivered and paid for under the work of this Division 32 Section, Playground Protective Surfacing.

2.9 CONCRETE

- A. As per specification section 321313 – Site Concrete.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. All excavation, filling, compacting and grading of backfill materials, including base and sub base materials, ordinary borrow, drainage fill and structural associated with and used in the installation of the items of this Division 32 Section, Playground Protective Surfacing, will be as specified under the Division 31 Section, Earthwork, and performed and paid for under the work of this Division 32 Section, Playground Protective Surfacing.

3.2 CONCRETE

- A. Concrete, if used, will be as specified under the Division 32 Section Site Concrete.

3.3 SITE PREPARATION

- A. Prior to installing the protective surfacing, verify the playground equipment and site improvements are installed in accordance with Section 321800 PLAYGROUND EQUIPMENT, and Section 323100 SITE IMPROVEMENTS.

3.4 LAYOUT

- A. Verify layout of the use zone perimeters for all equipment before installation begins. The use zone is defined as the area beneath and immediately adjacent to a play structure or equipment that is designated for unrestricted circulation around equipment; and on whose surface it is predicted that a user would land when falling from or exiting the equipment. Also, the use zone is associated with the following terms; "Clear Area," and "Fall Zone". The use zone shall be free of hard surfaces, objects or obstacles that a child could run into or fall on top of and be injured. Use zone perimeters shall not overlap hard surfaces. Notify Landscape Architect of any problems or discrepancies prior to proceeding with installation.

3.5 SUBGRADE

- A. Correct subgrade irregularities to ensure the required depth of protective surfacing is provided. The subgrade elevation shall be as required by the manufacturer.

3.6 SUBSURFACE

- A. Install the subsurface in a true, even plane, and sloped to provide positive drainage as indicated.

3.7 SUBBASE

- A. Tolerance of aggregate subbase shall be within a maximum similar to 1/4 inch in 10 feet. Compact aggregate subbase to a maximum 95 percent, ASTM D1557. The compaction shall be completed in accordance with Section 313200 EARTHWORK. Compaction testing shall be completed for each area of base course. If testing indicates base does not meet required compaction, re-compact and test again at no expense to the owner. Sand, gravel, and wood products shall not be installed over a concrete, aggregate, or bituminous subbase.

3.8 FALL HEIGHT

- A. Verify Protective Surfacing depths meet play equipment and component fall height requirements prior to installation. Notify Landscape Architect and County Project Manager of any discrepancies prior to proceeding with installation.

3.9 INSTALLING SYNTHETIC SURFACING SYSTEM

- A. Install in accordance with manufacturer's installation requirements and as detailed. Surfacing edges shall fully adhere to the subsurface. Fully cover the subsurface to ensure no hard surfaces are exposed through displacement of loose fill. Rolled or beveled containment curb or transition edges shall maintain the full thickness required to meet fall height requirements. Material shall cover foundation and cutouts around elements penetrating the surface. Seams shall be the minimum necessary and shall be tight.

3.10 TILE SYSTEM INSTALLATION

- A. Tile shall be laid out to ensure that end cuts are equal. Tile shall be installed in accordance with manufacturer's instructions. Hardware shall be as recommended by the manufacturer. Tile shall be bonded to the subsurface with an adhesive approved by the manufacturer. Cutouts shall be filled with sealant according to manufacturer's instructions to eliminate voids at equipment. Sealant shall be the minimum amount necessary, shall not exceed a maximum 3/8 inch width. Where excessive voids occur at cutouts, tile shall be removed and refitted. The tile system shall be installed throughout the play equipment use zone with the proper thickness.

3.11 POURED-IN-PLACE RUBBER SURFACING

- A. Poured-in-Place Rubber surfacing shall be installed in accordance with manufacturer's instructions. Hardware shall be as recommended by the manufacturer. Rubber surfacing shall be applied as approved by the manufacturer by a certified Rubber Surfacing Installer. Rubber surfacing shall be placed to eliminate voids at equipment. Excessive voids occurring at equipment will have to be corrected prior to acceptance. The rubber surfacing system shall be installed throughout the play equipment use zone with the proper thickness.

3.12 ENGINEERED WOOD CHIP INSTALLATION

- A. Submit a minimum 1 gallon sample.
- A. Engineered wood chips shall be installed over gravel drainage course as detailed an in accordance with manufacturer's instructions to depths specified and required to meet minimum fall height requirements, but in no case less than 12" deep.

3.13 RESTORATION AND CLEAN UP

- A. When the operation has been completed, clean up and protect the site. Existing areas that have been damaged from the operation shall be restored to original condition at the Contractor's expense.
- B. Clean Up: The site and play events shall be cleaned of all materials associated with the operation. Play events and surfaces shall be cleaned of dirt, stains, filings, and other blemishes occurring from shipment and installation. Cleaning methods and agents shall be as recommended by the manufacturer.

3.14 PROTECTION

- A. The area shall be protected as required or directed by providing barricades and signage.

3.15 Disposal of Materials

- A. Excess and waste material shall be removed and legally disposed of off-site.

3.16 PROTECTIVE SURFACING ACCEPTANCE

- A. Submit record of measurements and findings by the certified playground safety inspector. When the protective surfacing is installed, the play events and protective surfacing shall be thoroughly inspected and measured to verify the playground meets manufacturer's recommendations, as follows:
 - 1. Measure use zone distances to determine the area is free of hard surfaces, objects or obstacles. Determine exceptions to use zone overlaps occur in accordance with ASTM F1487. Measure play event fall height and compare to critical height value for the thickness of installed synthetic surfacing. Measure play event fall height and depth of loose fill protective surfacing.
 - 2. The finished installation shall have the appearance of a single covering. Protective surfacing that does not comply shall be reinstalled. Hardware that does not comply shall be replaced. Ensure positive drainage for the area and the lowest elevation of protective surfacing subgrade has been provided.
 - 3. A written report describing the results of the evaluation shall be provided.

3.17 RE-INSTALLATION

- A. When re-installation is required, the following shall be accomplished. Re-install the product as specified. Provide new replacement materials supplied by the manufacturer (material acquisition of replacement parts is the responsibility of the Contractor). Damage caused by the failed installation shall be repaired at the Contractor's expense.

END OF SECTION 321816

SITE IMPROVEMENTS – SECTION 323100

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The General Documents, as listed on the Table of Contents, and applicable parts of Division 1, General Requirements, will be included in and made a part of this Section.
- B. Examine all Contract Documents and all other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SUMMARY

- A. The work of this Section consists of providing all labor, equipment, materials, coordinating with owner's vendor (for owner provided materials), incidental work, and construction methods necessary to furnish and install designated Site Improvements and related items as indicated on the Contract Documents, as specified in this Section, and includes, but is not limited to, the following:

- 1. Pavilions
- 2. Playground Equipment
- 3. Playground Protective Surfacing
- 4. Park Monument Sign
- 5. Site Furnishings (pavilion picnic tables, backed benches, backless benches, bench tops for seat walls, bike racks, doggy waste stations)
- 6. Drinking Fountains
- 7. Tree Guards
- 8. Concrete Dished Sphere Play Element
- 9. Concrete Sand Table Play Element
- 10. Concrete Chess Table
- 11. Concrete Corn Hole Game
- 12. Concrete Seat Walls
- 13. Stacked Stone Slab Walls at Splash Pad
- 14. Landscape Boulders
- 15. Boulder Walls (single row only)
- 16. Natural Stone Stairs and Stepping Stones
- 17. Climbing Wall Grips
- 18. Headwaters Splash Pad Feature
- 19. Boat Racer Splash Pad Feature
- 20. Interactive Water Stone Slab Splash Pad Feature
- 21. Stone Columns at Splash Pad
- 22. Metal Art Sculpture at Center Plaza
- 23. Seat Wall with Pipes Feature
- 24. Concrete Column with Wind Sculpture
- 25. Concrete Column Entry Feature
- 26. Pipe Entry Features
- 27. Tunnel Mound
- 28. Oolitic Playground Sand
- 29. ADA Parking Signage
- 30. No Parking Signage
- 31. Traffic Signage and Painted Arrows
- 32. Custom Concrete Embankment Slide
- 33. Faux Bridge at Splash Pad
- 34. Scavenger Hunt Plaques
- 35. Informational Signs
- 36. Selfie Station imbed

37. Chain Link Fence
38. Metal Railing, barriers, and guardrails

1.3 RELATED WORK UNDER OTHER SECTIONS

- A. Related work specified and included in other Sections of the Specifications:

1. Division 31 - Earthwork
2. Section 321313 – Concrete Paving

1.4 REFERENCES

- A. The following standards will apply to the work of this Section:

1. American Society for Testing and Materials (ASTM).
 - a. ASTM A-53/A53M-01 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - b. ASTM D143-94(2000)e1 Standard Methods of Testing Small Clear Specimens of Timber.
 - c. ASTM D 198-99 Standard Test Methods of Static Tests of Lumber in Structural Sizes.
 - d. ASTM E 228-95 Standard Test Method for Linear Thermal Expansion of Solid Materials With a Vitreous Silica Dilatometer.
2. TT-C-490C, Methods I and III.
3. AWS standard D1.1.

1.5 SUBMITTALS

- A. Furnish for approval all Manufacturers' specifications for all items listed in this Section
- B. Shop Drawings: The contractor shall submit Shop Drawings where noted for review and acceptance prior to product fabrication or delivery to the site. Shop Drawings shall be complete with respect to quantities, dimensions, specified performance and design criteria, materials, color, and similar data to enable an adequate review of the information required.
- C. Color Samples: Provide color samples for all equipment.
- D. Samples for Verification: For each of the following:
1. Landscape Boulder –sample of landscape boulder identifying source, including name and telephone number of supplier. Samples shall demonstrate representative colors, size, and overall form.
 2. Stone for Stone Slab Walls – sample not required but stone shall be selected at Quarry with contractor and Landscape Architect.
 3. Oolitic Sand – 1 gallon zip lock bag sample identifying source, including name and telephone number of supplier.
- E. Sample Panels and Mockups
- a. Job mock-up: Prior to installation of stacked stone slab walls and boulder walls, erect sample wall mock-ups showing proposed stone size, pattern, texture, using materials, erection methods, jointing, and workmanship required for final work.
 - b. Obtain Landscape Architect's and Owner's Authorized Representative's acceptance of visual qualities of mock-up before start of any remaining stone work.

- c. Mock-ups may remain in place as part of finished construction once approved.

1.6 SUBSTITUTIONS

- A. Any proposed product substitutions shall be in accordance with the General Conditions; shall meet or exceed specified warranty; shall be equivalent in specific features and qualities such as performance, weight, size, durability, visual effect; shall be compatible with the rest of the work; and shall not require any changes or revisions to the Construction Documents..

1.7 QUALITY ASSURANCE AND STANDARDS

- A. Workmanship and finish will be equal to the best practice of modern shops for each item of work.
- B. Inspect all components for correct fabrication and compliance with Specifications.

1.8 DELIVERIES, STORAGE, AND HANDLING

- A. Store delivered Site Improvement items under this Section in a manner to prevent wracking or stress of components, and to prevent mechanical damage or damage by the elements.
- B. Protect all stored materials and items from weather, careless handling and vandalism.
- C. Items, which become rusted or damaged because of non-compliance with these conditions, will be rejected and will be replaced without additional cost to the Owner.

1.9 GENERAL INSTALLATION

- A. Configure or secure exposed anchors, bolts or fasteners in such a way as to prevent their casual removal by use of vandal-proof heads or fastenings unless otherwise specified on Drawings.
- B. Provision, delivery and installation of all materials, except as otherwise specified under other Sections of this Specification, will be in accordance with and paid for under the work of this Division 32 Section, Site Improvements.
- C. Unless specifically called out in the Contract Documents, galvanized steel or cast iron sections to be joined will not be welded after galvanizing but will be mechanically attached by means of unexposed sleeves and fasteners sufficient to provide secure attachment under normal usage.
- D. Set freestanding site improvement items plumb vertically and horizontally, regardless of the pitch of the finished surrounding grade unless otherwise shown on the Contract Documents.
- E. The Contractor will be responsible for timing the delivery of site improvement items to minimize the on-site storage time prior to installation.
- F. Protect all stored materials from weather, careless handling, and vandalism.
- G. Contractor will be responsible for the correct location of site improvement items. Take particular care to maintain shapes, plumb and level during the pouring of concrete.
- H. All Work will be accurately set to established lines and elevations and rigidly set in place to supporting construction.

1.10 COORDINATION

- A. The Work of this Division 32 Section, Site Improvements, will be completely coordinated with the work of other Sections. Verify dimensions and work of other trades that adjoin materials of this Section before installing items specified.
- B. Contractor shall work with the City and necessary equipment representatives to coordinate delivery of all Owner Provided Materials in a timely manner as necessary to keep construction on schedule.

1.11 GUARANTEE

- A. The Contractor will furnish and deliver standard written manufacturer's guarantee in Owner's name covering all materials and workmanship under this Division 32 Section, Site Improvements, in addition to, and not in lieu of, guarantee requirements set forth under Division 1, General Requirements, and other liabilities which the Contractor may have by law or other provisions of the Contract Documents.
- B. Pay for repairs of any damage to any part of the project, or caused by defects in his work and for any repair to the materials or equipment caused by replacement. Complete all repairs to the satisfaction of the Owner's Representative.
- C. Replace any part of the work installed under this contract requiring excessive maintenance. Work of this nature will be considered defective. Replace at no cost to the Owner upon notification during the one-year guarantee period.

PART 2 PRODUCTS

2.1 OWNER PROVIDED & OWNER VENDOR INSTALLED EQUIPMENT/IMPROVEMENTS

- A. Medium Pavilions (28' x 40'): Owner provided as specified in products and materials schedule. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor and installer for delivery and installation at proper time and construction sequencing to keep the project on schedule. Contractor will also be responsible for grading work, concrete pad, and electrical and lighting work associated with Pavilions.
 - 1. Owner's Vendor Installer will be responsible for footings and footing excavation and installation/erection of pavilion.
- B. Small Pavilions (15'x 30'): Owner provided as specified in products and materials schedule. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor and installer for delivery and installation at proper time and construction sequencing to keep the project on schedule. Contractor will also be responsible for grading work, concrete pad, and concrete seat walls associated with Pavilions.
 - 1. Owner's Vendor Installer will be responsible for footings and footing excavation and installation/erection of pavilion.
- C. Playground Equipment: Owner provided as specified in products and materials schedule including the items listed below. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor and installer for delivery and installation at proper time for construction sequencing to keep the project on schedule.
 - 1. Contractor will also be responsible for layout and preparation of playground areas including sub-grading, installation of walls and hardscape/paving features installation.

2. Contractor shall be responsible to provide staking and layout points as needed for Owner's equipment installer to properly locate their equipment. **Special Care shall be taken by contractor to verify layout and construction of surrounding playground area improvements to provide proper space for required fall zones as shown on the drawings.**
 3. Owner's Vendor Installer will be responsible for equipment installation and any associated footings, including excavation for footings.
 4. Playground Equipment to be Owner Provided and Owner Vendor Installed includes the following:
 - a. Oodle Swing
 - b. Swing 1 – 8' Tall (with Expression Swing)
 - c. Cozy Dome
 - d. Fossil Dig
 - e. Forest Shop
 - f. Omnispin Spinner
 - g. Cozy Cocoon
 - h. Weevos (2-5 play structure)
 - i. 30" Tunnel Slide
 - j. Harp
 - k. Lilypad Cymbals
 - l. Contrabass Chimes
 - m. Manta Ray instrument
 - n. Tuned Drums
 - o. Speedway 85' Zipline
 - p. Zipkrooz Assisted Zipline
 - q. Swing 2 – 7' Tall (with tire swing)
 - r. Global Motion
 - s. TT-OLA Balance Beam
 - t. Single Hill Loops
 - u. Wavy 4 Rail Climber
 - v. 12' Play Odyssey Tower (5-12 play structure)
 - w. Erosion Boulder
 - x. Crab Trap (5-12 play structure)
 - y. 64" Wiggle Ladder
 - z. Double Embankment Slide
 - aa. Optigear Play Panel
 - bb. Ball Maze Play Panel
 - cc. Match 4 Play Panel
- D. Playground Surfacing: Owner provided as specified in products and materials schedule including the items listed below. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor and installer for delivery and installation at proper time for construction sequencing to keep the project on schedule.
1. Contractor shall be responsible for preparation of the area including sub-grading, drainage and layout of surfacing areas for Owner's Installer. Owner's Installer will be responsible for base course and base course compaction for surfacing.
 2. Playground Surfacing Includes:
 - a. Rubber Tiles
 - b. Poured-in-Place Rubber Surfacing
 - c. Synthetic Turf
 - d. Engineered Wood Chips
 - e. Swing Mats
- E. Monument Sign (Park Entry): Monument Park Sign to be provided and installed by Owner's Vendor in location shown on the drawings. Contractor is responsible for mow curb and all

associated landscaping surrounding the Monument Sign. Coordinate with owner's contractor as required to work out sequencing and timing of sign construction to work with schedule of park construction.

- F. Informational Signs: To be owner provided, owner's vendor installed. Coordinate with owner's contractor as required to work out sequencing and timing of sign construction to work with schedule of park construction.

2.2 OWNER PROVIDED/CONTRACTOR INSTALLED EQUIPMENT/IMPROVEMENTS

- A. Pavilion Picnic Tables: To be provided by Owner as specified in products and materials schedule for Contractor to install. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- B. Backed and Backless Benches: To be provided by Owner as specified in products and materials schedule for Contractor to install. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- C. Wall Mounted Bench Tops for Seat Walls: To be provided by Owner as specified in products and materials schedule for Contractor to install. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- D. Bike Racks: To be provided by Owner as specified in products and materials schedule for Contractor to install. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- E. Dog Waste Station: To be provided by Owner as specified in products and materials schedule for Contractor to install. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- F. Drinking Fountain: To be provided by Owner as specified in products and materials schedule for Contractor to install. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- G. Tree Guards: To be provided by Owner as specified in products and materials schedule for Contractor to install. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- H. Concrete Dished Sand Sphere Play Element: To be provided by Owner as specified in products and materials schedule for Contractor to install. Contractor shall install as detailed. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- I. Concrete Sand Table Play Element: To be provided by Owner as specified in products and materials schedule for Contractor to install. Contractor shall install as detailed. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- J. Concrete Chess Table and Seats: To be provided by Owner as specified in products and materials schedule for Contractor to install. Contractor shall install as detailed. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- K. Concrete Corn Hole Game: To be provided by Owner as specified in products and materials schedule for Contractor to install. Contractor shall install as detailed. Contractor shall be

responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.

- L. Scavenger Hunt Plaques – To be Owner Provided contractor installed with anticipated size to be 12' x18" size.

2.3 CONTRACTOR PROVIDED & CONTRACTOR INSTALLED SITE IMPROVEMENTS

- G. Concrete Seat Walls: Provide as detailed and in accordance with specification Section 321313 Concrete
- H. Stacked Stone Slab Walls: Stone for stacked stone slab walls shall be as specified in product and materials schedule. **Stone to be handpicked by Contractor and Landscape Architect at quarry in size ranges as noted.** Walls to be provided as detailed in locations shown on the drawings.
- I. Landscape Boulders: Provide landscape boulders of hard, durable stone washed free of loam, sand, clay and other foreign substance. Landscape boulders shall be provided in quantities, sizes, and general shapes as indicated on drawings. Boulders shall have naturally flat tops with naturally rounded corners. Boulder color shall be buff to tan and of similar color of stone used for Stone Slab Walls and Stone Columns at Splash Pad (see materials schedules on Layout and Materials Plans. Representative samples shall be submitted at the site for approval of color, shape, and size. Approval of sample does not constitute final acceptance. All boulders shall be approved on site by Owner's Authorized Representative upon delivery to verify compliance with the sample and shape and size. Boulders not having naturally flat tops with rounded edges will be rejected
- J. Boulder Walls: Provide boulder wall as detailed in locations shown on drawings. Stone products used for boulder wall shall be as specified in products and materials schedule and as detailed.
 - 1. All boulder walls shall be installed by same installer to ensure look of Boulder Walls matches across the whole project. No Exceptions.
 - 2. Submit Sample for approval prior to delivery to the site.
 - 3. Construct Wall Mock up for approval prior to constructing wall.
- K. Natural Stone Steps & Stepping Stones: Provide natural stone steps and stepping stone of size, type, and material as specified in products and materials schedule and as detailed.
 - 1. Stairs & Stepping Stones: Size and type as specified on the product and materials schedule and as detailed.
 - 2. Submit Sample for Approval.
- L. Climbing Wall Grips (to be attached to Concrete Wall): To be provided as specified in the products and materials schedule in locations shown on the drawings. Layout and spacing of climbing wall grips shall be reviewed on-site by the Landscape Architect.
- M. Specialty Splash Pad Features:
 - 1. Headwaters Feature: Provide as detailed in locations shown on the plans.
 - 2. Boat Racer Feature: Provide as detailed in locations shown on the plans. **Concrete for boat racer shall meet specification of splash pad concrete.**
 - 3. Stone Slab Interactive Water Feature: Provide as detailed in locations shown on the plans.
 - 4. Stone Columns: Provide as detailed in locations shown on the plans.
 - 5. Submit Shop Drawing for approval of materials, colors, layout, fabrication and to insure design intent is achieved.

6. If shop drawings differ from or add to the design of the structural engineered drawings, they shall bear the seal and signature of a structural engineer registered in the state of Utah.
 7. Coordinate as required with splash pad contractor for piping, nozzles, and necessary coordination of entire splash pad construction.
- N. Metal Art Sculpture at Center Plaza:
1. Provide Art Feature and associated components in locations shown and as detailed on the drawings.
 2. Decorative Metal Entry Components – Approved metal fabricator to be Metal Arts Foundry (contact Kevin Maag, 801.768.4442, ext. 101) or approved equal. Contractor to submit qualification information for approval of other metal fabricators for approval by owner and Landscape Architect. Install as detailed after approval of shop drawings. **Submit shop drawings for review and approval.** If shop drawings differ from or add to the design of the structural engineered drawings, they shall bear the seal and signature of a structural engineer registered in the state of Utah.
 3. All steel post members to be 304L stainless steel.
 4. Metal cutout panel to have raw finish treated with chemical patina (to weather the steel) and then coated with Nicolas Lacquer to seal and minimize rust drip.
- O. Seat Wall With Pipes Features:
1. Provide Seat Wall Pipe Features and associated components in locations shown and as detailed on the drawings.
 2. Concrete seat wall as detailed. Coordinate with metal fabricator and installer for proper sequencing and installation of stainless steel pipe components.
 3. Decorative Metal Components – Approved metal fabricator to be Metal Arts Foundry (contact Kevin Maag, 801.768.4442, ext. 101) or approved equal. Contractor to submit qualification information for approval of other metal fabricators for approval by owner and Landscape Architect. **Submit shop drawings for review and approval.** Install as detailed after approval of shop drawings. If shop drawings differ from or add to the design of the structural engineered drawings, they shall bear the seal and signature of a structural engineer registered in the state of Utah.
 4. All steel members to have 304L Stainless Steel Finish.
- P. Concrete Columns with Wind Sculpture Feature:
1. Provide concrete columns with turbine features and associated components in locations shown and as detailed on the drawings.
 2. Concrete columns as detailed. Coordinate with metal fabricator and installer for proper sequencing and installation of stainless steel pipe components.
 3. Decorative Metal Entry Components – Approved metal fabricator to be Metal Arts Foundry (contact Kevin Maag, 801.768.4442, ext. 101) or approved equal. Contractor to submit qualification information for approval of other metal fabricators for approval by owner and Landscape Architect. **Submit shop drawings for review and approval.** Install as detailed after approval of shop drawings. If shop drawings differ from or add to the design of the structural engineered drawings, they shall bear the seal and signature of a structural engineer registered in the state of Utah.
 4. All steel members to have 304L Stainless Steel Finish.
 5. Scavenger Hunt Plaques: shall be owner provided and contractor installed on columns in locations as shown in the drawings. Plaques are anticipated to be approximately 12"x18" in size and anchored into concrete column.
- Q. Concrete Column Entry Features
1. Provide concrete entry columns in locations shown and as detailed on the drawings.
- R. Pipe Entry Features:

1. Provide Pipe Entry Features and associated components in locations shown and as detailed on the drawings.
 2. Decorative Metal Entry Components – Approved metal fabricator to be Metal Arts Foundry (contact Kevin Maag, 801.768.4442, ext. 101) or approved equal. Contractor to submit qualification information for approval of other metal fabricators for approval by owner and Landscape Architect. **Submit shop drawings for review and approval.** Install as detailed after approval of shop drawings. If shop drawings differ from or add to the design of the structural engineered drawings, they shall bear the seal and signature of a structural engineer registered in the state of Utah.
 3. All steel members to have 304L Stainless Steel Finish.
- S. Tunnel Mound: Provide Tunnel Mound in locations shown on the drawings and as detailed. Contractor to provide and install tunnel pipe, base course and shotcrete and coordinate with Poured In Place Rubber Surfacing contractor for requirements needed for Poured In Place Rubber Surfacing installation.
- T. Play Mound: Contractor responsible to shape subgrade and base course per playmound details and coordinate with Poured in Place Rubber Surfacing contractor in preparation for Owner's Vendor to install play surfacing.
- U. Oolitic Playground Sand (at sand area in playground): Sand shall be as specified in products and materials schedule. Sand must be Oolitic Sand as specified. **A different type of sand will not be approved. Sand shall be screened as required to remove any debris, gravel, or rock.**
- V. ADA Parking Signage: Provide ADA Parking Signs as detailed and in locations shown on the drawings and in conformance with all ADA Standards. Provide shop drawing for approval.
- W. No Parking Signs: Provide No Parking Signs as detailed and in locations shown on the drawings. Provide shop drawings for approval.
- X. Traffic Signage and Painted Direction Arrows: Provide Traffic Signage such as Stop Signs, One Way, etc., and directional arrows meeting all City Standards and Requirements in locations shown on the drawings and in conformance with all Traffic Standards. Painted Directional Arrows shall meet Manual of Uniform Traffic Control Devices (MUTCD) standards.
- Y. Embankment Slide: Provide as detailed in location shown on the drawings. Contractor shall reference the latest edition of CPSC Public Playground Safety Handbook, section 5.3.6.3.1 Embankment Slides, and take care to install embankment slide in accordance with outlined requirements and guidelines.
- Z. Faux Bridge at Splash Pad: Provide as detailed in location shown on the drawings. Submit shop drawing and obtain approval of colored concrete color prior to construction.
- AA. Selfie Station Imbed – Provide as detailed in locations shown on plan. Submit shop drawing for approval prior to delivery to site.
- BB. Chain Link Fencing: Provide chain link fencing as detailed and in accordance with specification section 323113-Chain Link Fences and Gates.
- CC. Metal Play Ladder: contractor to provide metal play ladder as detailed in locations as shown on the plan. Submit shop drawing and obtain approval of ladder fabrication and color prior to construction.
- DD. Metal Railings & Barriers:
 1. Handrails: Provide metal handrails as detailed and in accordance with specification section 057210-Metal Railings.

2. Metal Playground Barrier: Provide metal playground rail barriers as detailed and in accordance with specification section 057210-Metal Railings.
3. Embankment Slide Top Rail: Provide embankment slide top rail as detailed and in accordance with specification section 057210-Metal Railings
4. Contractor to submit shop drawings for review for all railings, showing layout, finish, and color prior to fabrication and delivery to the site

2.4 EARTHWORK MATERIALS

- A. All backfill materials, including base and sub base materials, ordinary borrow, drainage fill and structural fill will be as specified under the Division 31 Section, Earthwork, of this Specification, and provided, delivered and paid for under the work of this Division 2 Section, Site Improvements.

PART 3 EXECUTION

3.1 EARTHWORK

- A. All excavation, filling, compacting and grading of backfill materials, including base and sub base materials, ordinary borrow, drainage fill and structural associated with and used in the installation of the items of this Division 32 Section, Site Improvements, will be as specified under the Division 31 Section, Earthwork, and performed and paid for under the work of this Division 32 Section, Site Improvements.

3.2 CONCRETE

- A. Concrete footing placement, protection and formwork will be as specified under the Division 32 Section Site Concrete, of this Specification and installed and paid for under the work of this Division 32 Section, Site Improvements. Concrete footings will be to the sizes noted on the Contract Documents.

3.3 OWNER PROVIDED & OWNER VENDOR INSTALLED EQUIPMENT/IMPROVEMENTS INSTALLATION

- A. Pavilions (28'x 40' and 15' x 30'): Pavilions to be installed by Owner's Vendor Installer. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor and installer for delivery and installation at proper time and construction sequencing to keep the project on schedule.
 1. Contractor shall be responsible for grading work, concrete pad, and electrical and lighting work associated with pavilions.
 2. Coordinate pavilion post footings with electrical work for electrical conduits at pavilion post footings.
 3. Owner's Vendor Installer will be responsible for footings and footing excavation and installation/erection of pavilion.
- B. Playground Equipment: Owner's Vendor to install listed playground equipment. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor and installer for delivery and installation at proper time for construction sequencing to keep the project on schedule.
 1. Contractor will be responsible for layout and preparation of playground areas including sub-grading, installation of walls and hardscape/paving features installation.
 2. Contractor shall be responsible to provide staking and layout points as needed for Owner's equipment installer to properly locate their equipment. **Special Care shall be taken by contractor to verify layout and construction of surrounding playground area improvements to provide proper space for required fall zones as shown on the drawings.**

3. Owner's Vendor Installer will be responsible for equipment installation and any associated footings, including excavation for footings.
- C. Playground Surfacing: Owner's Vendor to install Playground Protective Surfacing. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor and installer for delivery and installation at proper time for construction sequencing to keep the project on schedule.
1. Contractor shall be responsible for preparation of the area including sub-grading and placement of drainage in Engineered Wood Chip areas.
 2. Contractor shall also be responsible for layout of surfacing areas for Owner's Installer as needed for Owner's installer to install surfacing in locations, shapes, and areas as indicated on the drawings.
 3. Contractor will be responsible for base course and base course compaction for surfacing.
- D. Monument Sign (Park Entry): Owner will have a separate contractor construct Park Entry Monument Sign. Contractor shall coordinate with Owner's Contractor for proper sequencing to avoid delays and to keep project on schedule. Contractor shall be responsible for landscaping, irrigation, concrete mow curbs surrounding sign.
- E. Informational Signs: To be owner provided, owner's vendor installed. Coordinate with owner's contractor as required to work out sequencing and timing of sign construction to work with schedule of park construction.
- 3.4 OWNER PROVIDED/CONTRACTOR INSTALLED EQUIPMENT & IMPROVEMENTS
- A. Pavilion Picnic Tables: Install Owner provided picnic tables in locations shown on drawings, as detailed, and in accordance with manufacturer's installation instructions. Picnic Tables shall be secured to concrete slab with 4" rawl spike concrete anchor. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- B. Backed and Backless Benches: Install owner provided benches in locations shown on drawings, as detailed, and in accordance with manufacturer's installation instructions. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- C. Wall Mounted Bench Tops for Seat Walls: Install owner provided bench tops in locations shown on drawings and in accordance with manufacturer's installation instructions. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- D. Bike Racks: Install owner provided bike racks in locations shown on drawings, as detailed, and in accordance with manufacturer's installation instructions. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- E. Dog Waste Station: Install owner provided dog waste stations in locations shown on drawings, as detailed, and in accordance with manufacturer's installation instructions. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- F. Drinking Fountain: Install owner provided Drinking Fountain in locations shown on drawings, as detailed, and in accordance with manufacturer's installation instructions. Drinking Fountains shall be installed with drainage sump as detailed. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.

- G. Tree Guards: Install owner provided tree guards in locations shown on drawings, as detailed, and in accordance with manufacturer's installation instructions. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- H. Concrete Dished Sphere Play Element: Install owner provided item in location shown on drawings and as detailed. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- I. Concrete Sand Table Play Element: Install owner provided item in location shown on drawings and as detailed. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- J. Concrete Chess Table and Seats: Install owner provided item in location shown on drawings, as detailed, and in accordance with manufacturer's installation requirements. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.
- K. Concrete Corn Hole Game: Install owner provided item in location shown on drawings, as detailed, and in accordance with manufacturer's installation requirements. Contractor shall be responsible to coordinate with Owner and/or Owner's vendor for timing of delivery as required to keep project on schedule.

3.5 CONTRACTOR PROVIDED/CONTRACTOR INSTALLED EQUIPMENT & IMPROVEMENTS

- A. Concrete Seat Walls: shall be installed as detailed in locations shown on the drawings.
- B. Stacked Stone Slab Walls: Install walls as detailed in locations shown on the drawings. See grading plan for elevations of top and bottom of walls.
 - 1. Layout and location of stone slab walls shall be reviewed on-site by Landscape Architect prior to installation.
 - 2. Construct Wall Mock up for approval prior to constructing wall.
- C. Landscape Boulders: Install landscape boulders as detailed and in locations shown on the drawings.
- D. Boulder Walls: Install boulder walls as detailed in locations shown on the drawings. See grading plans for elevations of top and bottom of wall.
 - 1. Layout and location of boulder walls shall be reviewed on-site by Landscape Architect prior to installation.
 - 2. Construct Wall Mock up for approval prior to constructing wall.
- F. Natural Stone Steps & Stepping Stones: Install natural stone steps and stepping stones as detailed in locations shown on the drawings. Stone stairs shall be uniform and true, with the slope on tread surfaces not to exceed 2%.
- G. Climbing Wall Grips (to be attached to Concrete Wall): Install climbing wall grips in accordance with manufacturer's installation recommendations. Layout and spacing of climbing wall grips shall be reviewed on-site by the Landscape Architect prior to installation.
- H. Headwaters Splash Pad Feature: Install components of Headwaters Splash Pad Feature as detailed in location shown on the drawings after approval of shop drawings. Contractor shall coordinate with splash pad contractor to ensure plumbing and splash pad equipment for headwaters feature is accounted for and fits and works properly.

- I. Boat Racer Splash Pad Feature: Install components of Boat Racer Feature as detailed in location shown on the drawings after approval of shop drawings. Contractor shall coordinate with splash pad contractor to ensure plumbing and splash pad equipment for headwaters feature is accounted for and fits and works properly.
- J. Stone Columns at Splash Pad: Install components of Stone Column Feature as detailed in location shown on the drawings after approval of shop drawings. Contractor shall coordinate with splash pad contractor to ensure plumbing and splash pad equipment for headwaters feature is accounted for and fits and works properly.
- K. Art Feature at Center Plaza: Install components of art feature as detailed in locations shown on the drawings after approval of shop drawings.
 - 1. Metal Silhouette Panel shall be securely attached with fabricator's approved fasteners and hardware.
 - 2. Concrete Seat walls and Pipe Member footings shall be coordinated to avoid conflicts.
- G. Seat Wall With Pipes Features:
 - 1. Install features as detailed in locations shown on the drawings and in accordance with approved shop drawings.
 - 2. Coordinate Pipe footings with wall footings to avoid conflicts.
- H. Concrete Columns with Wind Sculpture:
 - 1. Install concrete columns as detailed in locations shown on the drawings and in accordance with specification section 321313 Site Concrete.
 - 2. After approval of submitted Shop Drawings, install decorative metal wind sculpture components as detailed and in strict accordance with approved shop drawings.
- I. Pipe Entry Feature:
 - 1. Install pipe entry feature elements as detailed in locations shown on the drawings after approval of submitted Shop Drawings and in strict accordance with approved shop drawings.
- J. Tunnel Mound: Install pipe for tunnel mound and construct mound as detailed. Coordinate with Owner's Poured in Place Rubber Surfacing Contractor to ensure mound material compaction and preparation meets requirements for Poured in Place Rubber Surfacing. Tunnel Mound shall be constructed to meet applicable CPSC Playground guidelines.
- K. Play Mounds: Construct mound base as detailed. Coordinate with Owner's Poured in Place Rubber Surfacing Contractor to ensure mound material compaction and preparation meets requirements for Poured in Place Rubber Surfacing. Play Mounds shall be constructed to meet applicable CPSC Playground guidelines.
- L. Playground Oolitic Sand (at sand area in playground): Install specified sand to a depth specified on drawings in Playground Area in locations shown on the drawings and as detailed in accordance with all CPSC Playground Guidelines and manufacturer installation requirements.
- M. ADA Parking Signage: Install ADA Parking Signs as detailed and in accordance with all ADA Standards.
- N. No Parking Signs: Install signs as detailed in all locations shown on the drawings.
- O. Traffic Signage and Painted Direction Arrows: Install Traffic Signs and directional arrows in locations noted on the drawings as per Township Standards and Requirements and in

conformance with all Traffic Standards. Painted Directional Arrows shall meet Manual of Uniform Traffic Control Devices (MUTCD) standards.

- P. Embankment Slide: Install Embankment slide as detailed in location shown on the drawings. Contractor shall reference the latest edition of CPSC Public Playground Safety Handbook, section 5.3.6.3.1 Embankment Slides, and take care to install embankment slide in accordance with outlined requirements and guidelines.
- Q. Faux Bridge at Splash Pad: shall be installed as detailed in location shown on the drawings. Contractor shall coordinate with splash pad contractor to ensure all plumbing, drainage, and splash pad components are properly accounted for.
- R. Selfie Station Imbed – Embed icon as detailed and in accordance with shop drawings in locations shown on plan.
- S. Chain Link Fencing: install as detailed and in accordance with specification section 323113 Chain Link Fences and Gates.
- T. Metal Play Ladder: install as detailed in locations as shown on the plan.
- U. Metal Railings & Barriers:
 - 1. After approval of shop drawings, install metal railings and barriers as detailed and in accordance with specification section 057210-Metal Railings in locations shown on plans.
 - 2. **All locations for core drills and surface mounting must be reviewed and approved by Landscape Architect prior to drilling. No Exceptions!**
 - 3. All railing posts shall be plumb and true.
 - 4. All welds and seams shall be ground smooth.
 - 5. Finish and color to be as specified in Section 057210-Metal Railings.

END OF SECTION 323100

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Chain link fabric, posts, braces, anchorage, gates, miscellaneous hardware and appurtenances.

1.2 REFERENCES

- A. ASTM A 53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- B. ASTM A 121: Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
- C. ASTM A 392: Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
- D. ASTM A 491: Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
- E. ASTM A 585: Standard Specification for Aluminum-Coated Steel Barbed Wire.
- F. ASTM A 641: Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- G. ASTM F 567: Standard Practice for Installation of Chain-Link Fence.
- H. ASTM F 573: Standard Specification for Residential Zinc-Coated Steel Chain-Link Fence Fabric.
- I. ASTM F 626: Standard Specification for Fence Fittings.
- J. ASTM F 654: Standard Specification for Residential Chain-Link Fence Gates.
- K. ASTM F 668: Standard Specification for Poly(Vinyl Chloride) (PVC)-Coated Steel Chain-Link Fence Fabric.
- L. CLFMI: Chain Link Fence Manufactures Institute Product Manual for Chain Link Fence Installation.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate plan layout, grid, size and spacing of components, accessories, fittings, anchorage, and post section.
- B. Data: Submit manufacturer's installation instructions and procedures, including details of fence and gate installation.
- C. Submit sample of fence fabric and typical accessories.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Galvanizing: Class 3, ASTM A 121.
- B. Aluminizing: Class 2, ASTM A 585.
- C. Polyvinyl Chloride (PVC): With PVC coated materials, paint all posts, fittings, hardware and accessories as indicated to match PVC color. The fabric shall be hot dipped galvanized steel wire complying with ASTM A 392 and coated with a continuous PVC bonding process (minimum 15 mil thickness) in accordance with ASTM F 668. Color of PVC coating as indicated and applied free of voids, cracks, tears and to have a smooth and lustrous surface.
- D. Steel: Schedule 40, ASTM A 53.
- E. Cast-in-place Concrete: Class 3000 minimum, Section 321313.

2.2 CHAIN LINK FABRIC

- A. 11 gage steel wire fabric for all fences less than 60 inches in height and 9 gage for fences over 60 inches coated as follows.
 - 1. Zinc coating, ASTM A 392.
 - 2. Aluminum coating, ASTM A 491.
 - 3. Polyvinyl chloride coating, ASTM F 668.
- B. Unless indicated otherwise use chain link fabric that has approximately 2 inches square mesh and coated after fabrication.
- C. Knuckle finish top edge and twist and barb bottom edge on fabric less than 60 inches wide. For fabric 60 inches or greater in width, twist and barb finish on both edges. Provide fabric that barbing has been done by cutting the wire on the bias.
- D. Chain link fabric shall have Black Polyvinyl chloride coating.

2.3 TENSION WIRES AND FABRIC TIES

- A. Tension Wires: 7 gage galvanized coil spring steel wire, ASTM A 641.
- B. Fabric Fasteners: 9 gauge galvanized or 6 gage aluminum wire, or approved non-corrosive metal bands, for ties to fasten fabric to posts, rails, and gate frames. Fasten fabric to bottom tension wire spaced 24 inches on center.

2.4 TRUSS OR TENSION BARS

- A. Galvanized steel rod 3/8 inch diameter for truss or tension bars used in trussing gate frames and line posts adjacent in end, corner, slope, or gate posts. When used in trussing line posts, provide adjustment by means of galvanized turnbuckles or other suitable tightening devices.

- B. Tension Bars:
1. Galvanized high carbon steel bars not smaller than 3/16 inch x 3/4 inch for tensions bars to fasten fabric to end and corner posts and gate frames. Provide 1 tension bar for each end post and 2 for each corner and pull post per section of fabric.
 2. Use tension bar bands made from heavy pressed galvanized steel spaced on 15 inch centers to secure tension bars to posts.

2.5 POSTS, CAPS, RAILS, COUPLINGS

- A. Posts, Frames, Stiffeners, Rails:

Table 1 – Posts, Frames, Stiffeners, Rails	
Proposed Use	Nominal Type and Size
End, corner, slope and gate posts for single gates 6 feet or less in width and double gate 12 feet or less in width for: 1. Fence less than 72 in. high 2. Fence 72 inches or higher	2" Pipe 2 1/2" Pipe
Gate posts for single swing gates over 6 feet, but not over 13 feet in width and double swing gates over 12 feet, but not over 25 feet in width or for all slide gates with leaves larger than 6 feet	3-1/2" pipe
Gate posts for single swing gates over 13 feet, but not over 18 feet in width and double swing gates over 25 feet, but not over 36 feet in width	6" pipe
Gate posts for single swing gates over 18 feet in width and double swing gates over 36 feet in width	8" pipe
Frame for gates, <u>unless otherwise noted in gates section below.</u>	1-1/2" pipe
Stiffeners for gates	1-1/4" pipe
Line posts for fence 72 in. or higher	2" pipe
Line posts for fences less than 72 in. high	1-1/2" pipe, or 1-1/8" x 1-5/8" H
Top rail	1-1/4" pipe, or 1-1/2" x 1-1/4" H or <u>as detailed (whichever is greater)</u>
Bottom rail	1-1/4" pipe, or 1-1/2" x 1-1/4" H or <u>as detailed (whichever is greater)</u>

- B. Posts: Galvanized steel, at the indicated length.

- C. Caps: Pressed galvanized steel or malleable iron designed to fit securely over post ends forming a weather tight closure. Where top rail is used, provide cap to permit passage of top rail. "H" section posts do not require caps.
- D. Top, Intermediate and Bottom Rails: Galvanized steel, in lengths as required. Provide joint couplings to connect rails securely. Provide means for attaching top rail securely to each end, corner, line, slope and gate posts.
- E. Joint Coupling: Galvanized steel, 6 inches long minimum for each joint. 1 coupling in 5 shall have expansion spring. Couplings shall be outside sleeve type with bore of sleeve true to maintain adjacent lengths of rail in alignment.

2.6 FITTINGS AND HARDWARE

- A. Unless indicated otherwise, galvanize fittings and hardware.
- B. Rivets: Make all hardware attachments with galvanized steel rivets.

2.7 SUPPORT OR EXTENSION ARM

- A. Use support or extension arms for barbed wire that are of a type that can be attached to the tops of the posts and carry the number of wires indicated.
- B. Use only support arms on the fence for barbed wire that are capable of supporting a 250 pound vertical load at the end of the arm without causing permanent deflection.
- C. Single support arms are to be integral with a top post weather cap and have a hole for passage of the top rail when required.

2.8 GATES

- A. 6' Tall Industrial Strength Gates at Maintenance Building: 72" x 10' total width, 1 7/8" Super-40 Pipe Double Swing Gate with drop rod assembly. Gate framing and hardware shall be sized as required to support weight of gate and to prevent frame from sagging and twisting. Field measure and submit shop drawing of layout, fence members, and latching hardware for review and approval prior to fabrication or delivery to the site.
- B. Gate leaves more than (8 feet) wide shall have either intermediate members and diagonal truss rods, or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gates less than (8 feet) wide shall have truss rods or intermediate braces. Attach gate fabric to the gate frame by method standard with the manufacturer, except that welding will not be permitted. Arrange latches for padlocking so that padlock will be accessible from both sides of the gate regardless of the latching arrangement.
- C. Provide stops and keepers for all double gates. Latches shall have a plunger-bar arranged to engage the center stop. Arrange latches for locking. Center stops shall consist of a device arranged to be set in concrete and to engage a plunger bar. Keepers shall consist of a mechanical device for securing the free end of the gate when in full open position.

- D. Provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware and accessories.
- E. Assemble gate frames and attach hardware by welding or by using fittings and rivets to make rigid connections. Use same fabric as for fence. Install fabric with stretcher bars to gate frame at not more than 15 inch on center.
- F. Provide diagonal cross-bracing consisting of 3/8 inch diameter adjustable length truss rods on gates where necessary to prevent frame from sagging or twisting.
- G. Powder coat all gate members and hardware as in accordance with the specified color and finish.

2.9 GATE HARDWARE

- A. Manufacturer's standard products, installed complete.
- B. Hinges: Pressed steel or malleable iron to suit gate size, non-lift-off type, offset to permit 180 degree gate opening. Provide minimum of one pair of hinges for each leaf. 6 5/8"x 1 5/8" or 1 7/8".
- C. Malleable Gate Center Stop.
- D. Industrial Drop Rod Assembly - 1 7/8"
- E. Latch: Forked steel type or if drop rod required, plunger-bar steel type to permit operation from either side of gate. Provide locking device and padlock eye as integral part of latch.
- F. Keeper: Provide keeper for all vehicle gates which automatically engages the gate leaf and holds it in the open position until manually released.
- G. Gate Stops: Mushroom type or flush plate with anchors set in concrete to engage the center drop rod or plunger bar.

2.10 COLOR AND FINISH

- A. Color: All fence components shall be BLACK.
- B. All frame work and other fence components (with the exception of fence fabric) shall be finished with black gloss enamel by powder coat application. Prior to powder coating, all surfaces to be chemically cleaned and treated with Parker Bonderite and Chlorothene solvent or approved equals. The Powder coating must be a thermosetting "no-mar" TGIC polyester powder applied in a thickness of 4-5 mils by electrostatic coat and oven cured to a smooth and even surface. The coated fence components shall demonstrate the ability to endure a salt-spray resistance test in accordance with ASTM B117 without loss of adhesion for a minimum exposure time of 3,500 hours. Additionally, the coated components shall demonstrate the ability to withstand exposure in a weather-ometer apparatus for 1,000 hours without failure in accordance with ASTM D1499 and to show satisfactory adhesion when subjected to the cross-hatch test, Method B, in ASTM D3359. The polyester finish coat shall not crack, blister or split under normal use.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify utility location,
- B. Excavation, Section 31 23 16.
- C. Refer to ASTM F 567 and CLFMI products manual for chain link fence installation.
- D. Protect roots and branches of trees and plants to remain.
- E. Limit the amount of clearing and grading along the fence line to permit proper installation.

3.2 LAYOUT OF WORK

- A. Accurately locate and stake locations and points necessary for installation of fence and gates.
- B. General arrangements and location of fence and gates are indicated. Install except for minor changes required by unforeseen conflicts with work of other trades.

3.3 INSTALLATION OF POSTS

- A. Space line posts as follows:
 - 1. Tangent sections to 500 feet radius: 10 feet maximum.
 - 2. 200 feet radius to under 500 feet radius: 8 feet maximum.
 - 3. 100 feet radius to under 200 feet radius: 6 feet maximum.
 - 4. Under 100 feet radius: 5 feet maximum.
- B. Provide pull posts at 500 feet maximum intervals. Changes in line of 30 degrees or more are considered corners.
- C. Set all posts to true line and grade in concrete bases or in approved pipe sleeves or sockets. Check for vertical and horizontal alignment.
- D. Construct concrete bases for posts at least 10 inches in diameter. Place a minimum of 6 inches concrete below each post. Depth of post in concrete as follows.
 - 1. Line Posts: 18 inches.
 - 2. End, Pull, Corner and Gate Posts Less Than 6 inches Diameter: 24 inches
 - 3. Gate Posts: 30 inches.
- E. Where posts are required to be set in concrete walls or masonry, set sockets for the posts to a depth of at least 18 inches. Use sockets that consist of lengths of 0.048 inch galvanized metal pipe sleeves, with an inside diameter sufficient to allow the posts to fit loosely therein. Coat the inside of the socket and outside of the posts with an approved bituminous paint. Caulk the posts securely in place with lead wool.

3.4 INSTALLATION OF BRACE ASSEMBLIES

- A. Attached brace rail from end, pull, corner or gate posts to first ensuing line post. Install braces so posts are plumb when diagonal truss rod is under proper tension.

3.5 INSTALLATION OF RAILS

- A. Install rails level and plumb with grade between posts and attached to posts before stretching fabric. Top rails shall form continuous brace from end-to-end of each run of fence.

3.6 INSTALLATION OF FENCE FABRIC

- A. Place fence fabric on security side of posts unless otherwise specified. Place fabric approximately 1 inch above the ground. Maintain a straight grade between posts by excavating high points of the ground. Filling depressions with soil will be permitted only upon approval of ENGINEER.
- B. Stretch the fabric taut and securely fasten to posts. Fasten to end, gate, corner, and pull posts. Secure stretcher bars with metal bands spaced at 15 inch intervals. Cut the fabric and fasten each span independently at all pull and corner posts. Fasten to line posts with tie wire, metal bands, or other approved methods at 15 inches intervals. Attach the top edge of fabric to the top rail or tension cable at approximately 24 inches intervals. Attach bottom tension wire to fabric with tie wires at 24 inches intervals and secure to the end of pull posts with brace bands.

3.7 INSTALLATION OF GATES

- A. Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation.

3.8 REPAIR DAMAGED COATING

- A. Grind smooth and wire brush all welds made after galvanizing to remove loose or burned zinc coating, after which neatly coat the areas with 50-50 solder or as otherwise directed by ENGINEER. Make repairs to abraded or otherwise damaged zinc coating in a similar manner. Replace PVC coating.

END OF SECTION 323113

SECTION 328400 - IRRIGATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes piping, valves, sprinklers, specialties, controls, and wiring for automatic-control irrigation system.

1.3 SYSTEM DESCRIPTION

- A. Design of irrigation components: Locations of irrigation components on Construction Drawings may be approximate. Piping, sleeving and/or other components shown on Construction drawings may be shown schematically for graphic clarity and demonstration of component groupings and separations. All Irrigation components shall be placed in landscaped areas, with the exception of pipe and wire in sleeving under hardscapes.
- B. Construction requirements: Actual placement may vary as required to achieve a minimum of 100% coverage without overspray onto hardscape, buildings or other features.
- C. Layout of Irrigation Components: During layout and staking, consult with Project Manager to verify proper placement of irrigation components and to provide Contractor recommendations for changes, where revisions may be advisable. Small or minor adjustments to system layout are permissible to avoid existing field obstructions such as utility boxes or street light poles. Contractor shall place remote control valves in groups as practical to economize on quantity of valve clusters. Quick coupler valves shall be placed with valve groups as shown on plans.

1.4 WORK TO BE DONE

- A. Work to be done includes furnishing all labor, materials, equipment and services required to complete all irrigation work indicated on the Drawings, as specified herein, or both. The work to be performed under this Section shall consist of furnishing all labor and materials necessary to construct a complete working and tested sprinkler irrigation system as per all drawings and specifications, providing 100 percent head to head coverage on all lawns and planting areas on the site. Included also will be maintenance and warranties.
- B. The Contractor shall perform, but not be limited to, providing and installing a new irrigation system, and making applicable connections to the existing irrigation system as indicated on the Drawings.
- C. All work shall be done in accordance with the drawings and specifications, as well as applicable Salt Lake County water and electrical codes.

- D. The Contractor shall operate, maintain until acceptance, and guarantee the new system until all lawn and plants planted on this project have become established and have been approved by the Owner's Authorized Representative.
- E. The Drawings and Specifications must be interpreted and are intended to complement each other. The Contractor shall furnish and install all parts, which may be required by the Drawings and omitted by the Specifications, or vice versa, just as though required by both. Should there appear to be discrepancies or question of intent, the Contractor shall refer the matter to the Owner's representative for decision, and his interpretation shall be final, conclusive and binding.
- F. All necessary changes to the Drawings to avoid any obstacles shall be made by the Contractor with the approval of the Owner's representative.
- G. Trench excavation, back filling and bedding materials, together with the testing of the completed installation shall be included in this work.
- H. The work shall be constructed and finished in every respect in a good, workmanlike and substantial manner, to the full intent and meaning of the Drawings and Specifications. All parts necessary for the proper and complete execution of the work, whether the same may have been specifically mentioned or not, or indicated on the Drawings, shall be done or furnished in a manner corresponding with the rest of the work as if the same were specifically herein described.
- I. Record Drawing as well as Operating & Maintenance Manual generation, in accordance to these specifications shall also be included in this work.
- J. All landscape and hardscape areas disturbed shall be restored to original or better condition

1.5 SCOPE

- A. The irrigation system shown on the Drawings and described within these Specifications represents an automatic controller irrigation system supplied from the municipal culinary water system. The system is designed for a minimum operating pressure of 115 PSI at the irrigation connection point. **The irrigation contractor shall verify water pressure prior to construction and report any differences to owner's representative.**

1.6 RELATED WORK UNDER OTHER SECTIONS

- A. Carefully examine all of the Contract Documents for requirements that affect the Work of this Section.

1.7 REFERENCES

- A. Applicable requirements of accepted Standards and Codes shall apply to the Work of this Section and shall be so labeled or listed:
 1. American Society for Testing & Materials (ASTM)
 2. National Plumbing Code (NPC)
 3. National Electric Code (NEC)
 4. National Sanitary Foundation (NSF)
 5. American Society of Agricultural Engineers (ASAE)
 6. Underwriters Laboratories, Inc. (UL)

7. Occupational Safety and Health Regulations (OSHA)

1.8 PROTECTION OF EXISTING SITE IMPROVEMENTS

- A. The contractor shall take necessary precautions to protect site improvements to remain, including, but not limited to buildings, grounds, or utilities. Should damage be incurred by the contractor or the contractor's employees, the contractor shall repair the damage to its original condition at the contractor's own expense.

1.9 ORDINANCES, PERMITS AND FEES

- A. The Work under this Section shall comply with all ordinances and regulations of authorities having jurisdiction.
- B. The Contractor shall obtain any and all permits, tests and certifications required for the execution of Work under this Section. The County will pay fees for permits.
- C. Furnish copies of Permits, Certifications and Approval Notices to the Owner's Representative prior to requesting payment.
- D. Call Blue Stakes to verify location of existing utilities prior to commencement of work.

1.10 EXAMINATION OF CONDITIONS

- A. The Contractor shall fully inform himself of existing conditions on the site before submitting his bid, and shall be fully responsible for carrying out all work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual Work. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed, except those conditions described in the General Conditions.
- B. Verify available water supply pressure and flow characteristics **prior to** commencing irrigation work.

1.11 QUALITY ASSURANCE

- A. Contractor shall provide document or resume including at least the following items:
1. That Contractor has been installing sprinklers on commercial projects for ten previous consecutive years.
 2. Contractor is licensed to perform landscape construction in the State of Utah.
 3. Contractor is bondable for the work to be performed.
 4. References of five projects of similar size and scope completed within the last ten years. Three of the projects listed shall be local.
 5. Irrigation Project On-site Foreman or Supervisor has at least five consecutive years of commercial irrigation Installation experience.
 - a. Irrigation Project Foreman shall be a current Certified Irrigation Contractor in good standing as set forth by the Irrigation Association.
 - b. Irrigation Project Foreman shall be on Project site 100% of each working day.
 6. Provide evidence that Contractor currently employs workers in sufficient quantities to complete Project within time limits that are established by the Contract.

7. Provide list of employees to be assigned to this Project and their irrigation installation experience.

B. References: The Contractor must supply three references for work of this type and size with their bid including name and phone numbers of contact person(s).

1.12 TRAINING AND CERTIFICATIONS

A. Harco or an approved equal Joint Restraint Training: The irrigation contractor superintendent, project foreman, supervisors, and all installation personnel who will perform work using Harco or an approved equal Joints and Joint Restraints shall participate in an on-site training with a joint restraint authorized representative prior to beginning installation. It is the responsibility of the contractor to obtain such training and certifications and to provide copies of the "Certificate of Completion" for each person in accordance with the Submittal Requirements.

Certifications: All General laborers or workers on the Project shall be previously trained and familiar with sprinkler installation, and have a minimum of one-year experience. Those workers performing tasks related to PVC pipe and electrical components shall have certificates designated below:

1. All workers engaged in handling, assembling and gluing of PVC pipe shall carry on Project site a Certificate of Training from the IPS factory representative authorizing said worker to prime and glue PVC pipe. (Contact Bill Godwin, G & S Sales, 801 972-0659).
2. All workers engaged in the handling and installation of buried power wire, remote control valve wire, wire connectors, controllers and grounding equipment shall carry on Project site a Certificate of Training from Paige Wire factory representative authorizing said worker to install wire, wire connectors and grounding equipment. (Contact Vince Nolletti, Vice President Irrigation Operations, Paige Electric Co., LP, 559-431-2346).
3. **Documents verifying Certified Irrigation Contractor, PVC pipe certification and electrical component certification shall be provided to OAR at least 30 days in advance of any irrigation installation on Project site.**

1.13 TESTS AND INSPECTIONS

A. Observation: The Owner's Representative will be on site at various times to insure the system is being installed according to the Specifications and Drawings.

B. Operational Test: After completion of the system, test the operation of entire system in the presence of the Owner's representative. Demonstrate to the Owner's Representative that all irrigated areas are being adequately covered (See Part 3 - Execution). Any deficiencies identified at this time will require revisions and adjusting by the Contractor at the Contractor's expense. Any deficient irrigation head will be adjusted for proper coverage and set to proper depth at this time.

C. Inspections will be required for:

1. Hydrostatic test of irrigation main line – 150 psi for not less than 2 hours.
2. All piping system layout before backfilling.
3. Coverage test.
4. Final inspection / Start of Maintenance.
5. Final inspection.

D. Inspection Requests: Contractor shall notify the Project Manager a minimum of 48 hours (two working days) in advance for all inspection.

- E. Closing in Un-inspected Work: No work of this section shall be covered up or enclosed until it has been inspected, tested and approved by Project Manager.

1.14 SUBMITTALS

- A. Materials: At least thirty (30) days prior to ordering of any materials, the Contractor shall provide manufacturer catalog cut sheet and current printed specifications for each element or component of the irrigation system.
 - 1. Submittals shall be in electronic format as Adobe PDF documents.
 - 2. Provide pdf copies of submittals to Project Manager. No material shall be ordered, delivered or any work preceded in the field until the required submittals have been reviewed in its entirety and stamped approved.
 - 3. Delivered material shall match the approved samples.
 - 4. Substitutions: The Contractor shall use only materials and equipment that matches existing materials and equipment that are being replaced. No substitutions of materials will be approved on the sprinkler irrigation system.
- B. Invoices: Contractor shall provide to OAR any and all Distributor invoices containing Rain Bird products. This documentation is necessary for Owner to receive Maxicom dollar programming.
- C. Operation and Maintenance Manual: At least thirty (30) days prior to final inspection, the Contractor shall provide Operation and Maintenance manual to Project Manager, in Adobe PDF format, containing:
 - 1. Manufacturer catalog cut sheet and current printed specifications for each element or component of the irrigation system.
 - 2. Parts list for each operating element of the system.
 - 3. Manufacturer printed literature on operation and maintenance of operating elements of the system.
 - 4. Section listing instructions for overall system operation and maintenance. Include directions for Spring Start-up and Winterization.
 - 5. Guarantee and Warranty information and certificates
 - 6. Electronic PDF copy of Controller Map and two-wire wiring plan as outlined below in 1.14.G & 1.14.H.
 - 7. Submit irrigation watering schedules/times by zone for each controller for review. Contractor shall submit separate watering schedules for the Establishment Period and for after Establishment with recommendations to the Owner regarding the length of time Establishment Period watering schedule should be use.
- D. Owner's instruction: After system is installed, inspected and approved, instruct County in complete operation and maintenance procedures. Coordinate instruction with references to previously submitted Operation and Maintenance Manual.
 - 1. Contractor shall provide adequate notice to Owner for scheduling
- E. Materials to be furnished: The following items shall be supplied as part of this contract and shall be turned over to Owner at Final Inspection.
 - 1. Two (2) special tools / wrenches for disassembly and adjustment of each type of irrigation equipment/heads installed that require such special tools/wrenches.
 - 2. Two keys for each type of automatic controller.
 - 3. One valve box cover key.
 - 4. Documentation of Water Department's inspection and acceptance of backflow device.
- F. Project Record Copy:

1. Maintain at project site one copy of all project documents clearly marked "Project Record Copy". Mark any deviation in material installation on Construction drawings. Maintain and update drawing at least weekly. Project Record Copy to be available to Project Manager on demand.
 2. Completed Project As-built Drawings:
 - a. Prior to final inspection, prepare and submit to Project Manager accurate as-built drawings.
 - b. Show detail and dimension changes made during installation. Show significant details and dimensions that were not shown in original Contract Documents.
 - c. Field dimension locations of sleeving, points of connection, main line piping, wiring runs not contained in main line pipe trenches, valves and valve boxes, quick coupler valves, color of hot and spare wires – splice boxes, and the size of all underground piping, valves, and drains.
 - 1) Dimensions are to be taken from permanent constructed surfaces, features or finished edges located at or above finished grade.
 3. **The Contractor shall provide Survey Grade GPS coordinate location in CAD file and excel spreadsheet file with x,y,z values for each of the following items:** point of connection, water meter, backflow device, isolation valves, control valves, gate valves, filters, quick coupling valves, controller, flow meters, manual drain valves, and any other pertinent component of the irrigation system. Provide coordinates on as built drawings and recorded on a CD in WR format
- G. **Control Zone map:** Upon completion of system, place in each controller, a color-coded copy of the area that controller services; indicating zone number, type of plant material and location on project that zone services. Laminate map with heat shrink clear plastic. **Copy of Control Zone Map shall also be included in Operation and Maintenance Manual.**
- H. **Controller Wiring Map:** Each separate run of two-wire control wiring is to be a different color wire or marked with colored tape at all splices. The color of each separate two-wire run shall be indicated on the Control Wiring Map. The contractor shall also record amperage (mA) of each two-wire run from the farthest point on each run back to the controller and note amperage reading on the Controller Wiring Map. Controller Wiring Map shall be laminated with heat shrink clear plastic and placed in the controller(s). **Copy of Controller Wiring Map shall also be included in Operation and Maintenance Manual.**

1.15 DELIVERY, STORAGE AND HANDLING

- A. Store and handle all materials in compliance with manufacturer instructions and recommendations. Protect from all possible damage. Minimize on-site storage. During delivery, installation and storage of materials for Project, all materials shall be protected from contamination, damage, vandalism and prolonged exposure to sunlight. All material stored at Project site shall be neatly organized in a compact arrangement and storage shall not disrupt Project Owner or other trades on Project site. All material to be installed shall be handled by Contractor with care to avoid breakage or damage. Damaged materials attributed to Contractor shall be replaced with new at Contractor's expense.

1.16 SEQUENCING

- A. Perform site survey, research utility records, contact utility location services. The Contractor shall familiarize himself with all hazards and utilities prior to work commencement. Install sleeving prior to installation of concrete, paving or other permanent site elements. Irrigation system Point of Connection components, backflow prevention and pressure regulation devices

shall be installed and operational prior to all downstream components. All main lines shall be thoroughly flushed of all debris prior to installation of Remote Control Valves. All lateral lines shall be thoroughly flushed of all debris prior to installation of any sprinkler heads. Irrigation Contractor shall be required to submit detailed Construction Schedule to Owner prior to commencement. Schedule shall be updated weekly.

- B. Contractor shall schedule and organize work to minimize impact on park usage during public hours. Contractor shall confine work efforts to areas or zones which he can reasonably fence or protect, rather than spreading out trenching or other tasks across large areas of the site. Contractor is responsible to supply water to existing portions of the park during construction. Contractor is responsible to maintain existing turf and plant material in healthy condition. Any loss of turf or plant material due to Contractor neglect shall be replaced at by Contractor at no cost to Owner. Water to existing turf or plant material shall not be turned off for more than 48 consecutive hours. Contractor shall schedule his work to reduce or eliminate open trenches at the end of each work day.
- C. Contractor shall coordinate with Owner for the delivery of irrigation components that will be Owner provided Contractor installed as required to complete the irrigation work as shown on the drawings.

1.17 GUARANTEE

- A. The Contractor shall obtain in the Owner's name the standard written manufacturer's guarantee of all materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. All these guarantees shall be in addition to, and not in lieu of, other liabilities that the Contractor may have by law.
- B. In addition to the manufacturer's guarantees the Contractor shall guarantee the entire irrigation system, both parts and labor for a period of one (1) year from the date of project Substantial Completion. Warranty shall include filling and or repairing depressions or replacing turf or other plantings due to settlement of irrigation trenches or irrigation system elements. Valve boxes, sprinklers or other components settled from original finish grade shall be restored to proper grade. Irrigation system shall have been adjusted to provide proper, adequate coverage of irrigated areas.
- C. As part of the one-year guarantee the Contractor shall perform the first year-end winterization and spring start-up for the irrigation system in the presences of the designated maintenance personnel for the County. Winterization shall be coordinated with maintenance personnel and shall be completed no later than October 15th.
- D. The Contractor shall operate, maintain until acceptance, and guarantee the new system until all lawn and plants planted on this project have become established and have been approved by the Owner's Representative.
- E. The Contractor shall correct any deficiencies when notified during the guarantee period, and additionally correct, to the satisfaction of the Owner, any damage to buildings or grounds caused by deficient work at no cost to the Owner.
- F. All guarantees shall be in writing and submitted to the Owner's representative for review and approval on or before the date of Substantial Completion.

1.18 MAINTENANCE

- A. Provide the following services:
1. Winterize entire irrigation system installed under this contract with Project Manager.
 2. Winterize by 'blow-out' method using compressed air. Compressor shall be capable of minimum of 175 CFM. This operation shall occur at the end of first growing season after need for plant irrigation but prior to freezing. Compressor shall be capable of evacuating system of all water from main line pipe and lateral line pipe.
 - a. Contractor shall retrofit compressor with adjustable pressure regulation device. Compressor shall be regulated to not more than 60 PSI.
 3. Start up system the following spring after danger of freezing has passed. Contractor shall train Owner's Representative in proper start-up and winterization procedure.
 4. Check coverage and adjust as necessary.

1.19 COORDINATION

- A. The Contractor shall at all times coordinate his work closely with the Owner's representative to avoid misunderstandings and to efficiently bring the project to completion. The Owner's representative shall be notified as to the start of work, progression and completion, as well as any changes to the drawings before the change is made. The Contractor shall also coordinate his work with that of all other associated fields.
- B. The Contractor shall be held responsible for and shall pay for all damage to other work caused by his work, workmen or sub-contractors. Repairing of such damage shall be done by the Contractor who installed the work, as directed by the Owner's representative.

1.20 MAINTENANCE AND OPERATING INSTRUCTIONS

- A. Contractor shall include in their Bid an allowance for four (4) hours of instruction of Owner and/or Owner's personnel upon completion of check/test/start-up/adjust operations by a competent operator (The Owner's Representative shall be notified at least one (1) week in advance of check/test/start-up/adjust operations).

1.21 PROCEDURE

- A. Notify all city departments and/or public utility owners concerned, of the time and location of any work that may affect them. Cooperate and coordinate with them in the protection and/or repairs of any utilities.
- B. Provide temporary support, adequate protection and maintenance of all structures, drains, sewers, and other obstructions encountered. Where grade or alignment is obstructed, the obstruction shall be permanently supported, relocated, removed or reconstructed as directed by the Owner's representative.
- C. **SUBSTITUTION OF MATERIALS** The Contractor shall use only materials and equipment that matches existing materials and equipment that are being replaced. No substitutions of materials will be approved on the sprinkler irrigation system.
- D. **SYSTEM PRESSURE** The sprinkler irrigation system is designed for 115 pounds per square inch static pressure at the irrigation connection point unless otherwise specified and is schematic only, with the intent to convey full head to head coverage of the lawn and planting

areas affected. The system must also provide the manufacturer's recommended minimum operating pressure or greater to every head while maintaining sufficient pressure to overcome the losses due to friction in the piping, fittings, and all other equipment.

1.22 SUBSTANTIAL COMPLETION

- A. The date of Substantial Completion for the irrigation system will be when the Maintenance and Operating Manual has been approved, the As-Built Record Drawings have been submitted, and the irrigation system is working as intended as demonstrated during final inspection. This will be determined by observation by the Landscape Architect and Owner's Representative.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials to be incorporated in this system shall be new and without flaws or defects and of quality and performance as specified and meeting the requirements of the system. All material overages at the completion of the installation are the property of the Contractor and shall be removed from the site.
- B. No material substitutions from the irrigation products described in these specifications and shown on the drawings shall be made without prior approval and acceptance from the Owner's Representative. If there is an existing sprinkler irrigation system on the site, the Contractor shall remove any lines being abandoned, and cap or plug the ends of lines remaining in service with proper fittings and thrust blocks. The Contractor shall remove or relocate existing heads and/or connect new lines to existing lines, as indicated on the plans.
- C. Any existing head, valve, valve marker, valve box, or other existing equipment located where there will be a grade or surface material change, shall be adjusted up or down to its proper position in relation to the new finished grade, at no additional cost to the owner, unless the plans show it to be relocated.

2.2 PVC IRRIGATION PIPE

- A. All Main Line Pipe 4" or larger shall be PVC Class 200 O-ring pipe conforming to ASTM D1785-83 and ASTM D-1684 with ratings printed on pipe.
- B. All Main Line or Lateral Line Pipe 3" or smaller shall be Schedule 40 PVC plastic pipe ASTM D 1785 (see plans for sizes and locations) with ratings printed on pipe.
- C. Flex swing pipe shall be THICK-WALLED POLY PIPE as manufactured by TORO or RAINBIRD. This pipe is to be used only between spray heads/bubblers and lateral lines and shall not exceed a distance of 2 ft. and shall only be used on heads of 7 GPM or less.

2.3 PVC IRRIGATION FITTINGS

- A. Fittings for mainline pipe sizes 3" or larger shall be Harco or approved equal joint restraint or M.J.or equal fittings with transition gaskets at all changes of direction tees, ells, caps, etc. M.J.

fittings to be greased, wrapped, and 'megalugged'. An exception for automatic valves: Fitting transition from main line pipe may be Harco ductile iron fitting.

- B. Fittings for pipe 2 ½" or smaller shall be:
 - 1. PVC Mainlines – SCH 80 for all solvent weld fittings
 - 2. PVC Lateral Lines – SCH 40 for all solvent weld fittings
 - 3. Use Weld-on, IPS P-70 Primer and Weld-on IPS PVC 711 plastic pipe cement. Products are to be applied per manufacturer's specifications. All connections on main lines must be allowed to set for twenty-four hours prior to pressurization.
- C. M.J. tees, SCH 80 S tees with SxT sch. 80 bushings are approved on PVC mainlines 2 ½" and smaller for automatic sprinkler valve installation.
- D. All tees coming out of main lines or valves and other fixtures (with the exception of Harco or approved equal swivel tees), shall be horizontal so that no weight or pressure may be exerted through the fixture on the top or bottom of the main line. Depending on mainline size, tees shall be Harco or approved equal Ductile Iron fittings or Sch. 80 SXSXS with SXT Sch. 80 bushing of appropriate size to the valves and Sch. 40 SXT tees for the head or heads. See detailed drawings. Maximum of two auto valves per main line tee.
- E. All tees coming out of the lateral lines for heads and other fixtures, shall be horizontal so that no direct weight or pressure may be exerted through the head to the top or bottom of the lateral line. Tees on lateral lines shall also be SXSXT to the head swing joints. See detailed drawings.
- F. No bends other than very gradual in pipe shall be permitted. The Contractor shall use elbow fittings of 90 and 45 degrees as the situations demand. The use of 22.5 degree or smaller angle fittings shall only be used as approved by Salt Lake County.
- G. All nipples and risers to be schedule 80 PVC.
- H. Flex Swing Piping – Schedule 80 threaded 1/2" or 3/4" x "barbed insert" elbows.
- I. Quick Coupler– as detailed
- J. Pop-Up Rotor Irrigation Heads – SCH 80 Double Swing Joint
- K. All solvent welded joints shall be made with IPS Weld-on-Line, P-70 Primer and No. 711 cement.
- L. Lateral lines shall be connected by either solvent welded or threaded connections. Use IPS Weld-on-Line, P-70 Primer and No. 711 cement for solvent welded connections and Teflon tape for threaded connections.

2.4 SLEEVES

- A. Sleeves shall be installed for all irrigation pipe and wire under non-soil areas and where indicated on the Drawings. Sleeve size shall be twice the nominal size of the pipe, and a minimum of 4 inches unless otherwise noted. Control wires shall be sleeved separately within their own sleeve. PVC Sch. 40 water pipe shall be used except where noted.

2.5 WIRE CONDUIT

- A. Standard Control Wire: Conduit for wiring to controllers or sensors shall be SCH-80 PVC, size as indicated chart.

Number of Wires	Minimum Conduit Size
1-11	1 1/4"
15-22	1 1/2"
15-22	2"
23-35	2 1/2"
35-50	3"

- B. Two-Wire Control Wire: Conduit for two-wire path, master valve wiring, or communication cable shall be 1" HDPE 100 PSI Poly Pipe. Install a standard size valve box as a 'Pull Box' at minimum of every 150'.

2.6 BACKFLOW PREVENTER

- A. Provide Backflow Preventer as specified and detailed on the drawings. Provide Concrete Filled 6" Metal Bollards around Backflow Preventer assembly and point of connection equipment as shown on the plans.

2.7 BACKFLOW PREVENTER ENCLOSURE

- A. Not Required.

2.8 PUMP ASSEMBLY

- A. No Pump - Not Required This Contract

2.9 HYDROMETERS, FLOW SENSORS, AND MASTER VALVES

- A. All Hydrometers, Master Valves and Flow Sensors shall be of the size and type as specified on the drawings and installed in their own separate valve box. Valve boxes shall be sized as detailed. If not otherwise indicated, Hydrometers, flow sensors, or master valves larger than 6" in size shall be installed in a Rainbird VB-MAX-H jumbo valve box as required to contain all associated fittings and equipment while still allowing adequate room for access and servicing. Valve box sized as necessary to allow adequate room for servicing.

2.10 ELECTRONIC CONTROL VALVES

- A. All electric remote control valves shall be of the size and type as specified on the drawings. Do not mix lawn and shrub zones. No valve shall be installed more than 12" inches below finished grade. All pipe on the control valve manifolds shall be Schedule 80 PVC pipe.

2.11 DRIP CONTROL VALVE ASSEMBLIES

- A. All Drip Control Valve Assemblies shall be of the size and type as specified on the drawings and include a remote control valve, inline pressure regulator, and basket filter.
- B. Drip Control Valve Assembly includes:
 - 1. Drip Control Valve Assembly (size and type as indicated on the drawings including valve, filter, and pressure regulator).

2.12 VALVE BOXES

- A. Valve boxes for control valves shall be heavy duty rectangular valve box with bolt down cover and stainless steel bolts as manufactured by Carson or approved equal. Valve boxes shall be sized to provide ample room for access and repair. No valve box shall rest directly upon the valve or any fixture associated with it. Each valve box shall be centered on the valve it covers. Each valve box shall have 6 inches of pea gravel placed in the bottom underneath the valve and lines to reduce the potential of mud and standing water therein.
- B. Valve boxes for quick coupling valves, manual isolation valves, and manual drain valves shall be 10" round valve box as manufactured by Carson or approved equal.
- C. Valve boxes for approved wire splices shall be 10" round valve box as manufactured by Carson, model 910-10 or approved equal...
- D. Valve box extensions shall be provided as required for proper box depth.
- E. Standard valve box is to be used for two wire "pull boxes".

2.13 AUTOMATIC CONTROLLER – OWNER PROVIDED CONTRACTOR INSTALLED

- A. Automatic controller(s) shall be owner provided and contractor installed of the type specified on the plans. Pedestal Mounted controllers shall be provided as specified for field applications. It shall be the Contractor's responsibility to install and supply junction box and separate breaker to furnish power to a new controller(s). AG2401 surge protection shall also be provided at the incoming power and low voltage power side. Grounding shall be per the national electrical code and the Controller Grounding detail shown on the plans. Contractor shall also provide additional ground measures as required by the controller manufacturer to meet minimum requirements for controller warranty.
- B. All WeatherTrak equipment shall be inspected and approved by a WeatherTrak approved Specialist (Joe Jackson, 801-404-1371). Contractor shall be responsible for obtaining inspection approval and shall have any rejected installation repaired and re-inspected at no cost to the Owner. Contractor shall include a site consultation for the new controller(s) (with Joe Jackson, 801-404-1371. (1) Site consultation is required for controllers with 48 stations or less and (2) Site Consultations are required for controllers with more than 48 stations.

- C. Controller(s) are to be purchased with a 10 year subscription service and an extended warranty of 10 years. – This is to be Owner Purchased/Provided.
- D. The Contractor shall be required to provide conduit, wiring, and all materials along with the labor necessary to make the controller operational and in compliance with local electrical codes.
- E. When an existing controller is used for part of a new sprinkler irrigation system, the Contractor shall coordinate the setting, wiring, use, and all maintenance operations pertaining thereto, with the County Park's Maintenance personnel.
- F. Contractor shall be responsible for connection, tie in, and programming of new irrigation zones to existing controllers. Coordinate with County Park's Personnel to ensure disruption of watering of existing landscape does not occur.

2.14 CONTROL WIRE

- A. Standard Control Wire: All standard irrigation control wire shall bear approval as UF/UL PE type of underground feeder and each conductor shall be of electrical conductivity grade copper in accordance with ASTM-30. All control wire shall be specifically designed for direct burial use. Sizes shall be #14 ga for control wire and spare wire and #12 ga. For common wire. A minimum loop of 24 inches shall be left at each valve, at each splice, and at each controller for expansion and/or servicing of the wire. All splices shall be water-tight, as specified above. All wire, crossing water, attached to bridges, going under paving, or where conditions require protection, shall be housed in conduit or sleeves, all out of ground conduits shall be metal rigid conduit. All buried conduit can be P.V.C. conduit.
- B. All common or ground wires shall be White. Where more than one controller is required, a different color hot wire shall be used for each controller.
- C. The pigment or color of the wires shall be integrated into the covering, rather than painted on. No aluminum wire shall be used on this project!

2.15 TWO-WIRE CONTROLLER WIRE

- A. Shall be 14-2 Paige Electric Maxi Cable P7072D double jacketed, double insulated direct bury control wire and shall be run from the controller to each decoder.
- B. All Maxi-cable wire to be installed in 1" HDPE conduit. In areas where two-wire conduit span between valve boxes is greater than 150, Contractor shall install standard size valve box as conduit pull box every 150' and install extra cable length as noted.
- C. For trouble shooting purposes, a star configuration is to be used as opposed to a looped configuration.
- D. An electric decoder cable fuse devise (DCFD) to be installed at all splits in the 2-wire path where more than two runs of Maxi Cable come together. Install DCFD and extra cable in standard size valve box.
- E. Each two-wire branch is to be either a different color of wire, or marked with colored tape at all splices for troubleshooting purposes and recorded on the Controller Wiring Map.

- F. An extra 36" of cable shall be installed on both the incoming and outgoing runs of two-wire cable at each control valve to allow maintenance personnel to lift control valves out of box for maintenance and servicing.
- G. 36" of extra cable length to be installed at all splices and conduit pull boxes, and valve boxes.
- H. Contractor shall clearly indicate on As-Builts and Controller Wiring Map the two wire path routing, with each color of wire, and record the amperage of each two-wire run from the farthest point on each run back to the controller on the As-Builts and Controller Wiring Map.

2.16 TWO WIRE DECODERS

- A. Two-Wire Decoders shall be Owner Provided, Contractor Installed. All two wire decoders shall be WT2W-SVD-11P. Only one decoder to one valve shall be used with no exceptions.
- B. Contractor to install decoders as per manufacturer's installation instructions. New decoder to be numbered in sequence with current system.
- C. Decoders are to be pre-addressed from the manufacturer.

2.17 LINE SURGE PROTECTION ALONG TWO-WIRE PATH

- A. Standalone surge protection along two-wire path is required: WT2W-LSP.
- B. Surge protection is to be installed per manufacturer's recommendations at a minimum of every 500' or every 5 decoders/valves, whichever is less. Additionally, surge protection is to be installed along the two-wire path, within close proximity to the irrigation controller, and at the end of each two-wire spur longer than 50'.
- C. Grounding is to be installed at each line surge protection installed as per decoder grounding details and shall meet manufacturer's minimum grounding requirements as necessary to maintain product warranty. All grounding shall allow for 10 OHMS of resistance or less.

2.18 TRACER TAPE

- A. Tracer Tape shall be installed with all irrigation mainlines.
- B. Detectable Tracer Tape shall be (for Open-Trench Installation): Presco 1776 Detectable Underground Warning Tape or approved equal with minimum 5 mil thickness, durable laminate construction and permanently imprinted with black ink.

2.19 COMMUNICATION CABLE

- A. For direct wiring from flow sensor to new controller(s) –
 - 1. All flow sensor communication cable from flow sensor to controller(s) shall be Paige Electric PE-393 communication cable direct wired.
 - 2. All master valve communication cable from master valve to controllers shall be (1) #14 AWG Red Control Wire with (1) #12 AWG White Common Ground direct wired.

3. Communication cable shall be connected to flow sensor according to manufacturer's recommendations. Communication cable shall be run from the flow sensor at the noted points of connection and run to controller.
- B. All communication cable and master valve wiring shall be direct runs with no splices.
- C. All connections or splices for Flow Sensor Cable shall be 3M-SLIC connector.
- D. All connections or splices for Master Valve Cable shall be 3M-DBR/Y.
- E. Communication wire and master valve control wire to be installed in 1" HDPE conduit.
- F. Communication wire and master valve control wire shall be installed in its own individual conduit.

2.20 SHUT OFF AND ISOLATION VALVES

- A. Mainline Isolation Valves – Gate Valves: Gate Valves shall conform to AWWA specification C 509. They shall be of Class 200 cast iron body. Resilient-seated Gate Valve and shall have a non-rising stem with rubber "O" rings. Stems shall be of cold rolled, solid bronze, high tensile strength. Valve shall be high strength cast iron, fully encapsulated urethane rubber wedge. Gate valves shall be hydrostatically pressure tested for 400 P.S.I. and shall be designated for a working pressure of 200 P.S.I. shall be American made - waterous brand, Milwaukee or equal.
- B. Unless otherwise shown or specified, valves on the main line sized 2" and larger shall have flanged end connections. Valves 1-1/2" and smaller shall have threaded end connections i.e., non-rising stem. Buried valves shall have 2" square operating nuts. No handles or wheels will be permitted. Valves inside structures shall have wheel handles. Unions shall be installed on each side of all valves except flanged valves. Each valve shall contain a resilient wedge urethane rubber seat.
- C. Ball Valves – to be used at quick couplers: A Ford B11444 heavy duty ball manual valve shall be installed upstream from each quick coupler or group of quick couplers on one supply line for water shut-off and maintenance. Access ball valve with a 2" PVC sleeve-capped by a Weathermatic 906L cap, within a 10" round Brooks Box.
- D. Control Valve Manifold Isolation Valves: Shall be Harco or approved equal Iron IPS Lateral Isolation Valve (with square operating nut), sized to same size of largest downstream lateral line, and installed with a Harco or approved equal Ductile Iron IPS Swivel Joint Lateral Connection Swivel Tee.

2.21 QUICK COUPLER VALVES

- A. Each valve shall be a Rainbird 44 LRC heavy duty brass, two-piece, single lug locking cap.
- B. The Contractor shall provide to the Owner with at least 1 cap lock key and 1 quick coupling key with a swivel hose bib attached. These keys shall be delivered prior to final acceptance of the project.

2.22 MANUAL DRAINS

- A. All manual drain valves shall be Ford B11333 heavy duty brass, ball valves and installed as per details on the drawings. Manual drain valves shall be required at all low points in the main lines. Drain valves are to be installed on mainlines only.
- B. The location of each manual drain shall be shown on the "as built" drawing with dimensions from the nearest permanent fixture, such as a building corner, etc....
- C. Each manual drain valve will be accessed by a 2 inch P.V.C. Schedule 40 pipe sleeve, capped by a Weathermatic 906L locking valve cap with a RLK-1 key, no approved equals, enclosed within a 10" round Brooks Bolt down box - top of drain sleeve to be 3" - 6" below lids of Brooks Box.
- D. Each manual drain shall empty into a gravel sump, a minimum of 18 inches by 18 inches by 12 inches deep. The gravel shall be washed 3/4 inch rock. No pea gravel will be allowed.
- E. Automatic Drain Valves: Automatic drain valves shall not be used on this project.

2.23 CRUSHED STONE

- A. Crushed stone shall be 3/4" x #8 washed gravel. Crushed stone shall be used under valve boxes.

2.24 TRENCH BEDDING MATERIAL

- A. Bedding material shall be mortar sand material.

2.25 IRRIGATION HEADS

- A. Pop-up spray and rotor heads as specified on the drawings for all new irrigation areas.

2.26 BUBBLER HEADS

- A. Bubbler heads as specified on the drawings for all new irrigation areas.

2.27 THRUST BLOCKS & JOINT RESTRAINTS

- A. Provide joint restraints as per manufacturer's installation requirements and as detailed wherever the main line pipe:
 - 1. Changes any direction at tees, angles, and crosses vertical and horizontal.
 - 2. Changes size at reducers.
 - 3. Stops at a dead-end.
 - 4. Valves at which thrust develops when closed.
 - 5. Thrust blocks are only acceptable at Backflow Preventer Assembly, as detailed.

- B. The size and type of thrust block depends on pressure, pipe size, kind of soil, and type of fitting. As a general rule, one cubic foot (minimum) of class AA(AE) Type II concrete is required for each thrust block.
- C. Thrust blocks shall rest against undisturbed original earth in the direction of thrust.
- D. Upward Thrusts at Fittings: Where a fitting is used to make a vertical bend, use a bar to anchor the fitting to a thrust block braced against undisturbed soil. The thrust block should have enough resistance to withstand upward and outward thrusts at the fitting.

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine all contract documents applying to this Section noting any discrepancies and bringing the same to the attention of the Owner's Representative for timely resolution.
- B. The contractor, prior to installing the system, must verify existing water pressure. If there is a failure to obtain the needed pressure or if an excess of pressure exists for normal operation, the contractor shall contact the Owner's representative for any adjustments to the system. Failure to report any discrepancies in pressure due to whatever reason, and installation done prior to notification of the Owner's representative shall be done at the expense of the contractor.
- C. Make all field measurements necessary for the work noting the relationship of the irrigation work to the other trades. Coordinate with other trades (landscaping and other site work trades). Project shall be laid out as accurately as possible as indicated on the Irrigation Plans. The drawings, though carefully drawn, are generally diagrammatic to the extent that swing joints, offsets and all fittings are not shown.
- D. Irrigation heads, valves and quick coupler locations are shown on the drawings diagrammatically. It shall be the contractor's responsibility to determine the exact location of each irrigation head, valve and quick coupler to accommodate the conditions as found on the site in order to provide COMPLETE head to head coverage of all areas. Avoid installing valves in areas where curbs and sidewalks come together or at any intersection of two or more walkways. Do NOT exceed the manufacturer's recommended spacing or as shown on the drawings for the irrigation heads. Minor adjustments in the system will be permitted to clear existing fixed obstructions subject to the approval of the Owner's representative. All deviations from the drawings will be noted on the "As-Built" drawings.
- E. At all times, protect existing irrigation, landscaping, paving, structures, walls, footings, etc. from damage. Any inadvertent damage to the work of another trade shall be reported at once.
- F. The points of reference shall be the existing walks, buildings, and curbs. The staking shall be approved by the Owner's representative prior to commencing installation operations. Any changes in the system which appear necessary, due to field conditions, must be called to the attention of the Owner's representative and approved at the time.
- G. All irrigation heads will be set perpendicular to the finished grade unless otherwise designated on the drawings and specifications.
- H. Install all irrigation systems as per State and Local codes.

3.2 EXISTING IRRIGATION SYSTEM

- A. If there is an existing sprinkler irrigation system on the site, the Contractor shall remove any lines being abandoned, and cap or plug the ends of lines remaining in service with proper fittings and thrust blocks. The Contractor shall remove or relocate existing heads and/or connect new lines to existing lines, as indicated on the plans. Any existing heads or other hardware so removed, which are not to be relocated, will be returned directly to the Salt Lake County Parks Department or the Inspector.
- B. Any discrepancies between existing site conditions and those indicated on the plans shall be called to the attention of the Inspector and Landscape Architect, prior to continuance of the project.
- C. Any existing head, valve, valve marker, valve box, or other existing equipment located where there will be a grade or surface material change, shall be adjusted up or down to its proper position in relation to the new finished grade, at no additional cost to the owner, unless the plans show it to be relocated.
- D. Existing landscape areas disturbed as part of construction activities shall be repaired to pre-construction condition.

3.3 CONSTRUCTION STAKING

- A. The Contractor shall provide the necessary staking to obtain the layout shown on the plans. The points of reference shall be the existing walks, buildings, curbs, etc... The staking shall be approved by the Owner's Authorized Representative prior to commencing installation operations. Any changes in the system which appear necessary, due to field conditions, must be called to the attention of the Owner's Authorized Representative and approved at the time.

3.4 TRENCHES AND EXCAVATION

- A. Excavation work shall be as deep and as wide as will be required to safely perform the work, such as making mainline connections or forming vaults. Trenches shall be deep and wide enough to provide working space for placing specified thickness of mortar sand bedding underneath and around all new mainline pipe and fittings where the soil is rocky or gravelly. 18 to 30 inches of cover shall be placed over the top of all pipe and fittings on main lines (lines which maintain a constant water pressure). All trench bottoms shall be sloped so that the pipe will gravity drain back to the main connection point or the nearest manual drain. If the existing main line is deeper than 30 inches, the Contractor shall install a riser to a depth of 18 to 30 inches and then install the new line at the required 18-30" depth. At no time will the mainline be installed deeper than 30" unless prior approval by Owner's representative. Each pipe lying in a mainline or lateral line trench shall not touch any other pipe. Maintain a pipe separation distance of 6" between each pipe.
- B. All irrigation mainlines are to be in their own designated trench. **Mainlines and lateral lines shall not share the same trench.** There must be 24" minimum horizontal distance between main and lateral lines. There shall be 24" minimum distance between any irrigation trench and trenches of other trades. If more than one irrigation lateral line is required in a single trench, the trench shall be deep and wide enough to allow for at least 6" of separation, both vertically and horizontally between pipes.

- C. Trenches for lines supplying pop-up spray heads shall be deep enough to maintain a minimum of 8 to 14 inches of cover over the top of all pipe and fittings. Trenches for these lines shall be a minimum of 6 inches away from any walks and curbs, and of sufficient width to accommodate tees coming out sideways (horizontally) from the laterals.
- D. Trenches for lines supplying rotors shall be deep enough to maintain a minimum of 8 to 16 inches of cover over the top of all pipe and fittings. Trenches shall also be deep enough to guarantee that all swing joints drain back to the lateral and supply lines.
- E. Any rocks or other debris over one inch (1") in diameter uncovered during excavation or trenching shall be removed from the area. No rocks larger than one inch (1") in diameter nor any other debris shall be backfilled into the trenches.
- F. The contractor, in placing the irrigation lines, etc. may uncover material not suitable for finished grading. This material shall be removed from the site. After the installation of the lines, the finished grading shall be smoothed over and restored to its original condition, using additional topsoil where necessary.
- G. Any existing utility lines damaged during excavating or trenching shall be repaired immediately after notification of the utility owner and to his satisfaction. Should utility lines be encountered, which are not indicated on the plans, the Engineer or Landscape Architect shall be notified. The repair of any damage shall be done as soon as possible by the Contractor or the utility owner, and proper compensation will be negotiated by the County. Such utility locations shall be noted on the "as built" drawings required before final payment of the sprinkler irrigation system contract.

3.5 PIPE AND FITTINGS INSTALLATION

- A. The plans show the general arrangement of all piping. Should local conditions necessitate the rearrangement of some, or if piping can be run to better advantage, the contractor, before proceeding with the work, shall prepare and submit drawings of such to the Owner's representative and obtain written approval before commencing work shown on these drawings.
- B. Using proper width trencher chain, excavate a straight and true trench to a depth of 6-inches below pipe invert elevation for mainlines and 3-inches below pipe invert elevation for lateral lines.
- C. Loam encountered within the limits of trench excavation for irrigation mains and branch lines shall be carefully removed to the lines and depths as shown on the Drawings and stockpiled for subsequent replacement in the upper 6 inches of the trench from which it is excavated. Such removal and replacement of the quantities of loam shall be considered incidental to the irrigation system and no additional compensation will be allowed therefore.
- D. Where trenching is done in established lawn, care will be taken to keep the trenches only as wide as is necessary to accomplish the work. The trenches shall be backfilled as specified above and then 4 inches of topsoil will be placed to bring the trench up to existing grade so that sod can be laid. The new sod shall be first grade sod of standard width and shall be laid along the trenches so as to match the existing sod. No small pieces of sod shall be used and only standard lengths shall be accepted. No sod from the construction site shall be used unless otherwise specified.
- E. **Where soil is rocky or gravelly, a mortar sand bedding material shall be placed surrounding all piping as detailed.**

- F. No backfilling of trenches shall be done until the system has been inspected for proper trench depths, installation of equipment, control wire or two-wire conduit, and location of heads by the Owner's Authorized Representative.
- G. Before trenches are backfilled, the Contractor must show the Landscape Architect or Inspector, the redlined "as built" drawing he has been keeping on the site, showing that changes and corresponding dimensions have been recorded where changes have been made.
- H. Back filling shall be accomplished as follows: Backfill under and around the lines to the center line of the pipe shall be placed in maximum layers of 6 inches and thoroughly compacted. Any material that is to come in contact with the pipes shall be less than 1/4" in diameter and shall be imported for this specific use. Carefully place material around pipe and wire and water sock in place. Remainder of backfill shall be laid-up in 6-inch (maximum) lifts and water socked to compaction matching adjacent undisturbed area. Frozen material shall not be used for backfill.
- I. Special care shall be taken to assure complete compaction under the haunches of the pipe. Backfill compaction under the haunches of the pipe shall be compacted to the original density. Compaction requirements above the pipe shall be the same as for surrounding areas.
- J. All excavation under walks and roadways shall be compacted to 95% and all excavation in lawn and shrub areas shall be compacted to no less than 90%.
- K. The ends of all galvanized pipe shall be reamed and free of all inside scale or burrs. Threads shall be cut clean and sharp, and to a length equal to 1-1/8 times the length of the female thread receiving the pipe. The threaded pipe shall be screwed into a full length of the female thread.
- L. All threaded pipe joints shall be properly sealed with a pipe dope applied to and well worked over the areas to be joined. The dope for galvanized pipe shall be a white lead and pure linseed oil mixed to be a consistency of thick paint or it may be Teflon tape.
- M. Make all solvent-weld joints in strict accordance with manufacturer's recommendations, making certain not to apply an excess of primer or solvent, and wiping off excess solvent from each connection. Allow connections to set minimum 24 hours before pulling or pressure is applied to the system. Provide for expansion and contraction as recommended. Wire shall be laid in same trench as mainline and at pipe invert (see Wire Installation). All pipe joints shall be solvent welded together using IPS 70 Primer and IPS 711 cement.
- N. The Contractor shall provide adequate material for the connection of valves to the system, i.e., adapters, flanges, nuts, bolts, gaskets, etc...
- O. Mainline pipe shall have minimum 18 inches of cover (excavate to invert as required by pipe size). Lateral pipe shall have minimum 12 inches of cover (excavate to invert as required by pipe size).
- P. Cut plastic pipe with handsaw or pipe-cutting tool, removing all burrs at cut ends. All pipe cuts are to be square and true. Bevel cut end as required to conform to Manufacturer's Specifications.
- Q. Lines bordering curbs, buildings, or sidewalks shall be 12 inches away to allow for maintenance and access to the lines.
- R. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. At times, when installation of the piping is not in progress, the open end(s) of the pipe shall be closed by a watertight plug or other means. All piping, which cannot

temporarily be joined, shall be sealed to make as watertight as possible. This provision shall apply during the lunch hour as well as overnight. Pipe not to be installed that day shall not be laid out. Should water enter the trench during or after installation of the piping, no additional piping may be installed or back filled until all water is removed from the trench. Pipe shall not be installed when water is in the trench, when precipitation is occurring, or when the ambient temperature is at 42 degrees F or below. PVC pipe shall be snaked in the trench to accommodate for expansion and contraction due to changes in temperature.

- S. When the pipe lines are connected but before any heads are installed, the control valves shall be opened and flushed with a full head of water to clean out the system.
- T. Before trenches are backfilled all lines shall be pressurized and checked for leaks.
- U. Before any pipes are covered, the owner's authorized representative shall inspect the system for compliance with the specifications and drawings. Any required changes will be made at this time at no expense to the owner.

3.6 BACKFLOW PREVENTER INSTALLATION

- A. Install specified backflow preventer as detailed and in compliance with state and local codes.
- B. The **Contractor** shall install backflow prevention equipment after the point of connection (down stream) to the supplying utility lines and shall comply with local water district or State (whichever is most restrictive) requirements for such. See plans and details for more information. Install a quick coupler just down-stream of backflow device, for blow out purposes.

3.7 PUMP STATION ASSEMBLIES

- A. No Pump Required

3.8 HYDROMETERS, FLOW SENSORS, & MASTER VALVE INSTALLATION

- A. Install Hydrometers, Master Valves, and Flow Sensors as detailed and in accordance with manufacturer installation recommendations in their own separate valve box. Valve boxes shall be sized as detailed. If not otherwise indicated, Hydrometers, flow sensors, or master valves larger than 6' in size shall be installed in a Rainbird VB-MAX-H jumbo valve box as required to contain all associated fittings and equipment while still allowing adequate room for access and servicing. Threaded models of Hydrometers, Master Valves, and Flow Sensors shall be installed with unions both sides to allow for ease of maintenance and/or replacement.

3.9 ELECTRONIC CONTROL VALVE & DRIP CONTROL VALVE ASSEMBLY INSTALLATION

- A. Install valve assemblies as detailed. Control valves shall be installed on a level crushed stone base. Grade of base shall be consistent throughout. Valves shall be set plumb with adjusting handle and all bolts, screws and wiring accessible through the valve box opening.
- B. Adjust zone valve operation after installation using flow control device on valve.

- C. Do not install valves in areas where curbs and side walk come together or at any intersection of two or more walkways.
- D. Electronic control valves shall be installed with a Harco Ductile Iron IPS Lateral Isolation valve. installed upstream from electronic control valve. **No more than 2 control valves are to be downstream from a single lateral isolation valve.**

3.10 PIPE SLEEVING INSTALLATION

- A. Sleeving shall be installed wherever piping is going under a non-soil area, generally where indicated on the Drawings. Minimum cover over all sleeving pipe shall be 18 inches as shown on the detail except where noted otherwise.

3.11 SHUT OFF AND ISOLATION VALVE INSTALLATION

- A. Mainline Isolation Valves: Install mainline isolation valves as detailed in locations shown on the drawings. All main line buried gate valves shall be fitted with a 6" minimum diameter pipe sleeve and 10" round "Brooks" bolt down box. Install a quick coupler just down-stream of each gate isolation valve, for blow out purposes.
- B. Ball Valves at Quick Couplers: shall be installed upstream from each quick coupler or group of quick couplers on one supply line for water shut-off and maintenance. Access ball valve with a 2" PVC sleeve-capped by a Weathermatic 906L cap, within a 10" round Brooks Box.
- C. Isolation valves at valve manifold: Install Harco Ductile Iron IPS Lateral Isolation Valve on mainline as detailed on the upstream side control valves, no more than 2 control valves per 1 isolation valve.

3.12 QUICK COUPLER VALVE INSTALLATION

- A. Quick coupler valves shall be installed where specified on the plans. Each valve shall also be teed off the supply line with at least 24 inches of galvanized iron pipe and all fittings from that point up shall be galvanized iron. A Ford B11444 heavy duty ball manual valve shall be installed upstream from each quick coupler or group of quick couplers on one supply line for water shut-off and maintenance. Access ball valve with a 2" PVC sleeve-capped by a Weathermatic 906L cap, within a 10" round Brooks Box.
- B. Quick coupler valves shall be installed within a 10" round Brooks Bolt Down Box unless next to concrete pad, then install to grade.

3.13 MANUAL DRAIN VALVES

- A. Install manual drain valves as detailed and specified above. Manual drain valves shall be required at all low points in the main lines. Drain valves are to be installed on mainlines only.

3.14 VALVE BOX INSTALLATION

- A. Furnish and install valve access boxes for electric valves, quick coupling valve, isolation valve, flushing valves, wire splices, etc.
- B. Valve access boxes shall be installed on a minimum 6-inch crushed stone base. Finish elevation of all boxes shall be at grade except where noted. All crushed stone shall be supplied by the Contractor and installed before valve box. Crushed stone shall not be poured into previously installed valve boxes.
- C. Valve boxes shall be set on a brick foundation which is placed on undisturbed soil. A 2" clearance must be maintained between the base of the valve and the crushed stone base.
- D. Valve manifolds shall be set a minimum of 2" below top of the box including gate valves. See the chart below for the number of valves allowed in each valve box. All valves must have ample room and access for repair.
- E. Install valve boxes no closer than three feet from sidewalks, curbs, and all hard surfaced areas. Do not install valve boxes at the low point of the landscaping.

3.15 IRRIGATION HEAD INSTALLATION

- A. Install all irrigation heads as shown in the details.
- B. All irrigation heads will be set perpendicular to the finished grade unless otherwise designated on the drawings and specifications. Rotor heads on hillsides will be adjusted to avoid cutting into the hill with the stream of water and causing excessive erosion.
- C. All pop-up spray heads shall be installed on Flex swing pipe with 1/2" spiral barbed ells and one street ell as detailed.
- D. All pop-up rotor heads will be installed at final grade on double swing joints. All swing joints must drain by gravity back to the supply lines.
- E. Heads installed in existing sod shall be set at the grade of the soil.
- F. All pipes, lines, and risers shall be flushed thoroughly with water before installation of any heads, All debris and rocks found at that time shall be removed from the area immediately.
- G. Prior to final acceptance of the project, all heads shall be raised or lowered to final lawn or planting grade.

3.16 BUBBLER INSTALLATION

- A. Install all bubblers as detailed.

3.17 ELECTRICAL WIRE CONDUIT INSTALLATION

- A. Electrical conduit shall be installed to the existing controller as necessary to house new control wires.

3.18 SLEEVING INSTALLATION

- A. Sleeving shall be installed wherever piping is going under a non-soil area, generally where indicated on the Drawings. Minimum cover over all sleeving pipe shall be 18 inches for all mainline and 12 inches for all lateral lines as shown on the detail except where noted otherwise.

3.19 ELECTRICAL CONTROL WIRE INSTALLATION

- A. Standard Control wiring shall only be used for wiring of valve to decoder and wiring of master valve as specified. Wiring shall be installed in the same trench as the main line wherever possible.
- B. Wire type and method of installation shall be in accordance with local codes for NEC Class II circuits of 30-volt A.C. or less.
- C. All connections made inside the box to connect wires to the valve shall be made inside a 3M-DBR/Y connector. Each connector shall be completely sealed and water proof with a minimum 24" wire loop.
- D. All wires shall be direct runs with no splices. Wires cannot be spliced without approval of Owner's representative or Project Manager.
- E. Splices in electric control wires shall be fitted with a 3M DBR/Y Direct Bury Splice Kit. No exceptions. All splices shall be contained in a valve box with extra length equal to 24" above the top of the valve box.
- F. Wire shall be pulled into controller with 12" minimum tail, and properly labeled. Any wire that comes from the ground to the controller must be housed in PVC conduit or flex conduit.
- G. It is important that the splice is absolutely waterproof so that there is no chance for leakage of water and corrosion build-up on the connection. All wiring shall be accomplished with as few splices as possible. Splice locations shall be shown on the Record Drawings.
- H. An expansion curl shall be provided within 6 inches of each wire connection to a solenoid and at least every 100 feet of wire length on runs more than 100 feet in length. Expansion curls can be formed by wrapping five (5) turns of wire around a 1-inch diameter or larger pipe and then withdrawing the pipe.
- I. Contractor shall provide a complete wiring diagram showing wire routing for the connections between the controller and valves. See section one for the inclusion of wiring diagram in operation and maintenance manuals.

3.20 TWO-WIRE CONTROL WIRE INSTALLATION

- A. Two-Wire Control Wire - shall be installed in the same trench as the main line wherever possible. All conduit shall be installed in trenches 6 inches to either side of the pipes so that the conduit is protected from damage during backfilling and maintenance operations. See detailed drawing showing the wire located in those positions. Conduit not placed in the trenches by the sides or under the pipes, shall be buried 18 inches or deeper and marked on the "as built" drawings.

- B. All connections made inside the box to connect wires to the valve shall be made inside a 3M-DBR/Y connector. Each connector shall be completely sealed and water proof with a minimum 36" wire loop.
- C. Two-wire conduit is to terminate inside valve box. Install a standard size valve box as a 'Pull Box' at minimum of every 150'.
- D. Install all with a minimum 3 feet expansion loop for both incoming and outgoing wiring on two wire path for ease of maintenance.

3.21 COMMUNICATION CABLE INSTALLATION

- A. Communication cable shall be run from the flow sensor at the points of connection and run to controller location(s). Controller location is shown on the drawings.
- B. Master Valve Control wire shall be run from the master valve at the points of connection and run to controller location(s). Controller location is shown on the drawings.
- C. All communication cable shall be direct runs with no splices.
- D. All connections or splices in communication cable shall be made with specified waterproof connectors.
- E. Coordinate with SLCO Grounds for specific installation requirements including trenching depths.
- F. Flow Sensor Communication wires and Master Valve Control wire shall be installed in their own separate conduit.

3.22 TRACE WIRE INSTALLATION

- A. Trace tape shall be installed in the same trench, bored holes and casings with irrigation mainline pipe during pipe installation. It shall be placed directly above the pipe as detailed.

3.23 CONTROLLER INSTALLATION – OWNER PROVIDED CONTRACTOR INSTALLED

- A. Install the owner provided controller(s) as detailed in the locations approved by Owner's Authorized Representative and the Landscape Architect.
- B. Contractor shall install controller(s) as detailed and in accordance with manufacturer's irrigation requirements.
- C. Contractor shall wire valves into controller(s) and set proper program.
- D. Wall mounted controllers shall be mounted at eye level on the wall of the structure designated on the plans.
- E. It shall be the Contractor's responsibility to install and supply junction box and separate breaker to furnish power to a new controller(s). AG2401 surge protection shall also be provided at the incoming power and low voltage power side. Grounding shall be per the national electrical code and the Grounding Grid detail shown on the plans.

- F. All WeatherTrak equipment shall be inspected and approved by a WeatherTrak approved Specialist (Joe Jackson, 801-404-1371). Contractor shall be responsible for obtaining inspection approval and shall have any rejected installation repaired and re-inspected at no cost to the Owner.

3.24 DECODERS (OWNER PROVIDED CONTRACTOR INSTALLED)

- A. Install the Owner provided decoders as per manufacturer's recommendations. Contractor to lay out decoders as required by system. No two valves are to share the same address. Decoders shall not be used for the flow sensor or master valve. Flow sensor is to be directly connected to the controller by communication wire and the master valve is to be connected with a #14 AWG Red Control wire and a #12 AWG Common White wire.
- B. All two wire decoders shall be installed inside valve box of control valve(s) in accordance with all manufacturers' installation recommendations.
- C. Grounding and line surge protection to be installed as per decoder grounding detail and per manufacturer's installation recommendations. Grounding wire shall be connected to grounding rods/plates with cadweld connection.

3.25 CHECK / TEST / START-UP / ADJUST

- A. Before any pipes are covered, the Owner's representative shall inspect the system for compliance with specifications and drawings. Any required changes will be made at this time at no expense to the owner.
- B. Flushing: After all piping, and valves are in place and connected, flush piping under a full head of water.
- C. Testing:
 - 1. Leakage test: test all lines for leaks under operating pressure. Main lines shall be tested before backfill for a period of not less than one hour, and shall have no leakage or loss of pressure. If leakage is present, repair all leaks and re-test.
 - 2. Coverage test: perform a coverage test in the presence of the Owner's Representative (notify Owner's representative at least seven (7) days in advance of scheduled coverage test). Representative will determine if the water coverage is complete and adequate. Readjust heads and/or head locations as necessary or directed to achieve proper coverage.
 - 3. When installation of all equipment is complete and backfilling, and grading operations are complete, the Contractor shall call for an operational test and major inspection of the sprinkler irrigation system. Notice by the Contractor shall be given, in writing, 3 days in advance to the OAR so that proper scheduling can be done for those who are to attend.
 - 4. At the appointed time, an inspection of all valve boxes, controllers, gate valves, and heads shall be made. The entire system will be tested to check for pressure, operation, water coverage, and head adjustment. A list of discrepancies (punch list), shall be written and distributed as needed. Each item on the list shall be corrected before the system will be approved by the Inspector who will notify the OAR before payment will be made. The Contractor will be back charged for time spent by County offices and consultants who have been brought to the site for a final inspection when the project is not ready for a final inspection.
 - 5. All testing shall be at the expense of the Contractor.

3.26 CLEANING AND ADJUSTING

- A. At the completion of the work, all parts of the installation shall be thoroughly cleaned. All equipment, pipe, valves and fittings shall be cleaned of grease, metal cuttings and sludge that may have accumulated by the operation of the system for testing.
- B. Upon completion of all installation work, Contractor shall remove all leftover materials, equipment and debris resulting from work of this section from the site in a safe and legal manner.
- C. Adjust valve boxes to grade as required.
- D. After completion of grading, planting, and mulching, carefully adjust irrigation heads for proper watering.
- E. Each control zone shall be operated for a minimum of 15 minutes and checked for consistency of delivering water. Valves, timing devices or other mechanical or electrical components, which fail to meet manufacture's standards, shall be rejected, replaced and tested until they meet the manufacturer's standards.

3.27 GUARANTEE AND MAINTENANCE

- A. The Contractor shall guarantee the workmanship, materials, fixtures, and equipment to be free from defects for a period of one year after the date of substantial completion. The contractor shall correct any deficiencies when notified during the warrantee period and correct in satisfactory condition any damage to the buildings or grounds, without cost to the owner. All guarantees shall be in writing and approved by the Owner's representative before submitting to the owner.
- B. In the Fall of the year during the installation and guarantee period, the Contractor shall meet with the County maintenance personnel on the site. The Contractor shall winterize the system by draining all of the water and doing everything necessary to insure protection of the system until Spring. Blowing out the lines by compressor shall be permitted during the 1 year guarantee. The individuals involved from both parties shall exchange all information necessary for the eventual take-over of the system by the County.
- C. The Contractor shall insure and guarantee complete drainage of the system. In working with or connecting to an existing system, he shall guarantee compatibility in operation and drainage between the two systems.
- D. The Contractor with the County maintenance personnel, inspector or OAR in attendance shall energize the sprinkler irrigation system again the following Spring and shall repair all defects found as a result of Winter damage, improper installation, improper maintenance, defective materials or inadequate sprinkler drainage.
- E. The Contractor shall coordinate with the landscaping sub-contractor during the entire landscaping and lawn establishment period on the use, scheduling, and maintenance of the sprinkler system.

3.28 FINAL INSPECTION

- A. At the end of the guarantee period, when the lawn and landscaping have been approved, the Contractor shall call for a final inspection of the sprinkler irrigation system. There shall be 5 days notice given, in writing, to the OAR, prior so that the appropriate people may attend.
- B. Prior to that time, all heads shall have been adjusted to their proper pattern, radii, and height. The system shall have been flushed out, checked for operation, and any defects corrected. The entire system will be inspected and checked to determine if everything is in working order to be turned over to the County. A final list of items found in need of correction (if any), will be made and the Contractor shall correct them. The Inspector will notify the OAR when he has verified that every item is acceptable. Upon acceptance of the system by the OAR, the County shall assume all responsibility for the system.

3.29 PAYMENT

- A. Payment of the sprinkler irrigation system portion of the contract shall be the lump sum indicated at the time of bidding and any subsequent amendments to the contract price. Partial payments may be made to the General Contractor upon his request and based upon the percentage of approved work completed.
- B. Final payment of the sprinkler irrigation system work shall be made upon acceptance of the system, as specified above and upon the request of the General Contractor. However, any problems arising at the end of the guarantee period will be corrected or subject to bonding action.

END OF SECTION 328400

SECTION 329000 - PLANTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Trees
 - 2. Shrubs and other plantings
 - 3. Fertilizers
 - 4. Tree staking & guying
 - 5. Edging
 - 6. Mulch
 - 7. Landscape Boulders
- B. Related Sections include the following:
 - 1. Section 329119 – Fine Grading and Soil Preparation
 - 2. Section 328400 – Irrigation
 - 3. Section 329219 – Seeding
 - 4. Section 329223 – Sodding

1.3 DEFINITIONS

- A. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.
- B. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.
- C. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.
- D. Finish Grade: Elevation of finished surface of planting soil.
- E. Planting Soil Mix: Soil produced by homogeneously blending existing on site or imported topsoil, organic compost, and Utelite fines as specified and mixed with necessary soil amendments as determined by required soil tests.
- F. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each of the following:
 - 1. Bark Mulch – 1 gallon zip lock bag minimum sample size of bark mulch, identifying source, including name and telephone number of supplier.
 - 2. Stone Mulch– 2 gallon bucket minimum sample size for each sample of stone, identifying source, including name and telephone number of supplier.
 - 3. Weed Control Fabric: 18” x18” sample identifying source, including name and telephone number of supplier. Provide product specification information with sample.
 - 4. Landscape Boulders: sample of landscape boulder identifying source, including name and telephone number of supplier.
- C. Product Certificates: For each type of manufactured product, signed by product manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis for standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- D. Qualification Data: For landscape installer.
- E. Planting Schedule: Prepare a proposed planting schedule. Schedule the dates for each type of landscape work during the normal seasons for such work in the area of the site. Correlate work with specified maintenance periods to provide maintenance throughout the specified time period. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.
- F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer with a minimum 5 years experience whose work has resulted in successful establishment of exterior plants.
 - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when exterior planting is in progress.
 - 2. Qualification of Arborist: All work of pruning shall be performed by an arborist certified by the International Society of Arboriculture.
- B. All plants shall comply with Federal and State Laws requiring inspection for plant disease and infestations. Any inspection certificates required by law shall accompany each delivery of plants and such certificates shall be filed with the Owner's Authorized Representative.
- C. All Plants shall conform to the size, age, and condition as specified in the plant list shown on the drawings. **Undersized plant material will not be approved.** No additional compensation shall be due the contractor if larger than specified plant material is provided or must be provided to meet minimum size criteria.
- D. In all cases, the contractor shall be held responsible for all plant materials indicated on the plans unless otherwise directed in writing by the Landscape Architect.

- E. **Each bidder shall investigate sources of supply and satisfy himself that he can supply all of the plants mentioned in the planting lists in size, variety, and quantity noted and specified before his bid is submitted.** Failure to take this precaution will not relieve the successful bidder from his responsibility as contractor to furnish and install all plant material in strict accordance with the contract requirements without additional expense to the owner.
 - F. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
 - G. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.
 - H. Representative Plant photographs: The contractor shall provide actual photographs (one photograph minimum per plant species, variety, and/or cultivar), obtained from the plant source for each plant listed in the plant schedule to show representative standards of quality and compliance with the contract requirements. Plants shall be photographed with a person or some type of measuring device included in the photo to provide scale. Approval of the photographed plant materials does not constitute final acceptance. Plant material will be observed and inspected at the job site.
 - I. Plant Observation: After approval of plant photographs, Landscape Architect shall observe trees and shrubs, and other plant material at job site for compliance with requirements for genus, species, variety, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Trees with cut central leaders, split leaders, or crooked trunks will be rejected. Remove rejected plant materials immediately from Project site. Cost of replacements and project delays shall be born by the Contractor. All trees approved for the project will be individually tagged with the Landscape Architect's seals at the job site, and no trees shall be planted without such seals.
 - J. Selection: Contractor shall locate plant material sources and ensure plants are shipped in timely fashion for installation.
 - 1. Unauthorized substitutions will not be accepted. If proof is submitted that specific plants or plant sizes are unobtainable, written substitution requests will be considered for the nearest equivalent plant or size. All substitution requests must be made in writing.
 - K. Preinstallation Conference: Conduct conference at Project site to comply with project requirements as indicated in Division 1 Section "Project Management and Coordination."
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Notify Landscape Architect 3 working days prior to the proposed arrival of plant material on site.
 - B. Plant materials shall be examined by Landscape Architect at time of delivery on site. This inspection does not constitute final acceptance of plants. All plants will be inspected again at time of final inspection and once again at the end of the warranty period. Any plant found to be unacceptable at any of these inspections shall be immediately removed and replaced.
 - C. Do not prune trees and shrubs before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to

destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.

- D. Handle planting stock by root ball.
- E. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants in shade, protect from weather and mechanical damage, and keep roots moist.
 - 1. Set nursery stock on ground and cover roots with mulch.
 - 2. Do not remove container-grown stock from containers before time of planting.
 - 3. Water root systems of exterior plants stored on-site as often as necessary to maintain root systems in a moist condition.

1.7 COORDINATION

- A. Planting Restrictions: Plant during the following period. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 - 1. April 15 to October 15.
- B. Weather Limitations: Planting shall not take place when ground is snow covered or frozen.
- C. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns, unless otherwise acceptable to Landscape Architect.

1.8 JOB CONDITIONS

- A. Examine the finish grades, verify that elevations vary no more than 1/2" in 10 feet from the required line and grade set forth in the drawings, taking into account the elevation allowance needed to accommodate mulch depths. Observe the conditions under which work is to be performed, and notify the Landscape Architect of unsatisfactory conditions.
 - 1.
 - 2. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify the Landscape Architect for direction prior to planting.
- B. Proceed with and complete the landscape work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work required.
- C. The Contractor shall be fully responsible for any damage to existing trees. No pruning, thinning, or cutting will be allowed unless written permission is given by the Landscape Architect. The Contractor shall replace with like kind and size any trees or existing shrubs damaged by him or his sub-contractors.

1.9 WARRANTY/GUARANTEE PERIOD

- A. Special Warranty: Warrant the following exterior plants, for the warranty period indicated, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Contractor's control.
 - 1. Warranty Period for Trees and Shrubs and other plants: One year from date the entire project is substantially complete.
 - 2. Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.

3. Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
4. At the conclusion of the guarantee period and prior to final inspection by the Landscape Architect, the contractor shall be responsible for the removal of all tree stakes, and tree guys.
5. Any Replacement plants shall also be warranted for 1 year from the date of replacement planting.
6. Contractor shall provide specific maintenance instructions to be followed by the owner, including frequency and amount of water to be applied, any special care instructions, etc. These instructions shall be submitted to and reviewed by the Landscape Architect. If the contractor does not provide specific care information, County Grounds will maintain plantings to their best practice and standards and this will be deemed acceptable compliance for any warranty claim.

1.10 ESTABLISHMENT AND MAINTENANCE

- A. Trees and Shrubs: Maintain for the following establishment period by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings.
 1. Establishment and Maintenance Period: shall be until trees and shrubs are established but in no case less than ninety (90) days from date of Planting **and** up until the date of Final Acceptance throughout growing months (April 15th to October 15th). In the event the maintenance period is not completed before the end of the growing months then the maintenance period shall be carried over to the next year and start back up April 15th.
- B. Ground Cover and Plants: Maintain for the following maintenance period by watering, weeding, fertilizing, and other operations as required to establish healthy, viable plantings:
 1. Establishment and Maintenance Period: until Ground Cover and Plants are established but in no case less than ninety (90) days from date of Planting and up until the date of Final Acceptance throughout growing months (April 15th to October 15th). In the event the maintenance period is not completed before the end of the growing months then the maintenance period shall be carried over to the next year and start back up April 15th.

1.11 SUBSTANTIAL COMPLETION

- A. For all new plantings and landscape items to be considered Substantially Complete, the Maintenance and Operating Manual must be submitted and approved, all required submittals shall have been received and approved, and the planting shall be installed as intended as demonstrated during inspection. This will be determined by observation by the Landscape Architect and Owner's Representative. Salt Lake County will not issue substantial completion for only a portion of the project. The date for Substantial Completion for the project will be when all items of work on the project are Substantially Complete as determined by observation by the Landscape Architect and Owner's Representative.

1.12 INSPECTIONS

- A. The contractor shall request a site inspection with the Landscape Architect and Owner's Representative at the time of Substantial Completion and again at the end of the warranty period. Inspections will verify compliance to the drawings and specifications. Any items not

complying with the drawings and specifications shall be adjusted and/or repaired prior to issuing Substantial Completion or Final Acceptance.

1. The Landscape Architect shall be given a minimum of 7 days notice prior to the site inspections.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

- A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. Grade: Provide trees and shrubs of sizes and grades complying with ANSI Z60.1 for type of trees and shrubs required.
- C. Size and Planting Condition: As indicated on Drawings.
- D. Label each tree and shrub with securely attached, waterproof tag bearing legible designation of botanical and common name.

2.2 SHADE AND FLOWERING TREES

- A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.
- B. Small Ornamental Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as indicated on Drawings.
- C. Multistem Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as indicated on Drawings.

2.3 DECIDUOUS SHRUBS

- A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.

2.4 CONIFEROUS EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.

2.5 BROADLEAF EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.

2.6 PERENNIALS

- A. Form and Size: Provide healthy, field-grown plants from a commercial nursery, of container size, species and variety shown or listed and complying with requirements of ANSI Z60.1.

2.7 GROUND COVER PLANTS

- A. Ground Cover: Provide ground cover of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1.

2.8 PLANTING SOIL MIX

- A. Provide planting soil mix as specified in section 329119 – Fine Grading and Soil Preparation.

2.9 FERTILIZER

- A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer, O-F-241C, type 1, grade 16-16-8, level B with guaranteed chemical analysis of contents marked on the containers.
- C. Planting Tablets: Fertilizer planting tablets shall be tightly compressed commercial grade planting tablets having a 20-15-5 formula, weighing 21 grams each, as “Blue Chip,” “Grow-Power” planting tablets or “approved equal.” The planting tablets shall be delivered to the site in the original, unopened containers, bearing the manufacturer’s guaranteed analysis. Any damaged tablet will not be accepted.

2.10 LANDSCAPE EDGING

- A. Concrete Mow Curb: As detailed on Drawings.

2.11 BARK MULCH

- A. Bark Mulch: Clean, medium coarseness, shredded bark mulch. Submit sample for approval prior to placement.
- B. Engineered Wood Chips shall be used as mulch in some plant beds contained within the Playground Area as indicated on the planting plans and Playground Surfacing Plan (see LM-400). See specification section 321816 Playground Protective Surfacing. Engineered Wood Chips will be provided and placed by Owner’s Vendor. Landscape Contractor shall coordinate with Owner’s Vendor for scheduling of placement. Landscape Contractor shall also coordinate and oversee placement to insure planting is not damaged and that mulch is not placed against trunks or stems of plants.

2.12 CRUSHED STONE MULCH

- A. Hard, durable 2”-4” rounded stone cobble, washed free of loam, sand, clay and other foreign substance. Color to be similar in color to landscape stone/boulders as approved by Landscape Architect. Submit a minimum of 4 different color samples providing a range of colors from

buff/tan to brownish in color for color selection and approval to be approved of Landscape Architect. Submit sample for approval of size and color prior to delivery to the site.

2.13 WEED CONTROL FABRIC

- A. Weed Control Fabric shall be a roll type polypropylene or polyester fabric and shall be woven, needle punched or non-woven and treated for protection against deterioration due to ultraviolet radiation. Fabric shall be minimum 99 percent opaque to prevent photosynthesis and seed germination from occurring yet allowing air, water, and nutrients to pass thru. Minimum weight shall be 5 ounces per square yard with a minimum thickness of 20 mils with a 20 year guarantee.

2.14 LANDSCAPE BOULDERS

- A. Provide as specified in specification section 323100 Site Improvements. Do not deliver to site until physical samples have been approved by Landscape Architect.

2.15 STAKES AND GUYS

- A. Tree stakes shall be two inch (2") diameter, by eight foot (8') minimum long straight grained pine and driven to a minimum depth of eighteen inches (18") into firm soil beneath plant pit excavation. Height of stakes shall be below tree branching.
- B. Tree ties shall be VIT steel twist brace attached to stake with 1- 1/4" galvanized threaded nails. Field sample shall be approved by the Owner's Representative
- C. Guy wires and anchors on all evergreens and trees 4" caliper or larger shall be duckbill tree support system model # 68 DTS including anchors, galvanized steel, vinyl-coated cable, turnbuckles, tree collars and cable clamps, all pre-assembled. Install per manufacturer's specifications.
- D. Safety flagging for all diagonal guy wires shall consist of one half-inch (1/2") PVC sleeves.

2.16 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Herbicide:
 - 1. Provide selective post emergent herbicide for use in weed control. Provide Round-up or approved equal.
 - 2. Provide pre-emergent herbicide for use in planter beds for weed control. Provide Treflan or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive and plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Locate all underground utilities prior to digging. Do not place plants on or near utility lines. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.
- B. Herbicide Treatment: All planting beds shall be weed free prior to commencing soil placement, fine grading, and planting. Treat areas with a non-selective herbicide as necessary a minimum of ten (10) days prior to commencement of any planting or irrigation work to insure weed free planting areas. Herbicide applications shall be applied in accordance with manufacturer's recommendations and in accordance with section 3.16 Herbicide Application and Weed Control. The poisoned vegetation shall be allowed to completely die back, including the roots, before proceeding with the work. Dead vegetation shall then be removed from the site and disposed of in a legal manner.
- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- D. Lay out individual tree and shrub locations and areas for multiple exterior plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before planting. Make adjustments as required by Landscape Architect.
- E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

3.3 PLANTING BED ESTABLISHMENT

- A. Prepare subgrade of planting beds and spread Planting Soil Mix in accordance with specification section 329119 - Fine Grading and Soil Preparation.
- B. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture and in accordance with specification section 329119 – Fine Grading and Soil Preparation. Roll and rake, remove ridges, and fill depressions to meet finish grades prior to adding mulch.
- C. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.
- D. Install Landscape Edging as detailed in all location shown on the drawings.

3.4 TREE AND SHRUB EXCAVATION

- A. Pits and Trenches: Excavate circular pits with sides sloped inward. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.

- B. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
- C. Prior to planting, fill excavated tree/shrub pit with water and allow to percolate out. If after 24 hours, the water has not percolated out of the pit, notify the Owner's Authorized Representative. Do not plant until the problem has been corrected.

3.5 TREE AND SHRUB PLANTING

- A. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball 1"-2" above adjacent finish grades.
 - 1. Remove burlap, wire baskets, twine, and wrappings from root balls, taking care not to disturb root balls. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 2. Place planting soil mix around root ball in 12 inch lifts, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
- B. Set container-grown stock plumb and in center of pit or trench with top of root ball flush with adjacent finish grades.
 - 1. Carefully remove root ball from container without damaging root ball or plant.
 - 2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
- C. Add fertilizer plant tablets to planting pit. Fertilizer tablets shall be placed no deeper than eight inches (8") from finished grade and two inches (2') from the root ball. Add the required number of tablets as specified below.
 - 1. One (1) tablet per one (1) gallon container.
 - 2. Two (2) tablets per five (5) gallon container.
 - 3. Three (3) tablets per ten (15) gallon container.
 - 4. Four (4) tablets per two-inch (2") caliper tree.
 - 5. Six (6) tablets per three-inch (3") caliper tree.
 - 6. Eight (8) tablets per four-inch (4") caliper tree.
- D. Prepare a watering basin around the trunk as indicated on Drawings.
- E. Mulching: Apply specified thickness of mulch extending to edge of planting pit or trench. Do not place mulch within 4 inches of trunks or stems.

3.6 TREE AND SHRUB PRUNING

- A. Pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches. All cuts, scars and bruises shall be properly treated according to the directions of the Landscape Architect. Proper pruning techniques shall be used. Do not leave stubs and do not cut the leader branch. Improper pruning shall be cause for rejection of plant material.

3.7 GUYING AND STAKING

- A. Trees should not be staked except in rare cases. Stake and guy trees only when required by site conditions to insure viability of the tree and approved by Landscape Architect.
- B. Upright Staking and Tying: As detailed, trees shall be firmly staked, as shown on the Drawings. Stakes shall be of even height and neat in appearance, and shall not injure the root balls.
- C. Guying and Staking: As detailed, trees shall be firmly anchored and guyed as shown on the Drawings.

3.8 GROUND COVER AND PERENNIAL PLANTING

- A. Set out and space ground cover and plants as indicated.
- B. Dig holes large enough to allow spreading of roots, and backfill with planting soil.
- C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING BED MULCHING

- A. Mulch backfilled surfaces of tree wells, planting beds and other areas indicated on drawings.
 - 1. Mulch: Apply bark or stone mulch to the depths and locations indicated on the drawings. Do not place mulch against plant stems.

3.10 WEED CONTROL FABRIC INSTALLATION

- A. Remove all vegetation, including roots, from within the areas specified to receive Crushed Stone Mulch. Completely cover areas with the specified weed control fabric prior to placement of stone mulch. Overlap cut edges a minimum of twelve (12) inches and secure to subgrade according to manufacturer's recommendations. **Weed control fabric installation shall be inspected by Owner's Authorized Representative prior to covering.**

3.11 LANDSCAPE EDGING INSTALLATION

- A. Concrete Mow Curb: Install concrete edging materials as detailed in locations shown on the drawings.

3.12 LANDSCAPE BOULDER INSTALLATION

- A. Landscape Boulders: Install landscape boulders as detailed in locations shown on the drawings. Boulders shall be installed in locations as generally shown on the plans. Locations of boulders shall be approved on site by Landscape Architect prior to placement.

3.13 WATERING

- A. All plants shall be thoroughly watered immediately after planting; this shall mean full and thorough saturation of all backfill in the pits and beds during the same day of planting. Water shall be applied only by open end hose at very low pressure to avoid air pockets, injury or washing. When planted, watered, and fully settled the plants shall be vertical and the stand shall be slightly below the stand in the nursery.

3.14 SUPPLEMENTAL WATERING

- A. The Contractor shall hand water newly planted trees, twice a week for eight weeks.
- B. A minimum of five (5) gallons per tree per watering required. Amount may vary pending seasonal rainfall.
- C. Lightweight pickup truck with 55 gallon drum may be used to water trees. Any other method must be approved by Landscape Architect.
- D. The Contractor must locate and stake any sprinkling head or valve box within 10' feet of proposed tree location, and must establish direction of lateral or main sprinkling line that serves the staked sprinkler head or valve box. (This procedure will help eliminate hitting underground sprinkling system.)
- E. The Contractor shall take extra care to watch for sprinkling heads and valve boxes in lawn area. Any broken sprinkling heads or valve boxes, etc., shall be replaced by Contractor at no expense to owner.

3.15 HERBICIDE APPLICATION AND WEED CONTROL

- A. Application of pre-emergent herbicide is required. The contractor shall maintain the site weed free until the end of the establishment period.
- B. Apply herbicides so no damage to protected vegetation occurs whether inside or outside the project site. Damage to protected vegetation or vegetation outside the project site will be reimbursed to the owner or replaced by the Contractor in a manner satisfactory to the Owner's Authorized Representative, and according to the International Society of Arboriculture Method of "Valuation for Landscape Trees, Shrubs, and Other Plants," latest edition.
- C. Post Emergent Herbicide:
 1. Mix and apply post-emergent herbicide according to manufacturer's recommendations indicated in the "Weeds Controlled" section of the label, and apply to undesired, actively growing vegetation.
 2. Apply the spray mixture so that all undesired vegetation is uniformly covered, but avoid causing over-spray and drift. Spray target vegetation so that it is wet, but short of run-off.
 3. Prune all suckers at the base of any trees to the soil level prior to application.

4. Do not apply post-emergent herbicide in any of these conditions: When rainfall is expected within six hours; when there is growth stress as a result of drought, insects, disease, or plant damage, or when there is heavy dust on plants.
5. Do not walk or permit other traffic on treated areas when they are wet from application. Shoes and equipment may track spray solution to areas where vegetation is not to be treated.
6. Repeat application, as necessary to completely eradicate undesired vegetation.

D. Pre-emergent Herbicide:

1. Mix and apply pre-emergent herbicide according to manufacturer's recommendations and information on the side panel, and the following: Use granular applicators designed to apply herbicide at Manufacturer's suggested highest rate.
2. Calibrate the applicator according to the manufacturer's directions prior to use and check frequently during application to be sure the equipment is working properly and distributing the granules uniformly. Do not apply more than the recommended amount.
3. Apply granular herbicide according to manufacturer's recommendations and on site conditions and soil preparation requirements or restrictions appropriate to the herbicide used.
4. The pre-emergent application must be followed within 8 hours with overhead watering or rainfall equivalent to 1/2".

E. License: Use a state licensed applicator to apply herbicide.

F. Mechanical Control:

1. Mechanically control the weeds by pulling, cutting, hoeing, or by any other directed means approved by the Owner's Authorized Representative.
2. Weeds in a dormant stage or other condition which cannot be effectively controlled with post-emergent herbicide shall be removed from the site by mechanical methods.

3.16 ESTABLISHMENT AND MAINTENANCE

- A. Begin Maintenance immediately after planting.
- B. Maintain plants for the specified time frame previously indicated above and throughout the Establishment Period.
- C. Maintain plants by watering, pruning, cultivating and weeding as required for healthy growth. Restore planting saucers. Treat as required to keep plant materials free of insects and disease.
- D. The Contractor shall provide the owner with an approved irrigation schedule.
- E. The Contractor shall provide on-site maintenance instructions to the Owner's Authorized Representative and maintenance personnel prior to turning the project over to the Owner.

3.17 CLEAN-UP AND PROTECTION

- A. During exterior planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

3.18 DISPOSAL

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property. If approved by Owner, excess soils may be wasted on site.

END OF SECTION 329000

FINE GRADING, LASER GRADING, AND SOIL PREPARATION - SECTION 329119

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Related Sections include the following:
 - 1. Section 329000 – Planting
 - 2. Section 329219 – Seeding
 - 3. Section 329223 – Sodding

1.3 SUBMITTALS

- A. At least 30 days prior to ordering materials, the Contractor shall submit to the Landscape Architect representative samples, certifications, manufacturer's literature and certified test results for all materials as specified below. No materials shall be ordered or delivered until the required submittals have been reviewed and stamped approved by the Landscape Architect. Delivered materials shall match the approved samples.
- B. Laser Grading Equipment specification information to indicate compliance with the specified Laser Grading Equipment requirements.
- C. Approval shall not constitute final acceptance. The Landscape Architect reserves the right to reject, on or after delivery, any material that does not meet these Specifications.
- D. List of submittals required.
 - 1. Sample of manufactured Planting Soil Mix and soil analysis testing results.
 - 2. Sample of imported topsoil (component of the Planting Soil Mix) and soil analysis testing results.
 - 3. Sample of organic compost (component of the Planting Soil Mix) and sieve analysis.
 - 4. Sample UteLite (component of the Planting Soil Mix) and product data.

1.4 QUALITY ASSURANCE

- A. The following standards apply to the work of this Section:
 - 1. AOAC: Association of Official Agricultural Chemists.
 - 2. ASA: Methods of Soils Analysis, American Society of Agronomy, Soil Science Society of America, Inc., Madison Wisconsin, latest edition.
 - 3. American Society for Testing and Materials (ASTM).
 - 4. All applicable local codes and regulations.

- B. It is the intent of this specification that all materials herein specified and shown on the drawings shall be of the highest quality available and meeting the requirements specified.
 - C. The work of this Section shall be performed by a Contracting firm that has successfully installed work of a similar quality, schedule requirement, and construction detailing with a minimum of five (5) years experience.
 - D. All work shall be performed in accordance with the best standards of practice relating to the trade and under the continuous supervision of a competent foreman capable of interpreting the Drawing and Specifications.
 - E. Soil shall not be worked when moisture content is so great that excessive compaction occurs, nor when it is so dry, that dust will form in air or that clods will not break readily. Water shall be applied, if necessary, to provide ideal moisture content for tilling and for planting.
 - F. All accumulated debris and rubbish shall be cleaned up and removed from the site before commencing work. Clear and grub all dead vegetative matter. The site shall be weed free prior to proceeding with any work.
 - G. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
 - H. Topsoil Analysis: Furnish a soil analysis for any stockpiled and imported topsoil proposed for use as specified in this section by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 - 1. Report suitability of topsoil for lawn growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
 - I. Compost Testing Laboratory Qualifications: An independent, with the experience and capability to conduct testing indicated following U.S. Composting Council Seal of Testing Assurance procedures, or equivalent.
 - J. Compost Analysis: Provide documentation from supplier that compost has reached monitored temperature of 140 degrees Fahrenheit for at least one week.
 - 1. Test representative sample(s) of compost for the following parameters: pH, soluble salts, percent moisture, percent organic matter, particle size, and nutrient content, including: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), and Magnesium (Mg).
 - 2. Test compost for maturity. Provide Carbon-Nitrogen ratio.
- 1.5 JOB CONDITIONS
- A. Examine the subgrade, verify the elevations to be no more than plus or minus 2" above or below subgrade elevation which should allow for the depths required for topsoil and mulch throughout the planted areas. Observe the conditions under which work is to be performed, and notify the Landscape Architect of unsatisfactory conditions.

PART 2 - PRODUCTS

2.1 PLANTING SOIL MIX

- A. Planting Soil Mix: Shall consist of a ratio by volume of 50 percent topsoil, 25 percent organic compost, and 25 percent Utelite fines.
1. The Contractor shall provide Planting Soil Mix at locations and depths indicated on the Drawings to complete all planting areas, as specified in this Section and as directed by the Landscape Architect. Planting Soil Mix shall be produced by homogeneously blending the specified components prior to placement.
 2. Do not commence with mixing Planting Soil Mix until the review and approval of soil test results, organic compost certification submittal, and Utelite fines submittal.

2.2 TOPSOIL

- A. Native or Imported topsoil used for native seed areas as a component of the Planting Soil Mix for turf areas, plant beds, and tree planting pits. Submit soil test results certifying that any imported topsoil meets the texture and analysis outlined below.
1. Source: Topsoil will be obtained from the following sources:
 - a. Existing Topsoil Stockpiled on site (**topsoil samples indicate that adequate on-site topsoil is available to meet project needs**), or
 - b. Imported from naturally well-drained areas with a history of satisfactory vegetative growth that has not been stripped before.
- B. Screening of Stripped and Stockpiled Topsoil (**if alternate is accepted**) – Stockpiled Topsoil shall be screened in quantities required to supply the specified depths of planting soil mix (taking into consideration that topsoil is only 50% of specified planting soil mix) and topsoil (used for seeded areas) for the project. Stripped and Stockpiled Topsoil shall be screened to meet the requirements of this specification indicating that all topsoil shall be free of stone large than 1" in any dimension. Contractor shall be solely responsible to determine quantities required for screening.
- C. Imported Topsoil shall be "fine sandy loam" or "sandy loam" determined by mechanical analysis (ASTM D-22) and based on the "USDA Classification System."
- D. Imported Topsoil shall not contain less than four percent (4%) or more than eight percent (8%) organic matter as determined by the loss on ignition of oven-dried samples.
- E. The acidity range of the topsoil shall be pH 5.5 to 7.5.
- F. All Topsoil shall be free of stones 1 inch or larger in any dimension, with stone fragments (gravel or any soil particles greater than 2mm) <5% by volume, and free of all other extraneous materials harmful to plant growth. Soluble salts <2 (dS/m or mmho/cm) and sodium absorption ration (SAR) <3. The electrical conductivity (EC2) of a 1:2 soil-water suspension shall be equal to or less than 1.0 millimhos/cm. (Test minus sieve Number 10 material). For bidding purposes contractor can assume existing topsoil to be stripped and stockpiled meets the above stated criteria.

- G. No imported topsoil shall be delivered to the site or placed in planting areas until topsoil test results and recommendations have been reviewed and approved by the Landscape Architect. Such approval shall not constitute final acceptance. The Landscape Architect shall reject any material delivered to the site, which, after on-site, post-delivery testing, does not meet these specifications.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 6 to 8; moisture content 25 to 35 percent by weight; 100 percent passing through 1/2-inch sieve; soluble salt content of <5 dS/m or mmho/cm; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings. Compost shall conform as follows:
 - 1. Tested at minimum, every six months for noxious weeds.
 - 2. Organic matter source (feedstock): Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
 - 3. Organic Matter Content: 60 to 80 percent of dry weight as determined by ash method.
 - 4. Free of refuse (less than 1 percent by dry weight), plastics, contaminants or any material toxic to plant growth.
 - 5. Processed to meet U.S. Composting Council's Seal of Testing Assurance Program, or equivalent.
 - 6. Carbon to Nitrogen Ratio: 40 to 1 or lower.
 - 7. Composted for a minimum of 9 months and reach a monitored temperature of 140 degrees Fahrenheit for at least one week.

Toxic Elements Maximum Concentration (mg/kg dry weight)

Arsenic	41
Cadmium	39
Copper	1500
Lead	300
Mercury	17
Molybdenum	75
Nickel	420
Selenium	36
Zinc	2800

- B. Peat: No Peat shall be used in this project.
- C. Organic Compost Products available from Miller Companies (435-245-3157) and Diamond Tree Experts (801.262.1596) has generally met the specification requirements listed above.

2.4 UTELITE FINES

- A. Expanded shale lightweight aggregate. Available from Utelite Corporation, (801) 243-9348.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Planting Soil Mix and topsoil placement shall not commence until rough grades have been approved by the Landscape Architect.
- B. Planting Soil Mix shall be placed in all turf and shrub/groundcover plant beds to depths specified and in all tree planting pits as specified in this section and as directed by the Landscape Architect. Topsoil shall be placed in all Irrigated (non-turf) seed areas to depths specified on the drawings. Unirrigated (Native) seed areas require no additional topsoil.
- C. Undisturbed areas shall remain intact whenever possible.
- D. All landscape areas shall be weed free prior to commencing soil placement, fine grading, and planting. Treat areas with a non-selective herbicide as necessary to insure weed free planting areas. Herbicide applications shall be applied in accordance with manufacturer's recommendations and in accordance with section 3.4 Herbicide Application and Weed Control in section 329000-Planting.
- E. Planting Soil Mix Placement
 - 1. Immediately prior to placing and spreading the Planting Soil Mix or topsoil, loosen the subgrade of planting beds to a minimum depth of four inches (4"). Remove all stones greater than 3/4" in diameter and all weeds, sticks, debris, or rubbish. Such material shall be removed from the site and legally disposed.
 - 2. Spread Planting Soil Mix or topsoil over loosened subgrade to the depth indicated on the drawings. Do not spread Planting Soil Mix or topsoil if subgrade is frozen, muddy, or excessively wet.
- F. Planting Soil Mix and Topsoil shall be backfilled in lifts of no more than six inches (6"). Compact each lift to 85% prior to placing next layer of backfill.
- G. Add recommended soil amendments at rates specified in soil analysis recommendations identified in the soil test results and as directed by the Landscape Architect. Rototill amendments into the top 6 inches of soil to achieve a uniform mixture.
 - 1. Following the incorporation of soil amendments, the surface shall be re-compacted to meet the requirements of this section.

3.2 FINE GRADING

- A. When rough grading, weeding, soil preparation and soil amending have been completed, and soil has been thoroughly water settled, all planting areas should be smoothly graded, ready for placement of plant materials.
- B. Fine grading shall be done when soil is at optimum moisture content.
- C. Laser Grading - Final grading of the turf areas for sports fields and their surrounds shall be accomplished utilizing dual plane or conical laser operated equipment with a dual mast system capable of the following tolerances: Finished grade elevations of the field shall be within +/- 1/4" over the plane of the field." No point across the full width and full length of the field will be more than 1/4" above or below the specified plane. Laser graded areas shall be capable of demonstrating compliance by survey verification using a minimum 25-foot grid to verify grade and elevation.
 - 1. Laser grading equipment shall be laser controlled (not laser indicated) and shall be capable of maintaining accuracy across the entire width and length of the field area.

2. **Laser Grading shall be performed by Landscape Contractor or Landscape Contractor's Subcontractor. Laser grading shall not be directly subcontracted separately by the General Contractor**
- D. Finish grades (non-laser graded areas) - shall be smooth, even and on a uniform plane with no abrupt changes of surface. The finish grade shall not vary more than one half inch (1/2") in ten feet (10') from the required line, and grade set forth in the Drawings. Adjustments of finish grades shall be made at direction of Landscape Architect as required.
- E. Finish grade of mulch in shrub and groundcover areas shall be flush with paved surfaces, after top-dressed with depth of bark or stone mulch as specified on the drawings. Finish grade of soil in all seeded areas shall be one inch (1") below all paved surfaces prior to seeding.
- F. The Contractor shall maintain a minimum of two (2) percent drainage away from all buildings, structures, and walls. Finished grades shall be smoothed to eliminate puddling or standing water.
- G. All finished grades shall be a minimum of two (2) percent unless otherwise indicated on the plans or approved by the Owner's Authorized Representative prior to installation of any plant materials.

END OF SECTION 329119

SECTION 329219 - SEEDING

PART 1 GENERAL

1.1 SUMMARY

- A. The work to be performed under this division shall consist of furnishing all labor, equipment, and materials for producing a full stand of grass growing on all areas indicated on the plans. The work shall consist of, but not be limited to: grading, seed bed preparation, seeding, fertilizing, weed control, establishment, maintenance, guarantees, and repair in accordance with the project plans and specifications.
- B. Related Sections:
 - 1. Section 329119 – Fine Grading and Soil Preparation
 - 2. Section 328400 – Irrigation
 - 3. Section 329000 – Planting
 - 4. Section 329223 – Sodding

1.2 REFERENCES

- A. ISTA - The International Seed Testing Association
- B. AOSA - Association of Official Seed Analyst
- C. AASCO - The Association of American Seed Control Officials
- D. Utah Seed Law: Utah Code – Title 4, Chapter 6

1.3 SEEDED AREA ESTABLISHMENT AND MAINTENANCE

- A. Begin maintenance immediately after each area is planted and continue until acceptable stand of grass and plants is established, but for not less than the following periods:
 - 1. Irrigated Seed Mix (non-Turf) Areas: Until the grass stand is properly established meeting specified establishment criteria but in no case less than 90 days from planting and at least until date of final acceptance throughout growing months (April 15th to October 15th). In the event the maintenance period is not completed before the end of the growing months then the maintenance period shall be carried over to the next year and start back up April 15th.
- B. Maintain and establish grasses and plants by watering, fertilizing, herbicide application, weeding, replanting, and other operations. Roll, regrade, and replant bare or eroded areas.
- C. Watering: Provide and maintain temporary piping, hoses, and watering equipment to convey water from sources and to keep seeded area uniformly moist to a depth of 2 inches for the first two weeks after planting or as recommended by seed vendor. Water at the rate according to seed vendor's recommendations thereafter during the maintenance period.
- D. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

1.4 SUBMITTALS:

- A. Product Data: For each type of product indicated in the specification.

- B. Certification of Seed: From seed vendor for each seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each grass seed mixtures, identifying source, including name and telephone number of supplier.
- C. Drill Seeder specification data required to indicate compliance with the specified Drill Seeder requirements.
- D. Product Certificates: For fertilizers, from manufacturer.
- E. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.5 SUBSTANTIAL COMPLETION

- A. The date of Substantial Completion for the seeding will be **when the Establishment and Maintenance Period has been completed for all seed areas and seeded areas are established in accordance with the requirements of this specification and approved** by Landscape Architect and Owner's Authorized Representative. This will be determined by observation by the Landscape Architect and Owner's Representative. **Seeding Contractor shall coordinate with General Contractor to insure construction sequencing allows adequate time for completion of the Establishment and Maintenance period prior to overall project completion.**

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by County for maintenance of grasses during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful grass seed establishment.
 - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 3. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Technician - Exterior.
 - b. Landscape Industry Certified Lawncare Manager.
 - c. Landscape Industry Certified Lawncare Technician.
 - 4. Herbicide Applicator: State licensed, commercial.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD CONDITIONS

- A. Planting Restrictions: Plant in accordance with the following periods. Coordinate planting periods with initial establishment periods to provide required maintenance from date of planting completion.
 - 1. Irrigated Seed (Non-Turf) Areas: As required for germination and establishment prior to end of growing season.
 - 2. Days considered for the establishment period must be conducive to the growth and establishment of the seed and not non-growing seasonal months.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 MATERIALS

2.1 SEED:

- A. Irrigated Seed Mix (no shrubs in mix): shall be the mixture and applications rates shown below:

Poa compressa (Canadian Blue)	6.60 lbs.
Festuca ovina 'Azay" (Sheep Fescue)	3.50 lbs.
Poa sandbergii (Sandberg Blue Grass)	8.30 lbs.
Bouteloria gracilis 'Alm' (Blue Grama)	6.60 lbs.
<u>Lolium Perene –Turf Type (Perennial Rye)</u>	<u>5.0 lbs.</u>
Total	30 lbs.

- 1. Seed at a **rate of 30 pounds per acre.**
- 2. Irrigated seed mix shall be seeded at application rates indicated above.
- 2. Seed mix shall be seeded using the two step broadcast seeding/hydro-mulching process.

- B. Irrigated Seed Mix with Shrubs: shall be the mixture and applications rates shown below:

Poa compressa (Canadian Blue)	6.60 lbs.
Festuca ovina 'Azay" (Sheep Fescue)	3.50 lbs.
Poa sandbergii (Sandberg Blue Grass)	8.30 lbs.
Bouteloria gracilis 'Alm' (Blue Grama)	6.60 lbs.

<u>Lolium Perene –Turf Type (Perennial Rye)</u>	<u>5.0 lbs.</u>
<u>Artemisia Tredentata (Mountain Big Sage)</u>	<u>.25 lbs</u>
<u>Ericameria nauseous (Rubber Rabbit Brush)</u>	<u>.50 lbs</u>
<u>Linum Lewisii (Blue Flax)</u>	<u>2.0 lbs</u>
Total	32.75 lbs.

1. **Seed at a rate of 32.75 pounds per acre.**
2. Irrigated seed mix shall be seeded at application rates indicated above.
2. Seed mix shall be seeded using the two step broadcast seeding/hydro-mulching process.

- C. Unirrigated Native Seed Mix (for use in repair of unirrigated natural areas, if disturbed by construction): Seed mix shall be the mixture and application rates as shown below:

Slender Wheatgrass (Elymus trachycaulus)	3.25 lbs.
Annual Ryegrass (Lolium multiflorum)	2.0 lbs.
Crested Wheatgrass (Agropyron desertorum)	1.75 lbs.
Green needlegrass (Nasselia viridula)	1.75 lbs.
Indian ricegrass (Achnatherum hymenoides)	2.25 lbs.
Western Wheatgrass (Pascoyrum smithii)	2.75 lbs.
Bluebunch wheatgrass (Pseudoroegneria spicata)	2.25 lbs.
Thickspike wheatgrass (Elymus lanceolatus)	2.25 lbs.
Sheep fescue (Festuca ovina)	.40 lbs.
Sandberg bluegrass (Poa sandbergii)	.50 lbs.
Blue grama (Bouteloua gracilis)	.40 lbs.
Alkali sacaton (Sporobolus airoides)	.20 lbs.

Subtotal 19.75 lbs./acre

Add Quick-Guard nurse crop (Triticale sp.) 7 lbs/acre

Total 26.75 lbs/acre

1. Seed rates are listed as lbs./acre
2. Unirrigated Seed Mix indicated shall be seeded using the two step drill seed/hydromulching process. **Seeding shall take place after the first hard frost but no earlier than October 15th.**

- D. Seed mixtures shall meet the minimum tested requirements of Utah Seed Law. The seed shall be the current year's crop, guaranteed by the supplier as follows:

80% Germination Rate
72% Minimum Purity
No more than 2% inert matter
No noxious weeds
No more than 1/10% weed seed
28 pounds per bushel or equivalent.
80% pure live seed

- E. Apply the seed mixture at a rate as indicated. Prior to seeding the Contractor shall arrange for the inspector to check the seed in storage. Labels shall be obtained for the project Landscape Architect's file.

2.2 MULCH (WOOD FIBER):

- A. Wood Fiber Mulch shall be a wood material, which has been shredded, pulverized, or dissolved into small fibers. The mulch shall have been processed so that it will have no germination and

so that it forms a blotter-like ground cover. The material shall be air dry and contain no more than 15% moisture by weight.

- B. Wood Fiber Mulch shall be included as part of the Hydromulch slurry at a rate of 1500 lbs per acre.

2.3 TACKIFIER

- A. Tackifier shall be M-Binder tackifier derived from the plantago plant, or approved equal.
- B. Tackifier shall be applied as part of the hydromulch slurry at a rate of 80 lbs per acre.

2.4 DRILL SEEDER

- A. Drill seeder shall be approved for seeding of native grasses, capable of seeding at the required seed application rate and depth, and have a row spacing of 7" o.c.

2.5 FERTILIZER:

- A. The first application of fertilizer shall be a 16-16-16 mixture incorporated into soil during the seed application. The grass area shall be fertilized every 21 days following initial application. Apply one pound per 1,000 square feet of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight using the same mix until maintenance period is over.

2.6 HERBICIDES

- A. Retain applicable paragraphs in this article; revise to suit Project. Insert requirements for other types of pesticides, such as rodenticides, if required.
- B. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- C. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- D. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 EXECUTION:

3.1 EXAMINATION:

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Project Manager and replace with new planting soil.

3.2 SEED BED PREPARATION:

- A. Prepare subgrade of seed beds and spread Planting Soil Mix and topsoil in accordance with specification section 329119 – Fine Grading and Soil Preparation.
 - 1. Herbicide Treatment: All sod beds shall be weed free prior to commencing soil placement, fine grading, and planting. Treat areas with a non-selective herbicide as necessary to insure weed free planting areas. Herbicide applications shall be applied in accordance with manufacturer's recommendations and in accordance with section 3.13 Herbicide Application.
- B. Spread and evenly distribute the specified Planting Soil Mix or Topsoil over the areas to be seeded to the depth specified on the drawings and in accordance with specification section 329119 – Fine Grading and Soil Preparation.
- C. Irrigated (Non-Turf) Seed mix areas shall receive Topsoil to depths specified in the drawings.
- D. Unirrigated Seed Mix areas shall receive no topsoil as indicated on the drawings. Areas not receiving topsoil shall be prepared as if for Planting Soil Mix placement by loosening the subgrade of planting beds to a minimum depth of four inches (4"). Remove all stones greater than 3/4" in diameter and all weeds, sticks, debris, or rubbish. Such material shall be removed from the site and legally disposed.
- E. Fine grade in accordance with specification section 329119 – Fine Grading and Soil Preparation.
- F. The topsoil shall be moist enough to permit it to be worked properly. It shall not be so dry it is powdery nor so wet that it will puddle, or become hard when it dries.
- G. The topsoil shall be applied and graded smooth so that when settled the surface is free from ridges and depressions which will puddle or hold water.
- H. Roll any small areas containing new topsoil with hand roller. After rolling at a weight of 150-200 pounds per linear foot of roller, the bed shall again be graded to the specified grade with a smooth surface.
- I. Prepare final grade of large areas by passing a land-plane in three different direction over the entire area to be planted.
- J. The finished grade of the seedbed ready for seeding shall be 1 inch below the top surface of any concrete or paved area and will be free of weeds.
- K. Finished grades of areas adjoining existing native vegetation areas shall match the existing grade in every spot.
- L. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- M. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - a. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.

- b. Protect grade stakes set by others until directed to remove them.

3.3 FERTILIZING:

- A. The fertilizer specified above shall be spread evenly over the prepared seedbed in the amount specified above and at those times.

3.4 SEEDING AND MULCHING:

- A. IRRIGATED (NON-TURF) SEED MIX SEEDING: Use the two step broadcast seeding/hydro-mulching method described below.

- 1. Prepare the seed bed as specified above.
- 2. Sow the seed mixture at the specified rate in two directions with an approved mechanical seeder and rake or harrow seed lightly into soil.
- 3. Spray a mixture of water, tackifier, and Wood Fiber Mulch under pressure at the rates specified onto the prepared seedbed.

- B. UNIRRIGATED SEED MIX SEEDING: Use the two step drill seeding/hydro-mulching method described below.

- 1. Prepare the seed bed as specified above.
- 2. Sow the seed mixture using an approved drill seeder at the specified rate and to a depth of ¼". Seed shall be sown in two directions with half of the seed mix being used in one direction and the other half of the mix being used to seed in the other direction.
- 3. Spray a mixture of water, tackifier, and Wood Fiber Mulch under pressure at the rates specified onto the prepared seedbed

3.5 RE-SEEDING:

- A. The Contractor shall re-seed all bare ground spots more than 12 inches in any dimension that have not produced a stand of grasses and plants. Such re-seeding shall be at the Contractor's expense and shall comply with all applicable specifications in this section. The maintenance and guarantee period shall be the same for reseeded areas as for new lawn areas.

3.6 SMALL AREA REPAIR AND SEEDING:

- A. Small area repair and seeding shall consist of:

- a. Preparing the seed bed as specified.
- b. Applying the fertilizer as specified.
- c. Sowing the seed mixture uniformly over the area.
- d. Raking the seed and fertilizer into the soil.

- B. Any area less than 2,000 square feet, but larger than 1 square foot shall be seeded by this method. Areas larger than 2,000 square feet shall be re-seeded using the two step drill seeding/hydromulching method described above

- C. All areas seeded by this method shall be covered with sphagnum peat moss applied uniformly at a rate of two pony bales per thousand square feet.

- D. All slopes greater than 25 percent or any having a washing problem shall be protected with erosion-control blankets or shall be mulched with straw at a rate of one and one-half bales per thousand square feet. Jute, fiber matting, enkamat, curlex blanket, or other erosion control materials may be used upon approval of the project Landscape Architect.

3.7 SEED ESTABLISHMENT AND PLANTING TASKS

- A. The Contractor shall establish the seed by watering; mowing; protecting; repairing eroded areas; reseeded; and mulching as necessary; keeping the sprinkler irrigation system

operational and maintained by cleaning and replacing parts, heads, etc.; fertilizing; and keeping the area clean.

- B. The Owner's Authorized Representative must be present, observe, and approve the following seed planting tasks.
1. Pre-Planting Task:
 - a. Before seed is applied, the area must be hand raked to finished grade and approved in writing by project manager.
 - b. The establishment period shall be until seeded area is established and a minimum of 90 calendar days from the time the seeding operations are completed and at least until date of Final Acceptance.
 - c. If contractor does not obtain written approval from County representative for any of the specified seed establishment tasks (A-E) below, as determined during task inspections, he will forfeit that percent portion of the bid and it will be deducted from monthly payment request.
 2. Seed Establishment Tasks & Inspection Schedule:
 - a. Task A – (20%) Initial seed planting and fertilizing (16-16-16).
 - b. Task B – (30%) Fertilizing: 16-16-16 every 21 days (not including initial application) for a minimum of three applications.
 - c. Task C– (40%) Mowing: When grass has reached a height of 4" inches and subsequent mowing every 7 days until acceptance.
 - d. Task D – (5%) Weed Spraying: Following the third lawn cutting.
 - e. Task E – (5%) Reseeding: As necessary

3.8 WATERING OF SEEDED AREAS:

- A. The entire seeded area shall be watered with an operational sprinkler irrigation system as soon as possible after seeding (with the exception of Un-Irrigated Seed Mix Areas).
- B. Water the seeded areas in the amount and frequency recommended by seed supplier. Contractor shall be responsible to adjust watering time and frequency as needed throughout establishment based on site and weather conditions.
- C. Submit a watering schedule to the Project Landscape Architect.
- D. Submit a new watering schedule after the grass has been mowed and has stooled-out.
- E. Adjust each approved watering schedule to meet the needs of the grass and weather conditions.

3.9 TIME PERIOD

- A. The establishment period shall be a minimum of 90 days from seeding and at least until date of Project's Final Acceptance throughout growing months (April 15th to October 15th). In the event the seeded area is not established as an acceptable grass stand, then the establishment period shall continue until seeded area produces an acceptable stand of grass. In the event the establishment period is not completed before the end of the growing months then the establishment period shall be carried over to the next year and start back up April 15th.

3.10 PROTECTION

- A. The Contractor shall take all measures necessary to protect the new seeded areas from being run over by vehicles, eroded away by wind and water, or loss due to lack of water or disease.

3.11 ESTABLISHMENT, MAINTENANCE AND GUARANTEE **(FOR IRRIGATED SEED MIX ONLY)**

- A. General: Maintain and establish seed areas by watering, fertilizing, herbicide treatment, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable grass stand. Roll, re-grade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth grass stand. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and grass damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep grass and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. The seed maintenance period begins when the seed installation is completed and will be in effect for a minimum of 90 days **and** until the grass stand is properly established **and** at least until the date of Final Acceptance.
- C. Mowing frequency shall not be sooner than 7 days between mowing.
- D. Seeded Area installations shall meet the following criteria as determined by the Project Manager before Acceptance of Seeded Area and Substantial Completion will be issued in writing:
 - 1. Acceptable Irrigated Seeded Mix Grass Establishment: Establishment shall be achieved when the grass stand is a healthy, uniform, close stand of grass, free of weeds and surface irregularities, with no bare spots exceeding 12 x 12 inches in any 10 square foot area.
- E. Use specified materials to reestablish seeded areas that do not comply with requirements, and continue maintenance until grass is satisfactory.
- F. Written notice requesting establishment inspection shall be submitted to the Project Manager at least three (3) days prior to the anticipated inspection date.
- G. The Contractor shall maintain and guarantee the new seeded areas by including all operations to establish a 'close stand' of grass free from weeds and undesirable coarse or weed grasses. Such operations shall include but not be limited to: watering, weeding, re-seeding, mowing, spraying, fertilizing, and trimming. Pesticides shall not be applied within 3 weeks of grass seed germination.
- H. The Contractor shall maintain the sprinkling system installed on the project and if there is an existing system, he shall maintain it under the direct supervision of the Owner.

3.12 HERBICIDE APPLICATION

- A. Apply herbicides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with County's operations and others in proximity to the Work. Notify Project Manager before each application is performed.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.13 FIRST MOWING

- A. The irrigated (non-turf) seed areas shall be mowed to a height of 3 inches after it has reached a height of 4 inches. Do not cut more than 1/3 of blade at any one mowing. The clippings shall be removed. Mowing shall be done with sharp equipment on dry grass and firm soil.
- B. After first mowing, water grass sufficiently to moisten soil from 3 inches to 5 inches deep. The grass shall be watered at such intervals and at such a rate that puddling and runoff do not occur. Do not allow any area to dry out during the first 20 days. Repair damaged areas immediately. Reseed areas that are allowed to dry out.

3.14 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by seeding work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off County's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove non-degradable erosion-control measures after grass establishment period.
- E. The Contractor shall remove weekly, or as sufficient amounts accumulate, all unused material, or waste material from the premises. The site shall be left in a clean and orderly condition.

3.15 FINAL INSPECTION

- A. Within 10 days of the end of the establishment period, a written notice requesting an inspection shall be submitted to the Project Landscape Architect.
- B. Allow a minimum of three (3) working days for notification to those persons invited to attend prior to the inspection date.
- C. All areas designated for seed mix on the plans shall be covered with a reasonable stand of grass and acceptable to the Project Landscape Architect.
- D. All areas found unacceptable shall be reseeded in accordance with the above re-seeding specifications and shall be maintained by contractor until area is covered with an acceptable stand of grass and acceptable to the Project Landscape Architect. Such areas shall be maintained and guaranteed as stated above.

3.16 FINAL ACCEPTANCE:

- A. Seed Area maintenance and guarantees by the Contractor shall cease upon his receipt of written notice from the Project Landscape Architect indicating his final acceptance of the lawn and sprinkler irrigation system.

END OF SECTION 329219

SECTION 329223 - SODDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Furnish and install sodded lawn as described in Contract Documents, for all lawn areas.
- B. Related Sections include the following:
 - 1. Section 329119 – Fine Grading and Soil Preparation
 - 2. Section 328400 – Irrigation
 - 3. Section 329000 – Planting

1.3 QUALITY ASSURANCE

- A. The work of this Section shall be performed by a Contracting firm, which has successfully installed work of a similar quality, schedule requirement, and construction detailing with a minimum of five (5) years experience. Proof of experience shall be submitted per Samples, Submittals & Testing, refer to Section 1.6.
- B. All work shall be performed in accordance with the best standards of practice relating to the trade and under the continuous supervision of a competent foreman capable of interpreting the Drawings and Specifications.
- C. All accumulated debris and rubbish shall be cleaned up and removed from the site before commencing work. Clear and grub all dead vegetative matter. The site shall be weed free prior to proceeding with any work.
- D. Pre-Installation Meetings
 - 1. Participate in pre-installation meetings.

1.4 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329119 "Soil Preparation and Fine Grading" and drawing designations for planting soils.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- F. Substantial Completion: The point in time when the Work is sufficiently complete, in accordance with the Contract Documents, that the County can occupy or use the Work for its intended purpose.

1.5 STANDARDS

- A. The following standards and definitions shall apply to the work of this Section.
 - 1. AOAC: Association of Official Agricultural Chemists
 - 2. ASPA: American Sod Producers Specifications for Turfgrass Sod Materials and Transplanting/ Installing.
 - 3. ASTM: American Society for Testing and Materials

1.6 SAMPLES AND SUBMITTALS

- A. At least thirty (30) days prior to intended use, the Contractor shall provide the following samples and submittals for approval. Do not order materials until Landscape Architect's approval of samples, certifications, or test results has been obtained. Delivered materials shall closely match the approved samples.
 - 1. Sod: Submit a supplier's certificate showing sod composition by grass species conforms to the Specification requirements for each type of sod. Certification shall identify the source and include the name and telephone number of the supplier.
- B. Maintenance Instructions: At the time of Acceptance, the Contractor shall submit complete maintenance instructions for lawn care for the Owner's use. The instructions shall be reviewed for approval by the Landscape Architect as a pre-condition for Acceptance.

1.7 DELIVERY, STORAGE, & HANDLING

- A. Sod: Harvest, deliver, store, and handle sod in accordance with requirements of "American Sod Producers (ASPA) Specifications for Turfgrass Sod Materials and Transplanting/Installing," "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- B. During wet weather, allow sod to dry sufficiently to prevent tearing during lifting and handling.

1. During dry weather, protect sod from drying. Water as necessary to insure vitality and to prevent excess loss of soil in handling.
2. Sod which dries out will be rejected.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 COORDINATION

- A. Planting Restrictions: Plant during the following period. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 1. April 15 to October 15.
- B. All newly sodded areas shall be rolled as specified immediately after sod has been laid.

1.9 LAWN MAINTENANCE AND ESTABLISHMENT PERIOD

- A. Begin maintenance and establishment immediately after each area is sodded and continue until acceptable lawn is established, but for not less than the following periods:
 1. The Establishment Period shall begin at the time sodding for the entire project is completed and continues until all turf meets establishment criteria **and** up until date of final acceptance.
 2. Sodded Lawns: Minimum of 60 days from completion of sodding **and** up until date of final acceptance throughout growing months (April 15th to October 15th). In the event the maintenance period is not completed before the end of the growing months then the maintenance period shall be carried over to the next year and start back up April 15th
 3. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, re-grade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth lawn.
- B. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 2 inches for the first two weeks after planting. Water at the rate given in the turfgrass vendor's written recommendations thereafter during the maintenance period.
 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
- C. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 30 percent of grass height. Remove no more than 30 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades

bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow Kentucky Bluegrass 2-3 inches high.
2. Mow Low Water Use Grass 3-4 inches high. Once established, mowing should only be required monthly at most.

D. Kentucky Bluegrass lawn Post fertilization: Apply fertilizer every 21 days following initial application throughout maintenance period.

1. Use 16-16-16 fertilizer mixture, applying one pound per 1,000 square feet of actual nitrogen, 4 percent phosphorus and 2 percent potassium, by weight using the same mix until maintenance period is over.

E. Lawn maintenance by the Contractor shall cease upon receipt of written Notice of Substantial Completion from the Owner's Authorized Representative.

1.10 SUBSTANTIAL COMPLETION

A. Within 10 days of the end of the establishment period written notice requesting a substantial completion inspection shall be submitted to the Project Landscape Architect by the Contractor. Three days shall be allowed for notification to those persons invited to attend prior to the inspection date. All areas designated for grass or lawn on the plans shall be covered with a reasonable stand of grass and meet the Acceptable Turf Establishment criteria as outlined in section 3.7.. All areas found not to be acceptable shall be Re-sodded in accordance with the specifications. All such sod areas shall be maintained and guaranteed as stated in Sections 1.9 & 1.11. **Sodding Contractor shall coordinate with General Contractor to insure construction sequencing allows adequate time for completion of the Establishment and Maintenance period prior to overall project completion.**

1.11 WARRANTY/GUARANTEE PERIOD

A. Warranty / guarantee the sod for the period indicated below against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Contractor's control.

1. Warranty Period for the Lawn Sod is one (1) year from date of the Notice of Substantial Completion.
2. Replace any damaged sod until acceptance by Owner.
3. Fill any voids between sod pieces, repairing any eroded areas.
4. Protect the sod by watering, mowing, controlling insects, and fertilizing.
5. The contractor shall maintain the sprinkling system installed on the project and if there is an existing system he shall maintain it under the direct supervision of the Salt Lake County Recreation Division Maintenance personnel.
6. Advise Owner of any maintenance or watering procedures necessary to care for and promote plant life. All sod must be in satisfactory condition at the time of the substantial completion inspection.
7. Contractor shall provide specific maintenance instructions to be followed by the owner, including frequency and amount of water to be applied, any special care instructions, etc. These instructions shall be submitted to and reviewed by the Landscape Architect. If the contractor does not provide specific care information, County Grounds will maintain

plantings to their best practice and standards and this will be deemed acceptable compliance for any warranty claim.

PART 2 - PRODUCTS

2.1 KENTUCKY BLUEGRASS TURF SOD

- A. Kentucky Bluegrass Turf Sod: shall be a Kentucky Bluegrass mix developed for disease resistance and drought tolerance. Sod shall be certified, approved, Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Submit supplier's certification and seed mix information for approval prior to delivery to the site. Sodded area is to be used for a sports play field so **Sod shall not contain plastic or nylon mesh backing.**
- B. Turfgrass
 - 1. Only sod that has been grown on a commercial sod farm shall be used.
 - 2. Sod shall be of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
 - 3. Superior sod grown from certified, high quality, seed of known origin or from plantings of certified grass seedlings or stolons.
 - 4. Assure over-all high quality and freedom from noxious weeds or an excessive amount of other crop and weedy plants at time of harvest.
 - 5. Sod shall be machine cut at a uniform soil thickness of three-quarters inch (3/4") at the time of cutting. Measurement for thickness shall exclude top growth and thatch. Individual pieces of sod shall be cut to the supplier's standard width and length. Maximum allowable deviation from standard widths and lengths shall be five percent (5%). Broken pads and torn or uneven ends will not be acceptable. Sod shall be at least one year old from time of original seeding.
 - 6. Sod shall be harvested, delivered and installed within a period of 24 hours. Soil on sod pads shall be kept moist at all times.
 - 7. Stakes: Stakes for pegging the sod shall be sound hardwood approximately one inch by two inches (1" x 2") and of sufficient length to penetrate the mat, the seed bed and to a minimum depth of two inches (2") of subsoil. Stakes shall be free from insects and fungi and capable of remaining in the ground at least two years.

2.2 FERTILIZER

- A. Sustane 4-6-4 Natural Fertilizer mixture for first fertilizer application prior to sodding.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer, O-F-241C, type 1, grade 16-16-16, level B with guaranteed chemical analysis of contents marked on the containers.

2.3 MISCELLANEOUS PRODUCTS

- A. Herbicide:
 - 1. Provide non-selective post emergent herbicide for use in weed control. Provide Round-up or approved equal.

2. Provide pre-emergent herbicide for use in planter beds for weed control. Provide Treflan or approved equal.
- B. Pesticide:
1. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

3.2 PREPARATION

- A. Protection
1. Take care in preparation work to avoid conditions which will create hazards. Post signs or barriers as required.
 2. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc. Repair or replace damaged areas.
 3. Keep site well drained and landscape excavations dry.
- B. Surface Preparation – Newly Graded Subgrades
1. Limit lawn subgrade preparation to areas to be planted.
 2. Herbicide Treatment: All sod beds shall be weed free prior to commencing soil placement, fine grading, and planting. Treat areas with a non-selective herbicide as necessary to insure weed free planting areas. Herbicide applications shall be applied in accordance with manufacturer's recommendations and in accordance with section 3.4 Herbicide Application and Weed Control.
 3. Provide erosion-control
 4. Seven days maximum prior to sodding:
 - a. Prepare subgrade and spread Planting Soil Mix in accordance to specification section 329119 – Fine Grading and Soil Preparation.
 - b. Reduce elevation of planting soil to allow for soil thickness of sod.
 5. After lawn areas have been prepared, take no heavy objects over them except lawn rollers.

6. After preparation of lawn areas and with topsoil in semi-dry condition, roll lawn planting areas in two directions at approximately right angles with water ballast roller weighing 100 to 300 lbs. according to soil type.
7. Rake or scarify and cut or fill irregularities that develop as required until area is true and uniform, free from lumps, depressions, and irregularities.

C. Surface Preparation – Unchanged Subgrades

1. Limit lawn subgrade preparation to areas to be planted.
2. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
3. Loosen surface soil to a depth of at least 4 inches. Till soil to a homogeneous mixture of fine texture and break up all clods and lumps.
4. Remove stones larger than 3/4 inch in any dimension and clods, weeds, sticks, roots, and other extraneous matter and legally dispose them off of the Owner's property.

D. Finish Grading

1. Finish grades shall be in accordance with specification section 329119– Fine Grading and Soil Preparation. Adjustments of finish grades shall be made at the direction of the Landscape Architect as required. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.
2. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
3. Restore areas if eroded or otherwise disturbed after finish grading and before planting.
4. Final grade of soil in all turf areas shall be as required to allow the finished grade of top of sod (sod crown not including grass blades) to be 1" below top of adjacent pavement.
5. No sodding shall be done immediately after a rain storm or if a prepared surface has been compacted without first loosening the surface to a smooth, loose, uniformly fine texture just prior to sodding.
6. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
7. Before planting, obtain Project Manger's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.3 INSTALLATION

A. Laying of Sod

1. Prior to laying sod, apply Sustane 4-6-fertilizer to the entire surface to receive sod at the rate of 4 pounds per 1,000 square feet.
2. Apply other fertilizers and amendments in quantities necessary for suitable lawn growth as recommended by Soil Test Reports required by Specification Section 329119 Fine Grading and Soil Preparations.
3. Lay sod during growing season. Sodding during dry summer period, at freezing temperatures, or over frozen soil is not acceptable.
4. Lay sod within 24 hours of harvesting.
5. Lay sod to form a solid mass with tightly fitted joints, Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Cut out irregular or thin sections with a sharp knife. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

6. Lay sod flush with adjoining existing sodded surfaces.
7. Lay sod at sloping areas with the long dimension of individual sod strips laid parallel with the contours of the slope.
8. Anchor sod on slopes exceeding 6:1 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
9. Do not sod slopes steeper than 3:1.

B. After Sodding Is Complete

1. Roll horizontal surface areas in two directions perpendicular to each other.
2. Repair and re-roll areas with depressions, lumps, or other irregularities. Heavy rolling to correct irregularities in grade will not be permitted.
3. Saturate sod with fine water spray within two hours of planting to obtain moisture penetration through sod into top 2" of topsoil.
4. During first two weeks, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 2 inches.
5. Fertilize Kentucky Bluegrass every 21 days following initial application with a 16-16-16 fertilizer. Apply at a rate of one pound per 1,000 square feet of actual nitrogen, 4 percent phosphorus, and 2 percent potassium by weight using the same mix until maintenance period is over.
6. Fertilize Warm Season Turf Grass sod as recommended by sod manufacture.

3.4 TOP DRESSING

- A. All areas which are sodded shall be top dressed with the top dressing specified above during or at the end of the establishment period to fill in noticeable gaps between seams. The top dressing shall be first applied by spreading it over the sod and then carefully working it into the joints with a stiff brush or mat.
- B. All sodded areas shall be thoroughly watered after the top dressing is applied. Watering must be done carefully so as to avoid puddling or washing. Further work shall be curtailed until the area is dried sufficiently to allow sodding continuance without damage to already laid sod or the prepared bed.

3.5 TURF RENOVATION

- A. Renovate existing turf where indicated.
- B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
 1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 2. Install new planting soil as required.
- C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

- E. Mow, dethatch, core aerate, and rake existing turf.
- F. Remove weeds before sodding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off County's property.
- H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.
- I. Apply soil amendments and initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.
- J. Water newly planted areas and keep moist until new turf is established.

3.6 INSPECTION

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, re-grade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of sod. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 2. Sufficiently water turf with fine spray to establish sod. After establishment water at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
 - 3. The Contractor shall submit a watering schedule to the Project Manager.
- C. Mow turf as soon as top growth is tall enough to cut, no higher than 3 inches. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
 - 1. Mow Kentucky bluegrass to a height of to 2 inches.
- D. Turf Post-fertilization: Apply commercial fertilizer after initial mowing and when grass is dry.
 - 1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.
- E. Turf Establishment Service: Provided by skilled employees of landscape Installer. Maintain as required in "Acceptable Turf Establishment," article 3.7. Begin establishment services

immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Sodded Turf: minimum of 60 days from date of planting completion and until date of Final Acceptance.
 - a. When initial establishment period has not elapsed before end of planting season, or if turf is not fully established, continue establishment during next planting season.

3.7 ACCEPTABLE TURF ESTABLISHMENT

- A. The Contractor shall be responsible for all sodded areas during the Turf Establishment period. The Establishment Period shall begin at the time sodding for the entire project is completed and continues until all turf meets establishment criteria.
- B. Turf installations shall meet the following criteria as determined by the Project Manager before Acceptance of Turf and Substantial Completion will be issued in writing:
 1. Acceptable Sodded Turf: Turf Establishment shall be achieved when the turf is healthy, well-rooted, even-colored, viable turf, free of weeds, open joints, bare areas, and surface irregularities.
 2. No surface soil is visible when grass has been cut to height of 2".
 3. Sodded areas have been mowed **a minimum of three times.**
 4. Areas sodded after October 1 will be accepted the following spring (May 1st) approximately one month after start of growing season if specified conditions have been met.
 5. Reestablish lawns that do not comply with requirements and continue maintenance at not additional cost to the owner until lawns are satisfactory.
- C. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.
- D. Written notice requesting establishment inspection shall be submitted to the Project Manager at least three (3) days prior to the anticipated inspection date.

3.8 HERBICIDE APPLICATION AND WEED CONTROL

- A. Application of pre-emergent herbicide is required. The contractor shall maintain the sod weed free until the end of the establishment period.
- B. Apply herbicides so no damage to protected vegetation occurs whether inside or outside the project site. Damage to protected vegetation or vegetation outside the project site will be reimbursed to the owner or replaced by the Contractor in a manner satisfactory to the Owner's Authorized Representative, and according to the International Society of Arboriculture Method of "Valuation for Landscape Trees, Shrubs, and Other Plants," latest edition.
- C. Post Emergent Herbicide:
 1. Mix and apply post-emergent herbicide according to manufacturer's recommendations indicated in the "Weeds Controlled" section of the label, and apply to undesired, actively growing vegetation.

2. Apply the spray mixture so that all undesired vegetation is uniformly covered, but avoid causing over-spray and drift. Spray target vegetation so that it is wet, but short of run-off.
3. Prune all suckers at the base of any trees to the soil level prior to application.
4. Do not apply post-emergent herbicide in any of these conditions: When rainfall is expected within six hours; when there is growth stress as a result of drought, insects, disease, or plant damage, or when there is heavy dust on plants.
5. Do not walk or permit other traffic on treated areas when they are wet from application. Shoes and equipment may track spray solution to areas where vegetation is not to be treated.
6. Repeat application, as necessary to completely eradicate undesired vegetation.

D. Pre-emergent Herbicide:

1. Mix and apply pre-emergent herbicide according to manufacturer's recommendations and information on the side panel, and the following: Use granular applicators designed to apply herbicide at Manufacturer's suggested highest rate.
2. Calibrate the applicator according to the manufacturer's directions prior to use and check frequently during application to be sure the equipment is working properly and distributing the granules uniformly. Do not apply more than the recommended amount.
3. Apply granular herbicide according to manufacturer's recommendations and on site conditions and soil preparation requirements or restrictions appropriate to the herbicide used.
4. The pre-emergent application must be followed within 8 hours with overhead watering or rainfall equivalent to 1/2".

E. License: Use a state licensed applicator to apply herbicide.

F. Mechanical Control:

1. Mechanically control the weeds by pulling, cutting, hoeing, or by any other directed means approved by the Owner's Authorized Representative.
2. Weeds in a dormant stage or other condition which cannot be effectively controlled with post-emergent herbicide shall be removed from the site by mechanical methods.

3.9 CLEANING

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off County's property.
- C. Remove non-degradable erosion-control measures after grass establishment period.

3.10 PROTECTION

- A. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- B. Protect sodded areas against traffic or other use immediately after sodding is completed by placing adequate warning signs and barricades.
- C. Provide adequate protection of sodded areas against trespassing, erosion, and damage of any kind. Remove this protection after sodded areas have been accepted by Landscape Architect.

3.11 BASIS OF MEASUREMENT AND PAYMENT:

- A. Payment for this work shall be by lump sum price listed on the schedule of values as "turf installation."
 - 1. Payments for materials and labor will be made once the turf establishment period has ended and is determined by the County in writing to have met all the requirements of this specification.

END OF SECTION 329223

APPENDIX

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SECTION ITEM

Geotechnical Report



ENGINEERING • GEOTECHNICAL • ENVIRONMENTAL (ESA I & II) •
MATERIALS TESTING • SPECIAL INSPECTIONS •
ORGANIC CHEMISTRY • PAVEMENT
DESIGN • GEOLOGY

GEOTECHNICAL ENGINEERING STUDY (REVISED)

Magna Regional Park

4000 South 7200 West
Magna, Utah
CMT PROJECT NO. 12194

FOR:
Salt Lake County Parks & Recreation
2001 South State Street, Suite S4-700
Salt Lake City, Utah 84190

January 30, 2019

January 30, 2019

Mr. Dustin Wiberg
Salt Lake County Parks & Recreation
2001 South State Street, Suite S4-700
Salt Lake City, Utah 84190

Subject: Geotechnical Engineering Study (Revised)
Magna Regional Park
4000 South 7200 West
Magna, Utah
CMT Project No. 12194

Mr. Wiberg:

Submitted herewith is the report of our geotechnical engineering study for the subject site. This report contains the results of our findings and an engineering interpretation of the results with respect to the available project characteristics. It also contains recommendations to aid in the design and construction of the earth related phases of this project.

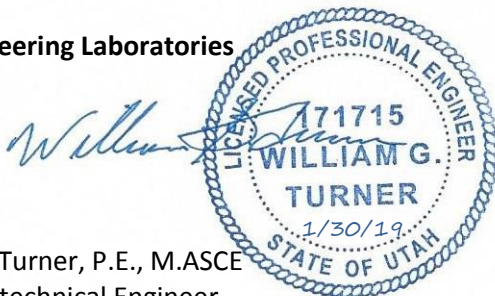
On December 13, 2018 and January 18, 2019, a CMT Engineering Laboratories (CMT) geologist was on-site and supervised the excavation of 20 test pits extending to depths of about 2 to 12.5 feet below the existing ground surface. Soil samples were obtained during the field operations and subsequently transported to our laboratory for further testing and observation.

Much of the site consists of gravelly soils with some sand and silt layers, to the maximum depths explored. Conventional spread and/or continuous footings may be utilized to support the proposed structures. A detailed discussion of design and construction criteria is presented in this report.

We appreciate the opportunity to work with you at this stage of the project. CMT offers a full range of Geotechnical Engineering, Geological, Material Testing, Special Inspection services, and Phase I and II Environmental Site Assessments. With 8 offices throughout Utah and Arizona, our staff is capable of efficiently serving your project needs. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at (801) 492-4132.

Sincerely,

CMT Engineering Laboratories



William G. Turner, P.E., M.ASCE
Senior Geotechnical Engineer

Reviewed by:

A handwritten signature in blue ink, likely belonging to Jeffrey J. Egbert.

Jeffrey J. Egbert, P.E., LEED A.P., M. ASCE
Senior Geotechnical Engineer

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1.0 INTRODUCTION

1.1 General

CMT Engineering Laboratories (CMT) was retained to conduct a geotechnical subsurface study for the proposed development of the site as a large regional park. The parcel is situated on the west side of 7200 West Street at about 4000 South in Magna, Utah, as shown in the **Vicinity Map** below.



VICINITY MAP

1.2 Objectives, Scope and Authorization

The objectives and scope of our study were planned in discussions between Mr. Dustin Wiberg of Salt Lake County Parks & Recreation and Mr. Bill Turner of CMT Engineering Laboratories (CMT). In general, the objectives of this study were to define and evaluate the subsurface soil and groundwater conditions at the site, and provide appropriate foundation, earthwork, pavement and seismic recommendations to be utilized in the design and construction of the proposed development.

In accomplishing these objectives, our scope of work has included performing field exploration, which consisted of the excavating/logging/sampling of 17 test pits to various depths, performing laboratory testing on representative samples, and conducting an office program, which consisted of correlating available data, performing engineering analyses, and preparing this summary report. This scope of work was authorized by returning a signed copy of our proposal dated October 18, 2018 and executed on October 20, 2018.

1.3 Description of Proposed Construction

We understand that the project will consist of constructing a large regional park, with soccer fields, a swimming/splash pad area and associated equipment building, maintenance buildings, pavilions, walking paths, parking areas and drive areas throughout the site. For the equipment and maintenance buildings, we project that maximum loads will be 4,000 pounds per lineal foot for walls and 150 pounds per square foot for floors.

We project the walking paths and the parking and drive areas will utilize asphalt surfacing. Traffic is projected to consist of a light volume of automobiles and pickup trucks, one or two daily medium-weight delivery trucks, a weekly garbage truck, and an occasional fire truck for the park's parking and drive areas. Sidewalks and walking paths will include some utility truck traffic. The west side of 7200 West Street will also be widened. Based on the UDOT website for annual average daily traffic (AADT), 7200 West had an AADT of 4,200 in 2015 and 4,500 in 2016. We project that 5% of the AADT consists of various truck types, with the majority being medium-weight delivery trucks.

Site development will require some earthwork in the form of cutting and filling, with maximum cuts and fills being on the order of 5 to 10 feet. If deeper cuts or fills are planned, CMT should be notified to provide additional recommendations, if needed.

1.4 Executive Summary

The most significant geotechnical aspects regarding site development include the following:

1. Topsoil and some areas of undocumented fill blanket the site, which will require removal beneath structures;
2. Potentially collapsible silt soils are present within part of the western area of the site (around TP-14), which visually contained pinholes, as confirmed by consolidation/collapse tests that indicated these soils have a collapse potential of about 8%; and
3. Foundations and floor slabs may be placed on suitable, undisturbed natural soils or on properly placed and compacted structural fill extending to suitable, undisturbed natural soils.

CMT must assess that topsoil, undocumented fills, potentially collapsible soils (where appropriate), debris, disturbed or unsuitable soils have been removed and that suitable soils have been encountered prior to placing site grading fills, footings, slabs, and pavements.

In the following sections, detailed discussions pertaining to the site and subsurface descriptions, geologic/seismic setting, earthwork, foundations, lateral resistance, lateral pressure, floor slabs, and pavements are provided.

2.0 FIELD EXPLORATION

In order to define and evaluate the subsurface soil and groundwater conditions at the site, 17 test pits were excavated on December 13, 2018 with a backhoe to depths of approximately 2 to 12.5 feet below the existing ground surface. Several test pits (TP-2, TP-5, TP-7, TP-9, TP-10, and TP-11) encountered excavation refusal and could not be extended to the desired depths due to the dense configuration and/or cementation of the subsurface soils. We returned to the site on January 18, 2019 and excavated an additional 3 test pits (TP-5A, TP-7A and TP-11A) within 10 to 15 feet of test pits TP-5, TP-7 and TP-11, extending to depths of 10.5 to 12 feet below the existing ground surface. Locations of the test pits are shown on **Figure 1, Site Plan**, included in the Appendix. The field exploration was performed under the supervision of an experienced member of our geotechnical staff.

Representative soil samples were collected by obtaining disturbed "grab" samples and cutting relatively undisturbed "block" samples from within each test pit. The samples were placed in sealed plastic bags and containers prior to transport to the laboratory.

The subsurface soils encountered in the test pits were logged and described in general accordance with ASTM¹ D-2488. Soil samples were collected as described above, and were classified in the field based upon visual and textural examination. These field classifications were supplemented by subsequent examination and testing of select samples in our laboratory. Graphical representations of the subsurface conditions encountered are presented on each individual Test Pit Log, **Figures 2 through 18**, included in the Appendix. A Key to Symbols defining the terms and symbols used on the logs, is provided as **Figure 19** in the Appendix.

When backfilling the test pits, only minimal effort was made to compact the backfill and no compaction testing was performed. Thus, settlement of the backfill in the test pits over time should be anticipated.

3.0 LABORATORY TESTING

3.1 General

Selected samples of the subsurface soils were subjected to various laboratory tests to assess pertinent engineering properties, as follows:

1. Moisture Content, ASTM D-2216, Percent moisture representative of field conditions
2. Dry Density, ASTM D-2937, Dry unit weight representing field conditions
3. Atterberg Limits, ASTM D-4318, Plasticity and workability

¹American Society for Testing and Materials

4. Gradation Analysis, ASTM D-1140/C-117, Grain Size Analysis
5. One Dimension Consolidation, ASTM D-2435, Consolidation properties
6. California Bearing Ratio, ASTM D-2937, Subgrade support properties

To provide data necessary for our settlement analyses, consolidation testing was performed on two representative samples of the surficial silt soils encountered at the site. Based upon data obtained from the consolidation testing, the silt soils at this site are moderately over-consolidated, moderately compressible under additional loading, and have a collapse potential of less than 0.5% (negligible) to about 8% (high) at a load of 2,000 psf when water was added (see the **Lab Summary Table** below). Detailed results of these tests are maintained within our files and can be transmitted to you, if so desired.

Laboratory test results are presented on the test pit logs (**Figures 2 through 18**), on **Figures 20 through 23** (Gradation and California Bearing Ratio test results), and in the following Lab Summary table:

LAB SUMMARY TABLE

Bore Hole	Depth (feet)	Soil Class	Sample Type	Moisture Content (%)	Dry Density (pcf)	Gradation			Atterberg Limits			Collapse (-) or Expansion (+)
						Grav	Sand	Fines	LL	PL	PI	
TP-1	1	SM	CBR	3		19	48	33				
TP-2	5	GP-GM	Bag	6				6				
TP-3	7	GM	Bag	6		55	28	17				
TP-4	4	GP-GM	Bag	4				7				
TP-5	2.5	GM	Bag	6		64	23	13				
TP-6	4	GP	Bag	2				2				
TP-7	4.5	GP-GM	Bag	4				7				
TP-8	1	ML	CBR	5		9	39	52				
TP-9	4	GM	Bag	8		62	22	16				
TP-10	4	GM	Bag	5		72	16	12				
TP-11	1.5	GM	Bag	6				16				
TP-12	4.5	ML	Block	16	83				35	30	5	< -0.5%
TP-13	3	GM	Bag	5				12				
TP-14	2	ML	Block	6	87				25	23	2	-8.0%
TP-15	4	GP-GM	Bag	2				7				
TP-15	8.5	CL	Block	29	78				37	23	14	-0.8%
TP-17	3.5	GP-GM	Bag	5				7				

3.2 Topsoil Testing

Specific samples for topsoil testing were obtained at the blue “+” locations shown on **Figure 1**, attached. The samples were designated according to the nearest test pit location, i.e. TP-3 for the east, TP-7 for the middle, and TP-9 for the west locations. The various nutrient constituents were measured and recommendations were given by the laboratory for adding specific fertilizer to provide ideal plant growing conditions. The results of these laboratory tests and recommendations are included after the figures in the Appendix.

4.0 GEOLOGIC & SEISMIC CONDITIONS

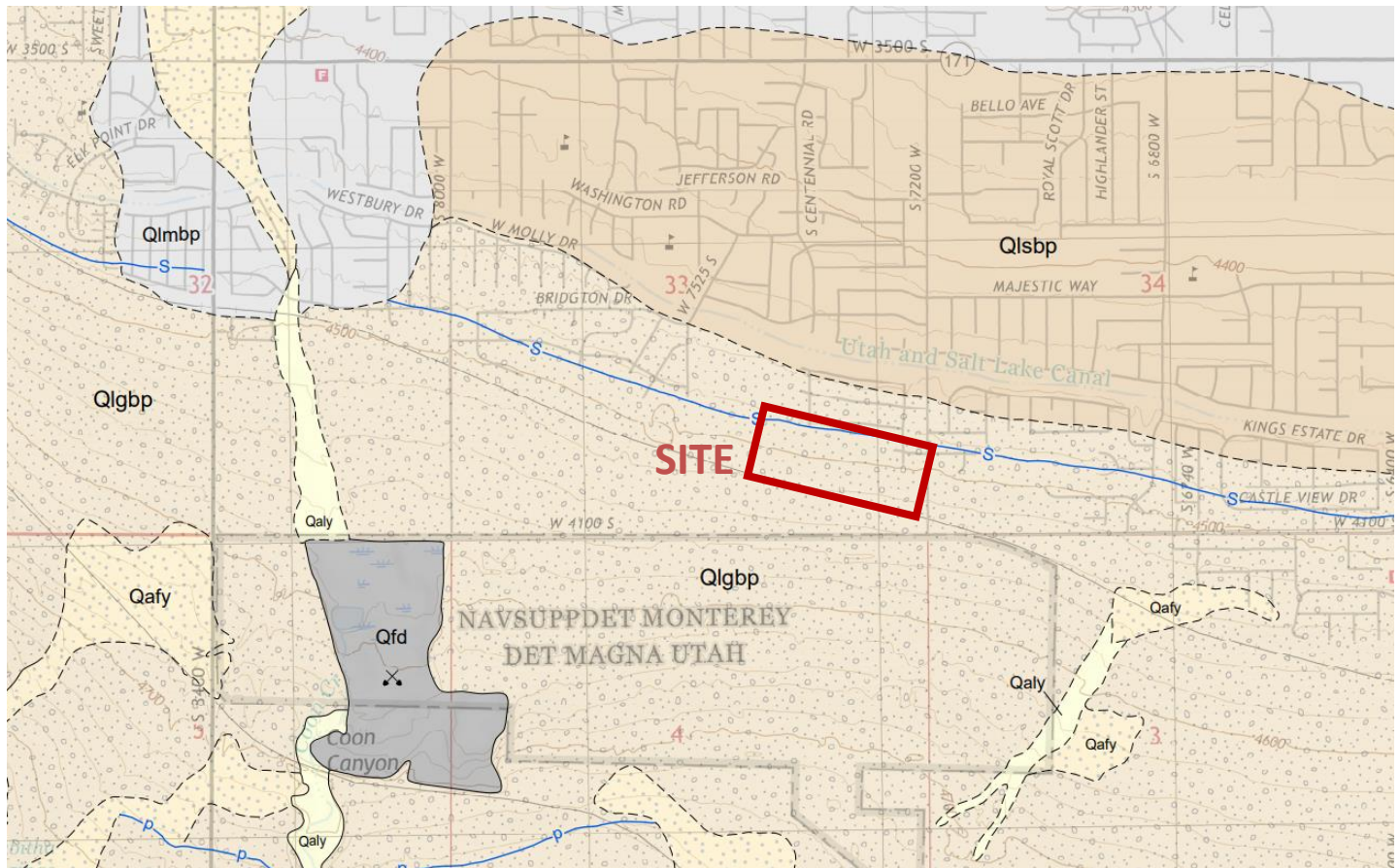
4.1 Geologic Setting

The subject site is located in the northwest portion of the Salt Lake Valley in north-central Utah. The site sits at an elevation of between approximately 4,470 and 4,540 feet above sea level. The Salt Lake Valley is a deep, sediment-filled basin that is part of the Basin and Range Physiographic Province and was formed by extensional tectonic processes during the Tertiary and Quaternary geologic time periods. The valley is bordered by the Wasatch Mountain Range on the east and the Oquirrh Mountains on the west. The Salt Lake Valley is located within the Intermountain Seismic Belt, a zone of ongoing tectonism and seismic activity extending from southwestern Montana to southwestern Utah. The active (evidence of movement in the last 10,000 years) Wasatch Fault Zone is part of the Intermountain Seismic Belt and extends from southeastern Idaho to central Utah along the western base of the Wasatch Mountain Range.

Much of northwestern Utah, including the Salt Lake Valley, was also previously covered by the Pleistocene age Lake Bonneville. The Great Salt Lake, located to the northwest of the valley, is a remnant of this ancient fresh water lake. Lake Bonneville reached a high-stand elevation of between approximately 5,100 and 5,200 feet above sea level at between 18,500 and 17,400 years ago. Approximately 17,400 years ago, the lake breached its basin in southeastern Idaho and dropped relatively fast, by almost 300 feet, as water drained into the Snake River. Following this catastrophic release, the lake level continued to drop slowly over time, primarily driven by drier climatic conditions, until reaching the current level of the Great Salt Lake. Shoreline terraces formed at the high-stand elevation of the lake and several subsequent lower lake levels are visible in places on the mountain slopes surrounding the valley. Much of the sediment within the Salt Lake Valley was deposited as lacustrine sediments during both the transgressive (rise) and regressive (fall) phases of Lake Bonneville and in older, pre-Bonneville lakes that previously occupied the basin.

The geology of the USGS Magna, Utah 7.5 Minute Quadrangle, that includes the location of the subject site, has been mapped by Solomon and others². The surficial geology at the subject site and adjacent properties is mapped as “Lacustrine gravel and sand of the Bonneville lake cycle, undivided” (Map Unit Qlgbp) dated to be upper Pleistocene. Unit Qlgbp is described in the referenced mapping as “Moderately to well-sorted, moderately to well-rounded, clast-supported, pebble to cobble gravel and pebbly sand; typically interbedded with, or laterally gradational to, lacustrine sand and silt; locally partly cemented with calcium carbonate; may be as much as 75 feet (25 m) thick.” No fill has been mapped at the location of the site on the geologic map. Refer to the **Geologic Map**, shown below.

²Solomon, B.J., Biek, R.F., and Smith, T.W., 2007, Geologic Map of the Magna Quadrangle, Salt Lake County, Utah; Utah Geological Survey Map 216, Scale 1:24,000.



GEOLOGIC MAP

4.2 Faulting

No surface fault traces are shown on the referenced geologic map crossing or projecting toward the subject site. The nearest mapped active fault trace is the Granger fault of the West Valley fault zone located about 5.5 miles east of the site.

4.3 Seismicity

4.3.1 Site Class

Utah has adopted the International Building Code (IBC) 2015. IBC 2015 determines the seismic hazard for a site based upon 2008 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points). For site class definitions, IBC 2015 (Section 1613.3.2) refers to Chapter 20, Site Classification Procedure for Seismic Design, of ASCE³ 7. Given the subsurface soils at

³ American Society of Civil Engineers

the site, including our projection of soils within the upper 100 feet of the soil profile, it is our opinion the site best fits Site Class D – Stiff Soil Profile, which we recommend for seismic structural design.

4.3.2 Ground Motions

The 2008 USGS mapping utilized by the IBC provides values of peak ground, short period and long period accelerations for the Site Class B boundary and the Maximum Considered Earthquake (MCE). This Site Class B boundary represents average bedrock values for the Western United States and must be corrected for local soil conditions. The following table summarizes the peak ground, short period and long period accelerations for the MCE event, and incorporates the appropriate soil correction factor for a Site Class D soil profile at site grid coordinates of 40.6848 degrees north latitude and -112.0689 degrees west longitude:

SPECTRAL ACCELERATION VALUE, T	SITE CLASS B BOUNDARY [Mapped Values] (g)	SITE COEFFICIENT	SITE CLASS D [Adjusted for Site Class Effects] (g)	DESIGN VALUES (g)
Peak Ground Acceleration	0.426	$F_a = 1.074$	0.458	0.305
Short Period Acceleration (0.2 Seconds)	$S_s = 1.066$	$F_a = 1.074$	$S_{MS} = 1.144$	$S_{DS} = 0.763$
Short Period Acceleration (1.0 Second)	$S_1 = 0.357$	$F_v = 1.686$	$S_{M1} = 0.602$	$S_{D1} = 0.401$

4.3.3 Liquefaction

The site is located within an area designated by the Utah Geologic Survey⁴ as having “Low” to “Very Low” liquefaction potential. Liquefaction is defined as the condition when saturated, loose, sandy soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Clayey soils, even if saturated, will generally not liquefy during a major seismic event.

A special liquefaction study was not performed for this site. We predominately encountered unsaturated, medium dense to very dense sand and gravel soils within the depths we explored. In our opinion, the soils we encountered support the mapped low to very low liquefaction potential designation.

4.4 Other Geologic Hazards

No landslide deposits or features, including lateral spread deposits, are mapped on or adjacent to the site. The site is not located within a currently known or mapped potential debris flow, stream flooding, or rock fall hazard area.

⁴ Utah Geological Survey, "Liquefaction-Potential Map for a Part of Salt Lake County, Utah," Utah Geological Survey Public Information Series 25, August 1994. https://ugspub.nr.utah.gov/publications/public_information/pi-25.pdf

5.0 SITE CONDITIONS

5.1 Surface Conditions

At the time the test pits were excavated the site consisted of a vacant field vegetated primarily with grasses and weeds. The site grade sloped downward to the north-northwest with an overall gradient of about 40 to 50 feet across the site. Based upon aerial photos readily available online dating back to 1997, the site appears to have been vacant since that time, with several dirt roads/trails through the site at that time and some grading occurring in about 2003 around the perimeter of the site (except along the south side). The site is bounded on the north by residences, on the east by 7200 West Street, on the south by railroad tracks and on the west and northwest by similar vacant land (see **Vicinity Map** in **Section 1.1** above).

5.2 Subsurface Soils

At the locations of the test pits we encountered approximately 1 to 3 feet of topsoil at the surface, with significant vegetation within the upper 3 to 6 inches and the topsoil primarily consisting of silty to clayey sand with some gravel and cobble/boulder size particles at the surface. Undocumented fill soils were not encountered in the test pits but are known to exist at the site, particularly around the northern and eastern sides of the site. Natural soils were observed beneath the topsoil, consisting of Silty SAND (SM) and Silty to Sandy GRAVEL (GM, GP-GM, GP) throughout most of the site, with some layers of SILT containing varying amounts of sand (ML) and CLAY with sand (CL). Some of the sand/gravel soils were fused/cemented and/or some locations contained boulders which prevented excavating to desired depths in TP-2, TP-5, TP-7, TP-9, TP-10, and TP-11. We subsequently returned to the site and excavated an additional 3 test pits (TP-5A, TP-7A and TP-11A) within 10 to 15 feet of test pits TP-5, TP-7 and TP-11 to depths of 10.5 to 12 feet below the existing ground surface. Smaller size boulders were encountered in the additional test pits, which indicates that boulder sizes will vary across the site but construction excavations will be able to extend to the intended depths.

The silt soils were moist, brown in color, and estimated to be stiff to very stiff in consistency. They also exhibited moderate over-consolidation and strength characteristics, as well as a negligible (less than 0.5% at TP-12) to high (about 8% at TP-14) potential for collapse when wetted.

The natural gravel and sand soils were dry to moist, brown to light brown to gray in color, and estimated to be medium dense to very dense. They will also exhibit moderately high strength and low compressibility characteristics.

For a more descriptive interpretation of subsurface conditions, please refer to the test pit logs, **Figures 2 through 18**, which graphically represent the subsurface conditions encountered. The lines designating the interface between soil types on the logs generally represent approximate boundaries - in situ, the transition between soil types may be gradual.

5.3 Groundwater

Groundwater was not encountered at the time of our field explorations within the maximum depth explored of about 12.5 feet below the existing ground surface. Therefore, groundwater is not anticipated to affect proposed construction.

Groundwater levels can fluctuate as much as 1.5 to 2 feet seasonally. Numerous other factors such as heavy precipitation, irrigation of neighboring land, and other unforeseen factors, may also influence ground water elevations at the site. The detailed evaluation of these and other factors, which may be responsible for ground water fluctuations, is beyond the scope of this study.

5.4 Site Subsurface Variations

Based on the results of the subsurface explorations and our experience, variations in the continuity and nature of subsurface conditions should be anticipated. Due to the heterogeneous characteristics of natural soils, care should be taken in interpolating or extrapolating subsurface conditions between or beyond the exploratory locations.

Also, when logging and sampling of the test pits was completed, the test pits were backfilled with the excavated soils but minimal to no effort was made to compact these soils. Thus, settlement of the backfill in the test pits over time should be anticipated.

6.0 SITE PREPARATION AND GRADING

6.1 General

All deleterious materials should be stripped from the site prior to commencement of construction activities. This includes loose and disturbed soils, topsoil, vegetation, etc. Based upon the conditions observed in the test pits there is topsoil on the surface of the site which ranged from 1 to 3 feet in thickness. When stripping and grubbing, topsoil should be distinguished by the apparent organic content and not solely by color; thus we estimate that topsoil stripping will need to include the upper 4 inches. There are also areas that have been graded (along the east and north sides of the site) and/or may have been disturbed due to past activities on the site; these soils are considered undocumented fill. All undocumented fill shall be removed from beneath structures. Outside of building footprints, proper preparation of undocumented fill and disturbed soils shall consist of scarifying to a minimum depth of 8 inches and compacting the soils in place. The exposed subgrade must then be proofrolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or loose soils are encountered, they must be removed (up to a maximum depth of 2 feet) and replaced with structural fill.

From a geotechnical standpoint, the potentially collapsible soils (mainly around TP-14) may remain in pavement areas if:

1. They are properly prepared by scarifying 12 inches, moisture conditioning to within $\pm 2\%$ of the optimum moisture, compacting the soils in place, and proofrolling as described above;
2. No more than 3 feet of subsequent overlying site grading fills are installed above the scarified/compacted soils;
3. Any planned subsurface detention systems are installed well away and down gradient from the pavement, and preferably below any remaining sequence of potentially collapsible clay soils;
4. Adequate site drainage is maintained to reduce the potential for subsurface soil saturation; and
5. The owner accepts the risk that some settlement of pavement areas could occur if the underlying potentially collapsible soils become wetted, which could result in minor to significant maintenance.

The site should be examined by a CMT geotechnical engineer to assess that suitable natural soils have been exposed and any deleterious materials, loose and/or disturbed soils have been removed, prior to placing site grading fills, footings, slabs, and pavements.

Fill placed over large areas to raise overall site grades can induce settlements in the underlying natural soils. If more than 10 feet of site grading fill is anticipated over the natural ground surface, we should be notified to assess potential settlements and provide additional recommendations as needed. These recommendations may include placement of the site grading fill far in advance to allow potential settlements to occur prior to construction.

6.2 Temporary Excavations

Excavations deeper than 8 feet are not anticipated at the site. Groundwater was not encountered within the maximum depth explored of about 12.5 feet at the time of our field explorations, and thus is not anticipated to affect excavations.

The natural soils encountered at this site predominantly consisted of sand/gravel. For sandy/gravelly (cohesionless) soils, temporary construction excavations not exceeding 4 feet in depth should be no steeper than one-half horizontal to one vertical (0.5H:1V). For excavations up to 8 feet and above groundwater, side slopes should be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils will be very difficult to maintain, and will require very flat side slopes and/or shoring, bracing and dewatering.

All excavations must be inspected periodically by qualified personnel. If any signs of instability or excessive sloughing are noted, immediate remedial action must be initiated. All excavations should be made following OSHA safety guidelines.

6.3 Fill Material

Following are our recommendations for the various fill types we anticipate will be used at this site:

FILL MATERIAL TYPE	DESCRIPTION RECOMMENDED SPECIFICATION
Structural Fill (Subbase if 15% max. passing #200)	Placed below structures, flatwork and pavement. Well-graded sand/gravel mixture, with maximum particle size of 4 inches, a minimum 70% passing 3/4-inch sieve, a maximum 20% passing the No. 200 sieve, and a maximum Plasticity Index of 10.
Site Grading Fill	Placed over larger areas to raise the site grade. Sandy to gravelly soil, with a maximum particle size of 6 inches, a minimum 70% passing 3/4-inch sieve, and a maximum 50% passing No. 200 sieve.
Non-Structural Fill	Placed below non-structural areas, such as landscaping. On-site soils or imported soils, with a maximum particle size of 8 inches, including silt/clay soils not containing excessive amounts of degradable/organic material (see discussion below).
Stabilization Fill	Placed to stabilize soft areas prior to placing structural fill and/or site grading fill. Coarse angular gravels and cobbles 1 inch to 8 inches in size. May also use 1.5-inch to 2.0-inch gravel placed on stabilization fabric, such as Mirafi RS280i, or equivalent (see Section 6.6).

We specifically tested those areas where significant cuts are planned and the removed soils will be used as fill. Below the surficial topsoil, the on-site gravel soils in these areas typically meet the fines (minus 200 sieve) requirements given above for structural fill and site grading fill, and within the east side (at the soccer fields) will also meet the ¾-inch sieve requirements. However the gravel soils within the southwest side have larger gravel particles and will not meet the ¾-inch sieve requirements; these soils could be screened or crushed to meet those requirements, or they could possibly be used if visual observations (instead of testing for compaction) are performed. On-site sand soils do not appear suitable for use as structural fill, but may be used as site grading fill and non-structural fill.

On-site silt soils may be used as site grading fill and non-structural fill, but are also moisture-sensitive. Note that such moisture-sensitive soils are inherently more difficult to work with in proper moisture conditioning (they are very sensitive to changes in moisture content), requiring very close moisture control during placement and compaction. This will be very difficult, if not impossible, during wet and cold periods of the year.

All fill material should be approved by a CMT geotechnical engineer prior to placement.

6.4 Fill Placement and Compaction

The various types of compaction equipment available have their limitations as to the maximum lift thickness that can be compacted. For example, hand operated equipment is limited to lifts of about 4 inches and most “trench compactors” have a maximum, consistent compaction depth of about 6 inches. Large rollers, depending on soil and moisture conditions, can achieve compaction at 8 to 12 inches. The full thickness of each lift should be compacted to at least the following percentages of the maximum dry density as determined by ASTM D-1557 (or AASHTO⁵ T-180) in accordance with the following recommendations:

⁵ American Association of State Highway and Transportation Officials

LOCATION	TOTAL FILL THICKNESS (FEET)	MINIMUM PERCENTAGE OF MAXIMUM DRY DENSITY
Beneath an area extending at least 4 feet beyond the perimeter of structures, and below flatwork and pavement (applies to structural fill and site grading fill) extending at least 2 feet beyond the perimeter	0 to 5	95
	5 to 10	98
Site grading fill outside area defined above	0 to 5	92
	5 to 10	95
Utility trenches within structural areas	--	96
Roadbase and subbase	-	96
Non-structural fill	0 to 5	90
	5 to 10	92

Structural fills greater than 10 feet thick are not anticipated at the site. For best compaction results, we recommend that the moisture content for structural fill/backfill be within 2% of optimum. Field density tests should be performed on each lift as necessary to verify that proper compaction is being achieved.

6.5 Utility Trenches

For the bedding zone around the utility, we recommend utilizing sand bedding fill material that meets current APWA⁶ requirements.

All utility trench backfill material below structurally loaded facilities (foundations, floor slabs, flatwork, parking lots/drive areas, etc.) should be placed at the same density requirements established for structural fill in the previous section.

Most utility companies and local governments are requiring Type A-1a or A-1b (AASHTO Designation) soils (sand/gravel soils with limited fines) be used as backfill over utilities within public rights of way, and the backfill be compacted over the full depth above the bedding zone to at least 96% of the maximum dry density as determined by AASHTO T-180 (ASTM D-1557). The natural sand and gravel soils at this site may meet these specifications.

Where the utility does not underlie structurally loaded facilities and public rights of way, on-site fill and natural soils may be utilized as trench backfill above the bedding layer, provided they are properly moisture conditioned and compacted to the minimum requirements stated above in **Section 6.4**.

6.6 Stabilization

The natural silt/clay soils at this site, if exposed during grading, may be susceptible to rutting and pumping. The likelihood of disturbance or rutting and/or pumping of the existing natural soils is a function of the load applied to the surface, as well as the frequency of the load. Consequently, rutting and pumping can be minimized by

⁶ American Public Works Association

avoiding concentrated traffic, minimizing the load applied to the surface by using lighter equipment and/or partial loads, by working in drier times of the year, or by providing a working surface for the equipment. Rubber-tired equipment particularly, because of high pressures, promotes instability in moist/wet, soft soils. If rutting or pumping occurs, traffic should be stopped and the disturbed soils should be removed and replaced with stabilization material. Typically, a minimum of 18 inches of the disturbed soils must be removed to be effective. However, deeper removal is sometimes required.

To stabilize soft subgrade conditions (if encountered), a mixture of coarse, clean, angular gravels and cobbles and/or 1.5- to 2.0-inch clean gravel should be utilized, as indicated above in **Section 6.3**. Often the amount of gravelly material can be reduced with the use of a geotextile fabric such as Mirafi RS280i or equivalent. Its use will also help avoid mixing of the subgrade soils with the gravelly material. After excavating the soft/disturbed soils, the fabric should be spread across the bottom of the excavation and up the sides a minimum of 18 inches. Otherwise, it should be placed in accordance with the manufacturer's recommendation, including proper overlaps. The gravel material can then be placed over the fabric in compacted lifts as described above.

7.0 FOUNDATION RECOMMENDATIONS

The following recommendations have been developed on the basis of the previously described project characteristics, including the maximum loads discussed in **Section 1.3**, the subsurface conditions observed in the field and the laboratory test data, and standard geotechnical engineering practice.

7.1 Foundation Recommendations

Based on our geotechnical engineering analyses, the proposed structures may be supported upon conventional spot and/or continuous wall foundations placed on suitable, undisturbed natural soils and/or on structural fill extending to suitable natural soils. Footings may be designed using a net bearing pressure of 2,000 psf if placed on suitable, undisturbed, natural soils or 2,500 psf if placed on a minimum 18 inches of structural fill. The term "net bearing pressure" refers to the pressure imposed by the portion of the structure located above lowest adjacent final grade, thus the weight of the footing and backfill to lowest adjacent final grade need not be considered. The allowable bearing pressure may be increased by 1/3 for temporary loads such as wind and seismic forces.

We also recommend the following:

1. Exterior footings subject to frost should be placed at least 30 inches below final grade.
2. Interior footings not subject to frost should be placed at least 16 inches below grade.
3. Continuous footing widths should be maintained at a minimum of 18 inches.
4. Spot footings should be a minimum of 24 inches wide.

7.2 Installation

Under no circumstances shall foundations be placed directly on potentially collapsible soils, on undocumented fill, topsoil with organics, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

Deep, large roots may be encountered where trees and larger bushes are located or were previously located at the site; such large roots should be removed. If unsuitable soils are encountered, they must be completely removed and replaced with properly compacted structural fill. Excavation bottoms should be examined by a qualified geotechnical engineer to confirm that suitable bearing materials soils have been exposed.

All structural fill should meet the requirements for such, and should be placed and compacted in accordance with **Section 6** above. The width of structural replacement fill below footings should be equal to the width of the footing plus 1 foot for each foot of fill thickness. For instance, if the footing width is 2 feet and the structural fill depth beneath the footing is 2 feet, the fill replacement width should be 4 feet, centered beneath the footing.

The minimum thickness of structural fill below footings should be equivalent to one-third the thickness of structural fill below any other portion of the foundations. For example, if the maximum depth of structural fill is 6 feet, all footings for the new structure should be underlain by a minimum 2 feet of structural fill.

7.3 Estimated Settlement

Foundations designed and constructed in accordance with our recommendations could experience some settlement, but we anticipate that total settlements of footings founded as recommended above will not exceed 1 inch, with differential settlements on the order of 0.5 inches over a distance of 25 feet. We expect approximately 50% of the total settlement to initially take place during construction.

7.4 Lateral Resistance

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of 0.30 for natural silt soils or 0.40 for natural sand/gravel soils and structural fill, may be utilized for design. Passive resistance provided by properly placed and compacted structural fill above the water table may be considered equivalent to a fluid with a density of 350 pcf. A combination of passive earth resistance and friction may be utilized if the friction component of the total is divided by 1.5.

8.0 LATERAL EARTH PRESSURES

It is possible that below-grade walls up to ± 4 feet tall will be constructed at this site. The lateral earth pressure values provided herein anticipate that native sand/gravel soils will be used as backfill material, placed and compacted in accordance with the recommendations presented herein. If other soil types will be used as backfill, we should be notified so that appropriate modifications to these values can be provided, as needed.

The lateral pressures imposed upon subgrade facilities will depend upon the relative rigidity and movement of the backfilled structure. For rigid basement walls that are not more than 10 inches thick, sand/gravel backfill may be designed using an at-rest equivalent fluid pressure of 55 pcf (psf/ft). This value assumes that the soil surface behind the wall is horizontal and that the backfill within 3 feet of the wall will be compacted with hand-operated compacting equipment.

9.0 FLOOR SLABS

Floor slabs may be established upon suitable, undisturbed, natural soils and/or on structural fill extending to suitable natural soils (same as for foundations). Under no circumstances shall floor slabs be established directly on potentially collapsible soils, or any topsoil, non-engineered fills, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

In order to facilitate curing of the concrete, we recommend that floor slabs be directly underlain by at least 4 inches of "free-draining" fill, such as "pea" gravel or 3/4-inch quarters to 1-inch minus, clean, gap-graded gravel. To help control normal shrinkage and stress cracking, the floor slabs should have the following features:

1. Adequate reinforcement for the anticipated floor loads with the reinforcement continuous through interior floor joints;
2. Frequent crack control joints; and
3. Non-rigid attachment of the slabs to foundation walls and bearing slabs.

10.0 DRAINAGE RECOMMENDATIONS

Some of the on-site near-surface silt soils are potentially collapsible when subjected to water, thus it is very important to the long-term performance of foundations and floor slabs that water not be allowed to collect near the foundation walls and infiltrate into the underlying soils. We recommend the following:

1. All areas around each structure should be sloped to provide drainage away from the foundations. We recommend a minimum slope of 4 inches in the first 10 feet away from the structure. This slope should be maintained throughout the lifetime of the structure.
2. All roof drainage should be collected in rain gutters with downspouts designed to discharge at least 10 feet from the foundation walls or well beyond the backfill limits, whichever is greater.
3. Adequate compaction of the foundation backfill should be provided. We suggest a minimum of 90% of the maximum laboratory density as determined by ASTM D-1557. Water consolidation methods should not be used under any circumstances.

4. Landscape sprinklers should be aimed away from the foundation walls. The sprinkling systems should be designed with proper drainage and be well-maintained. Over watering should be avoided.
5. Other precautions that may become evident during construction.

11.0 PAVEMENTS

Based on our laboratory testing (see **Figures 22 and 23**), the on-site soils have a California Bearing Ratio (CBR) of about 8% (sandy silt on west side) to 13% (silty sand on east side). We anticipate these soils will exhibit fair to good pavement support characteristics when saturated or nearly saturated. For our pavement recommendations, we utilized a CBR value of 8 for the park’s parking and drive areas, and a CBR value of 10 for the widening of 7200 West Street.

All pavement areas must be prepared as discussed above in **Section 6.1**. Under no circumstances shall pavements be established over topsoil, undocumented fills that are not properly prepared, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. In roadway areas, subsequent to stripping and prior to the placement of pavement materials, the exposed subgrade must be proof rolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or otherwise unsuitable soils are encountered, we recommend they be removed to a minimum of 18 inches below the subgrade level and replaced with structural fill.

Given the projected traffic as discussed above in **Section 1.3**, the following pavement sections are recommended for the given ESAL's (18-kip equivalent single-axle loads) per day:

MATERIAL	PAVEMENT SECTION THICKNESS (inches)				
	PARKING AREAS (3 ESAL'S per day)		DRIVE AREAS (6 ESAL'S per day)		7200 WEST (240 ESAL's per day)
Asphalt	3	3	3	3	6
Road-Base	7	4	9	4	8
Subbase	0	5	0	6	8
Total Thickness	10	12	12	13	22

Untreated base course (UTBC) should conform to city specifications, or to 1-inch-minus UDOT specifications for A-1-a/NP, and have a minimum CBR value of 70%. Material meeting our specification for structural fill can be used for subbase, as long as the fines content (percent passing No. 200 sieve) does not exceed 15%. Roadbase and subbase material should be compacted as recommended above in **Section 6.4**. Asphalt material generally should conform to APWA requirements, having a ½-inch maximum aggregate size, a 75-gradation Superpave mix containing no more than 15% of recycled asphalt (RAP) and a PG58-28 binder.

For concrete sidewalks, using 1 ESAL per day to represent utility truck traffic and a CBR of 8, we recommend the concrete be 5 inches thick and the road-base be a minimum 6 inches thick.

12.0 QUALITY CONTROL

We recommend that CMT be retained to as part of a comprehensive quality control testing and observation program. With CMT on-site we can help facilitate implementation of our recommendations and address, in a timely manner, any subsurface conditions encountered which vary from those described in this report. Without such a program CMT cannot be responsible for application of our recommendations to subsurface conditions which may vary from those described herein. This program may include, but not necessarily be limited to, the following:

12.1 Field Observations

Observations should be completed during all phases of construction such as site preparation, foundation excavation, structural fill placement and concrete placement.

12.2 Fill Compaction

Compaction testing by CMT is required for all structural supporting fill materials. Maximum Dry Density (Modified Proctor, ASTM D-1557) tests should be requested by the contractor immediately after delivery of any fill materials. The maximum density information should then be used for field density tests on each lift as necessary to ensure that the required compaction is being achieved.

12.3 Excavations

All excavation procedures and processes should be observed by a geotechnical engineer from CMT or their representative. In addition, for the recommendations in this report to be valid, all backfill and structural fill placed in trenches and all pavements should be density tested by CMT. We recommend that freshly mixed concrete be tested by CMT in accordance with ASTM designations.

12.4 Vibration Monitoring

Construction activities, particularly site grading and fill placement, can induce vibrations in existing structures adjacent to the site. Such vibrations can cause damage to adjacent buildings, depending on the building composition and underlying soils. It can be prudent to monitor vibrations from construction activities to maintain records that vibrations did not exceed a pre-defined threshold known to potentially cause damage. CMT can provide this monitoring if desired.

13.0 LIMITATIONS

The recommendations provided herein were developed by evaluating the information obtained from the subsurface explorations and soils encountered therein. The exploration logs reflect the subsurface conditions only at the specific location at the particular time designated on the logs. Soil and ground water conditions may differ from conditions encountered at the actual exploration locations. The nature and extent of any variation in the

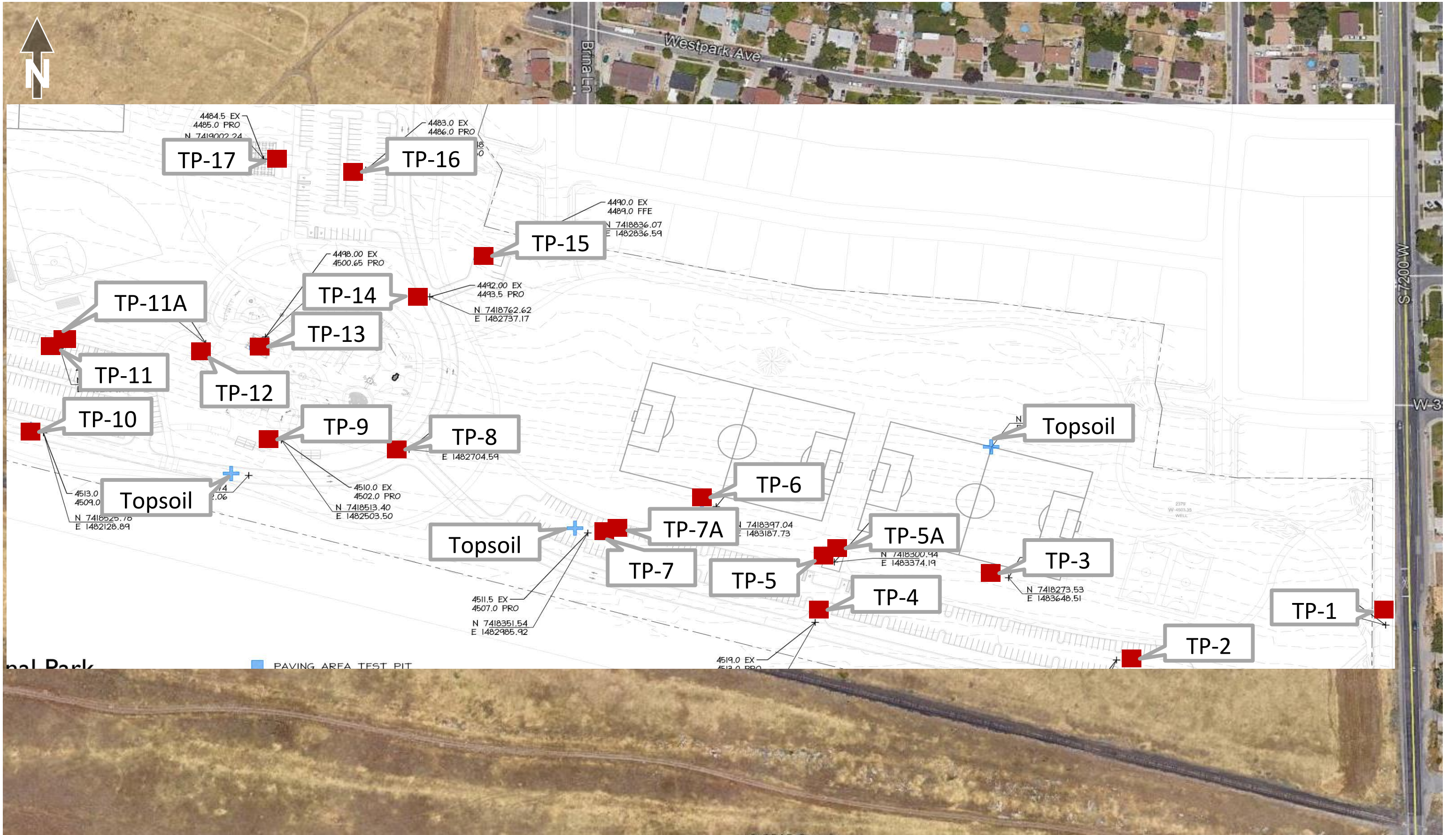
explorations may not become evident until during the course of construction. If variations do appear, it may become necessary to re-evaluate the recommendations of this report after we have observed the variation.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

We appreciate the opportunity to be of service to you on this project. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at (801) 492-4132. To schedule materials testing, please call (801) 381-5141.

APPENDIX

SUPPORTING
DOCUMENTATION



Magna Regional Park

Test Pit Log

TP-1

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 10'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg			
							Gravel %	Sand %	Fines %	LL	PL	PI	
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface											
2		Light Brown Silty SAND with gravel (SM) dry to slightly moist, dense (estimated)	CBR	3	19	48	33						
4		Light Brown Sandy GRAVEL with silt (GP-GM) slightly moist, very dense (estimated)		1									
6		silty sandy matrix is fused/cemented in some lenses		2									
8				3									
10		END AT 10'											
12													
14													
16													
18													
20													
22													
24													
26													
28													

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-2

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 9'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface										
2		Whitish brown Silty SAND with gravel (SM), cemented dry to slightly moist, dense (estimated)		4								
4		Light Brown Sandy GRAVEL with silt (GP-GM) slightly moist, dense (estimated)		5	6			6				
6												
8		soils become highly cemented		6								
10		REFUSAL AT 9'										
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-3

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 11'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg			
							Gravel %	Sand %	Fines %	LL	PL	PI	
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface											
2		Light Brown Silty GRAVEL with sand (GM), some cobbles slightly moist, dense (estimated)											
7				7	6		55	28	17				
11		END AT 11'											
12													
14													
16													
18													
20													
22													
24													
26													
28													

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-4

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 10'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface										
2		Light Brown Sandy GRAVEL with silt (GP-GM) slightly moist, dense to very dense (estimated)										
4				8	4				7			
6												
8												
8				9								
10		END AT 10'										
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-5

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 5.5'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface										
2		Light Brown Silty GRAVEL with sand (GM), some cobbles to boulders slightly moist, dense to very dense (estimated)		10	6		64	23	13			
4		very large boulder sized clasts		11								
6		REFUSAL AT 5.5'										
8												
10												
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-5A

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 12'
Water Depth: (see Remarks)

Date: 1/18/19
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface moist										
2		Light Brown Silty GRAVEL with sand (GM), some cobbles to smaller boulders slightly moist, dense to very dense (estimated)										
4				39								
6												
8		Light Brown Silty SAND with gravel (SM), slightly cemented slightly moist, dense (estimated)		40								
10		Light Brown Sandy GRAVEL with silt (GP-GM), some cobbles slightly moist, dense to very dense (estimated)		41								
12		END AT 12'										
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-6

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 5'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg			
							Gravel %	Sand %	Fines %	LL	PL	PI	
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface											
2		Light Brown Poorly Graded GRAVEL with sand (GP) slightly moist, very dense (estimated)											
4				12	2				2				
6		END AT 5'											
8													
10													
12													
14													
16													
18													
20													
22													
24													
26													
28													

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-7

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 5'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface										
2			moist									
4		Light Brown Sandy GRAVEL with silt (GP-GM)										
4		slightly moist, very dense (estimated)										
		large boulder sized particles present		13	4				7			
6		REFUSAL AT 5'										
8												
10												
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-7A

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 11'
Water Depth: (see Remarks)

Date: 1/18/19
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface moist										
2		Light Brown Sandy GRAVEL with silt (GP-GM), some cobbles and boulders moist, dense to very dense (estimated)										
4				42								
6												
8												
10												
11		END AT 11'										
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-8

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 6'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface										
2		Light Brown Sandy SILT (ML), some gravel, interbedded sand/gravel lenses slightly moist, very stiff (estimated)	CBR	5	9	39	52					
			14									
			15									
6		END AT 6'										
8												
10												
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-9

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 9'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface										
2		Light Brown Silty SAND (SM) slightly moist, loose to medium dense (estimated)		16								
4		Light Brown Silty GRAVEL with sand (GM), some large cobbles moist, medium dense (estimated)		17	8		62	22	16			
6		grades with less silt dense to very dense (estimated)										
8				18								
10		REFUSAL AT 9'										
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-10

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 9.5'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, some large boulders in upper 3'										
2		Light Brown Silty GRAVEL with sand (GM), some large cobbles slightly moist, dense to very dense (estimated)										
4				19	5		72	16	12			
6												
8				20								
10		REFUSAL AT 9.5'										
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-11

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 2'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg			
							Gravel %	Sand %	Fines %	LL	PL	PI	
0		TOPSOIL: brown silty to clayey Sand with some gravel, some large boulders											
2		Light Brown Silty GRAVEL with sand (GM), some large boulders moist, medium dense to very dense(estimated) REFUSAL AT 2'		21	6				16				
4													
6													
8													
10													
12													
14													
16													
18													
20													
22													
24													
26													
28													

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-11A

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 10.5'
Water Depth: (see Remarks)

Date: 1/18/19
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, some large boulders moist										
2		Light Brown Silty GRAVEL with sand (GM), some cobbles and small boulders moist, dense to very dense (estimated)		44								
6		Brown Sandy GRAVEL with silt (GP-GM), some cobbles slightly moist, dense to very dense (estimated)		45								
10				46								
10.5		END AT 10.5'										
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-12

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 10'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface										
2		Brown Sandy SILT (ML) moist, stiff to very stiff (estimated)										
6		Light Brown Silty GRAVEL with sand (GM) moist, dense to very dense (estimated)	22	16	83				35	30	5	
8												
10		END AT 10'	23									
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log



TP-13

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 10'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, some large cobble to smaller boulder sized clasts present in upper 2'										
2		Brown to Light Brown Silty GRAVEL with sand (GM) slightly moist, dense to very dense (estimated)										
4				25	5				12			
6				26								
10		END AT 10'										
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-14

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 5'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface										
2		Brown to Light Brown Sandy SILT (ML), pinholes slightly moist, stiff (estimated)		27	6	87				25	23	2
				28								
4												
		END AT 5'		29								
6												
8												
10												
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-15

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 12.5'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface										
2		Gray Sandy GRAVEL (GP-GM), some silt dry to slightly moist, medium dense to very dense (estimated)		30								
4		grades with less sand		31	2				7			
6		a lense of large cobbles and small boulders at 5'		32								
6		Brown Silty CLAY with fine sand (CL) moist, stiff (estimated)										
8				33	29	78				37	23	14
10												
12				34								
12.5		END AT 12.5'										
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-16

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 5'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, medium to small boulder sized particles near surface										
2		Gray Sandy GRAVEL (GP-GM), some silt dry to slightly moist, medium dense to very dense (estimated)		35								
4		grades with less sand		36								
6		END AT 5'										
8												
10												
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Magna Regional Park

Test Pit Log

TP-17

4000 South 7200 West, Magna, Utah

Equipment: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 10'
Water Depth: (see Remarks)

Date: 12/13/18
Job #: 12194

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: brown silty to clayey Sand with some gravel, large cobble to small boulder sized particles in upper 1'										
2		Gray Sandy GRAVEL (GP-GM), some silt, some coarse sand lenses slightly moist, dense (estimated) some layers are less sandy than others- bedding present										
4				37	5				7			
6												
8				38								
10		END AT 10'										
12												
14												
16												
18												
20												
22												
24												
26												
28												

Remarks: Groundwater not encountered during excavation.

Figure:

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI

COLUMN DESCRIPTIONS

Depth (ft.): Depth (feet) below the ground surface (including groundwater depth - see water symbol below).

Graphic Log: Graphic depicting type of soil encountered (see below).

Soil Description: Description of soils encountered, including Unified Soil Classification Symbol (see below).

Sample Type: Type of soil sample collected at depth interval shown; sampler symbols are explained below-right.

Sample #: Consecutive numbering of soil samples collected during field exploration.

Moisture (%): Water content of soil sample measured in laboratory (percentage of dry weight of sample).

Dry Density (pcf): The dry density of a soil measured in laboratory (pounds per cubic foot).

Gradation: Percentages of Gravel, Sand and Fines (Silt/Clay), obtained from lab test results of soil passing the No. 4 and No. 200 sieves.

Atterberg: Individual descriptions of Atterberg Tests are as follows:

LL = Liquid Limit (%): Water content at which a soil changes from plastic to liquid behavior.

PL = Plastic Limit (%): Water content at which a soil changes from liquid to plastic behavior.

PI = Plasticity Index (%): Range of water content at which a soil exhibits plastic properties (= Liquid Limit - Plastic Limit).

STRATIFICATION		MODIFIERS	MOISTURE CONTENT
Description	Thickness	Trace	Dry: Absence of moisture, dusty, dry to the touch.
Seam	Up to ½ inch	<5%	Moist: Damp / moist to the touch, but no visible water.
Lense	Up to 12 inches	Some	
Layer	Greater than 12 in.	5-12%	Saturated: Visible water, usually soil below groundwater.
Occasional	1 or less per foot	With	
Frequent	More than 1 per foot	> 12%	

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)	MAJOR DIVISIONS		USCS SYMBOLS	TYPICAL DESCRIPTIONS
	COARSE-GRAINED SOILS More than 50% of material is larger than No. 200 sieve size.	GRAVELS The coarse fraction retained on No. 4 sieve.	CLEAN GRAVELS (< 5% fines)	GW
GRAVELS WITH FINES (≥ 12% fines)			GP	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
			GM	Silty Gravels, Gravel-Sand-Silt Mixtures
SANDS The coarse fraction passing through No. 4 sieve.			CLEAN SANDS (< 5% fines)	SW
		SANDS WITH FINES (≥ 12% fines)	SP	Poorly-Graded Sands, Gravelly Sands, Little or No Fines
			SM	Silty Sands, Sand-Silt Mixtures
			SC	Clayey Sands, Sand-Clay Mixtures
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size.		SILTS AND CLAYS Liquid Limit less than 50%		ML
	SILTS AND CLAYS Liquid Limit greater than 50%	SILTS AND CLAYS Liquid Limit greater than 50%	CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
			OL	Organic Silts and Organic Silty Clays of Low Plasticity
			MH	Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils
	SILTS AND CLAYS Liquid Limit greater than 50%	SILTS AND CLAYS Liquid Limit greater than 50%	CH	Inorganic Clays of High Plasticity, Fat Clays
			OH	Organic Silts and Organic Clays of Medium to High Plasticity
HIGHLY ORGANIC SOILS		PT	Peat, Soils with High Organic Contents	

SAMPLER SYMBOLS

- Block Sample
- Bulk/Bag Sample
- Modified California Sampler
- 3.5" OD, 2.42" ID D&M Sampler
- Rock Core
- Standard Penetration Split Spoon Sampler
- Thin Wall (Shelby Tube)

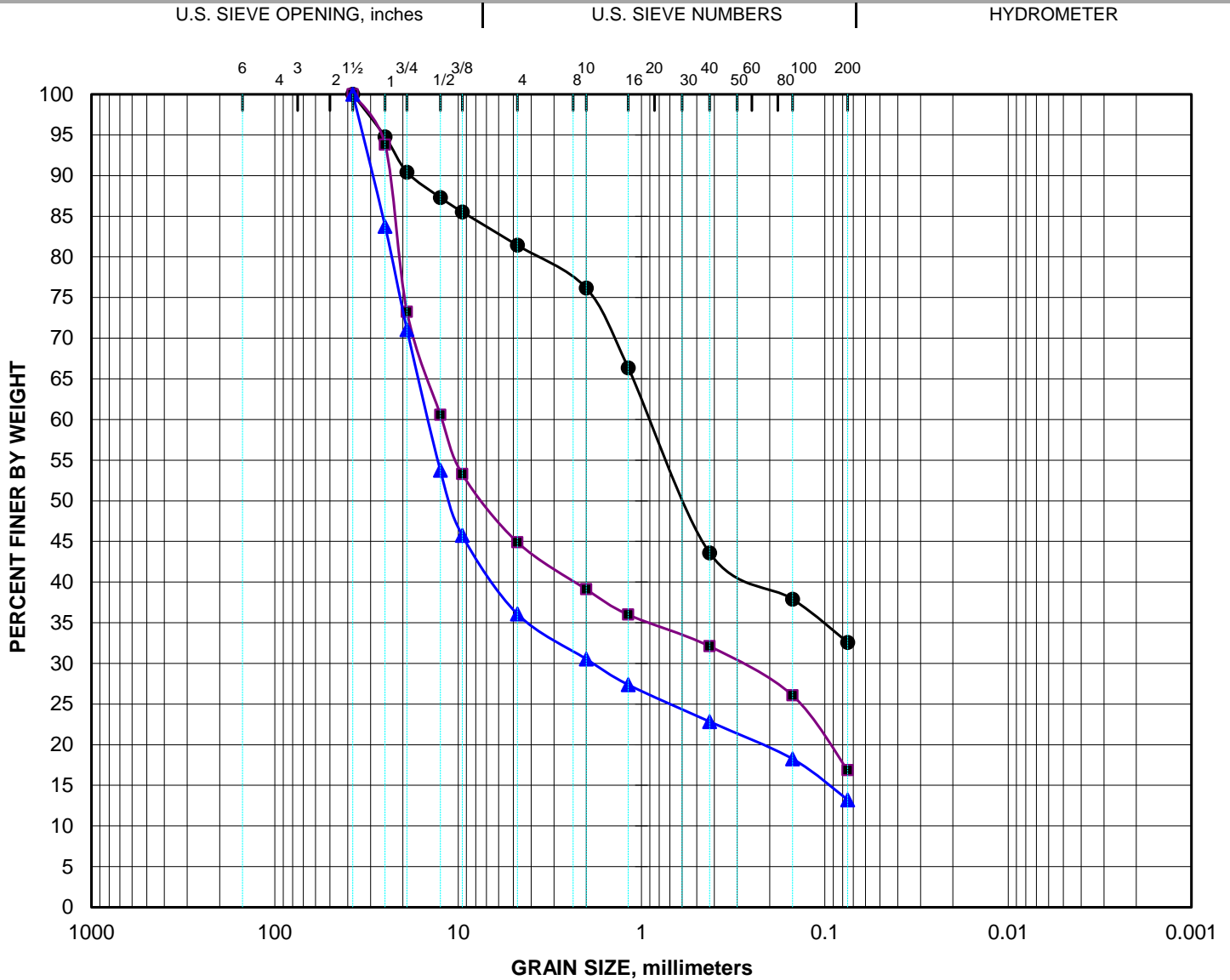
WATER SYMBOL

- Encountered Water Level
 - Measured Water Level
- (see Remarks on Logs)

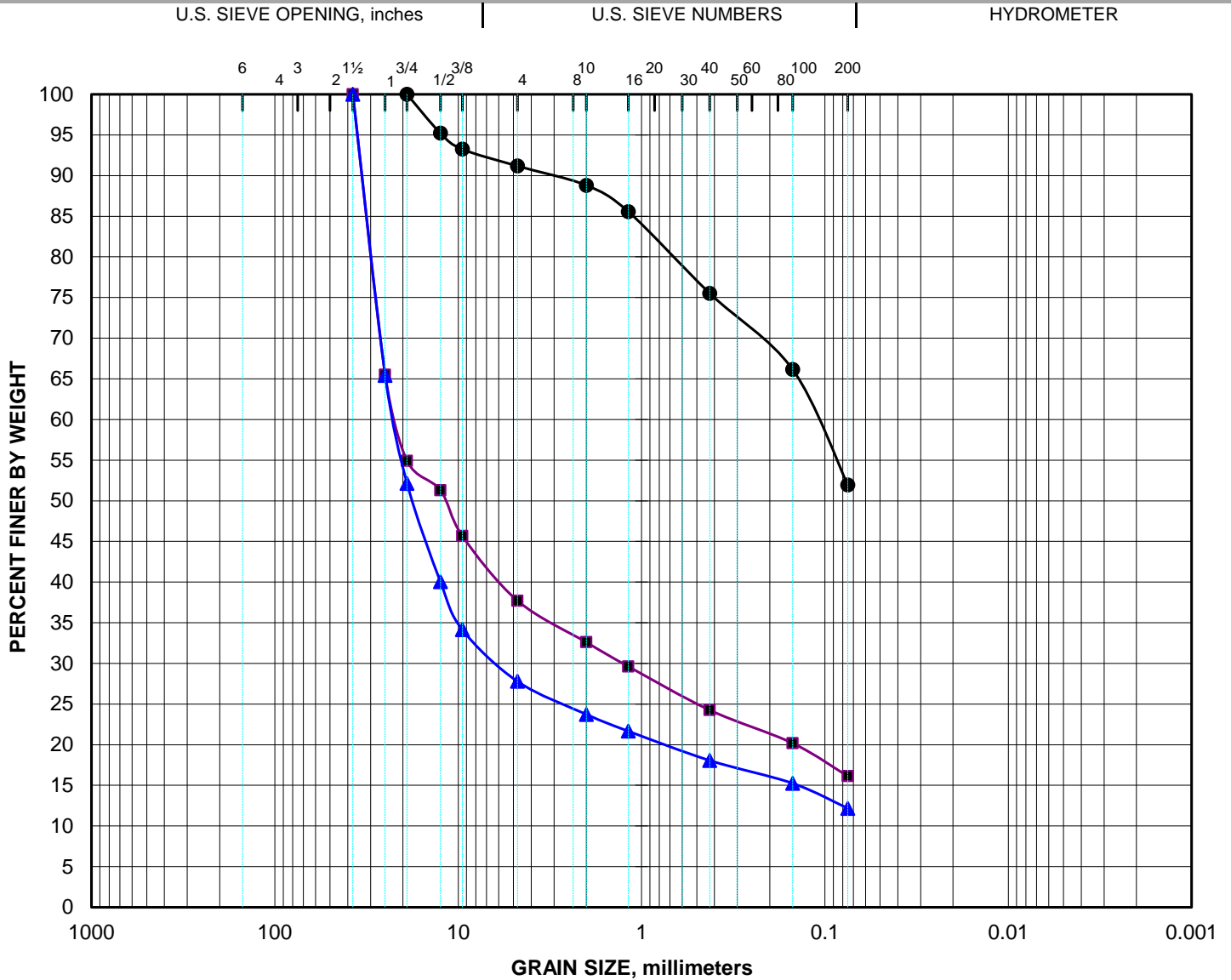
Note: Dual Symbols are used to indicate borderline soil classifications (i.e. GP-GM, SC-SM, etc.).

- The results of laboratory tests on the samples collected are shown on the logs at the respective sample depths.
- The subsurface conditions represented on the logs are for the locations specified. Caution should be exercised if interpolating between or extrapolating beyond the exploration locations.
- The information presented on each log is subject to the limitations, conclusions, and recommendations presented in this report.

Gradation Test: ASTM C-136 & C-117



Gradation Test: ASTM C-136 & C-117



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification						MC%	LL	PL	PI	Cc	Cu
● TP-8 CBR	Sandy SILT (ML)						5					
■ TP-9 @ 4 ft	Silty GRAVEL with sand (GM)						8					
▲ TP-10 @ 4 ft	Poorly Graded GRAVEL with sand (GM)						5				35.4	484
◆												

Specimen Identification	D100	D85	D60	D30	D15	D10	%Gravel	%Sand	%Silt	%Clay
● TP-8 CBR	19.0	1.11	0.076				9	39	52	
■ TP-9 @ 4 ft	37.5	31.4	21.7	1.26			62	22	16	
▲ TP-10 @ 4 ft	37.5	31.4	22.3	6.05	0.137		72	16	12	
◆										

Magna Regional Park
4000 South 7200 West, Magna, Utah



Lab Data

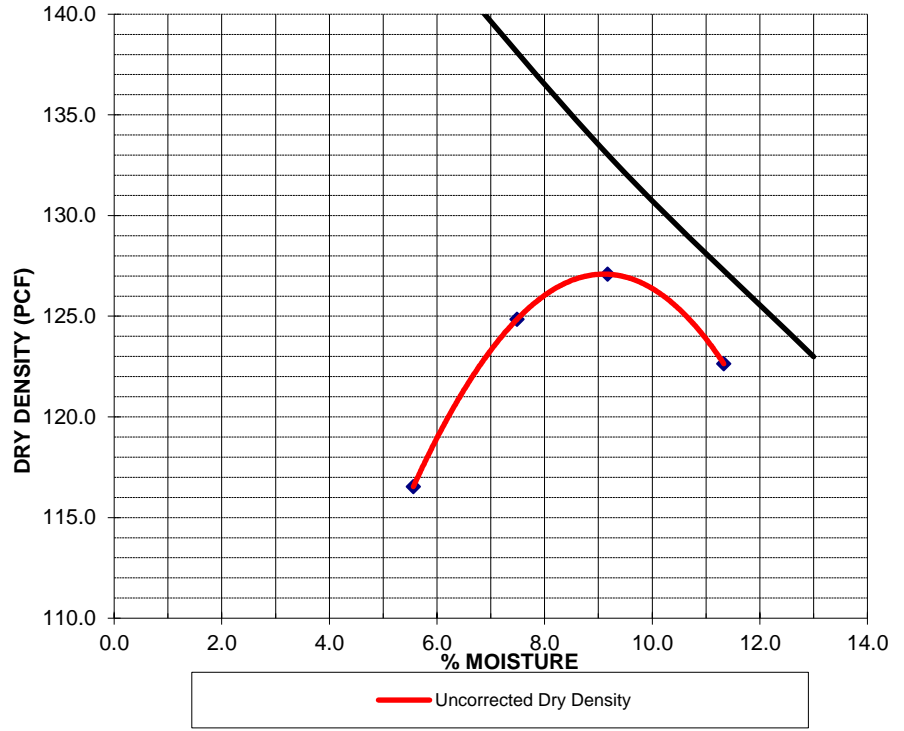
Date: 12/13/2018
Job #: 12194

Figure:

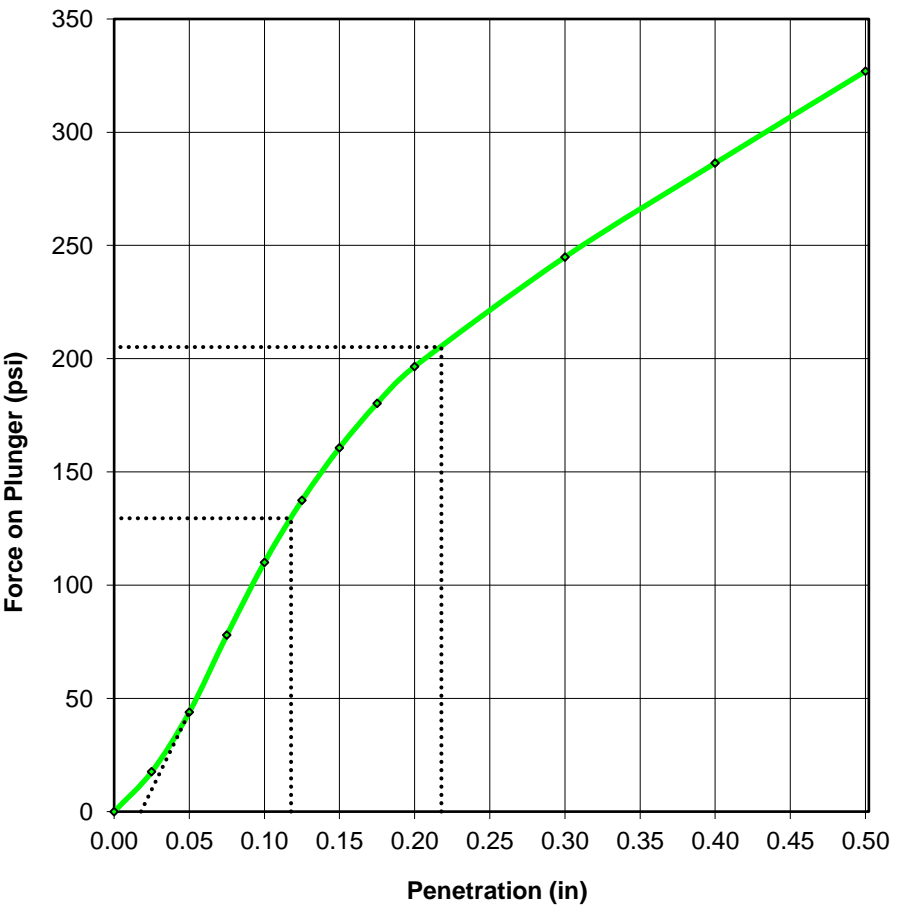
21

California Bearing Ratio Test: ASTM D2937

Sample Location	
Specimen A	TP-1
Moisture-Density Results	
ASTM or AASHTO:	ASTM
Compaction Test Number:	D1557
Compaction Method:	C
Maximum Dry Density (pcf):	127.1
Optimum Moisture Content (%):	9.1
Retained on 3/4-in.sieve (%):	0.0
Bulk Specific Gravity (Assumed):	2.7
Absorption (%) (Assumed):	2.0
(No Density Correction Needed)	



Sample Test Results	
% Gravel	19
% Sand	48
% Silt/Clay	33
Liquid Limit	--
Plasticity Index	--
Sample Description: Silty SAND with gravel (SM)	



CBR Results	
Surcharge Weight (lbs)	10
Soaking Period (hrs)	96
Swell, %	0.4
0.1 in Penetration	13.0
0.2 in Penetration	13.7
Moisture (%)	9.8
Density (pcf)	126.9
Final Moisture (%)	
Final Density (pcf)	
Relative Compaction (%)	99.8

Magna Regional Park

4000 South 7200 West, Magna, Utah

CMT ENGINEERING
LABORATORIES

Lab Data

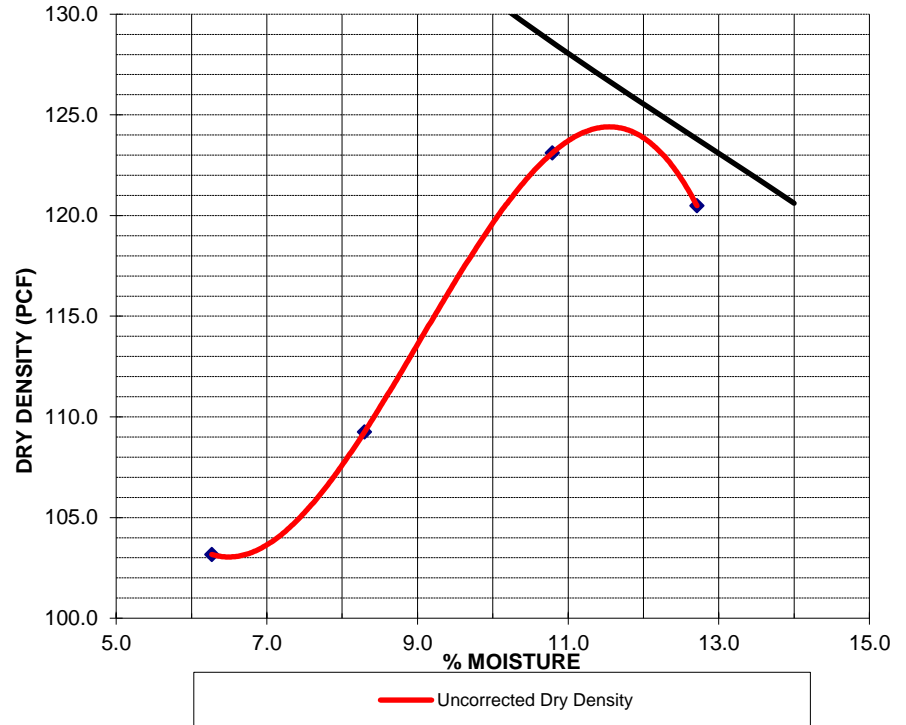
Date: 21-Dec-18
Job # 12194

Figure:

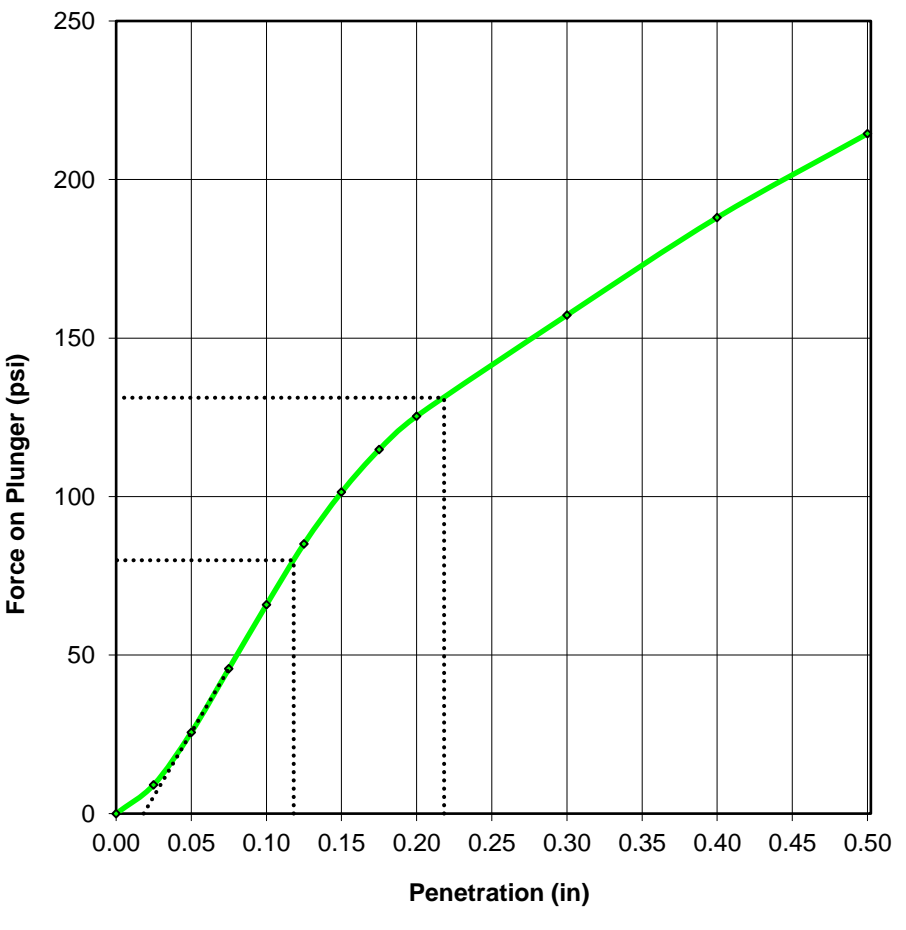
22

California Bearing Ratio Test: ASTM D2937

Sample Location	
Specimen A	TP-8
Moisture-Density Results	
ASTM or AASHTO:	ASTM
Compaction Test Number:	D1557
Compaction Method:	C
Maximum Dry Density (pcf):	124.2
Optimum Moisture Content (%):	11.5
Retained on 3/4-in.sieve (%):	0.0
Bulk Specific Gravity (Assumed):	2.7
Absorption (%) (Assumed):	2.0
(No Density Correction Needed)	



Sample Test Results	
% Gravel	9
% Sand	39
% Silt/Clay	52
Liquid Limit	--
Plasticity Index	--
Sample Description:	
Sandy SILT, some gravel (ML)	



CBR Results	
Surcharge Weight (lbs)	10
Soaking Period (hrs)	96
Swell, %	0.9
0.1 in Penetration	8.0
0.2 in Penetration	8.7
Moisture (%)	11.6
Density (pcf)	124.1
Final Moisture (%)	
Final Density (pcf)	
Relative Compaction (%)	99.9

Magna Regional Park

4000 South 7200 West, Magna, Utah

CMT ENGINEERING
LABORATORIES

Lab Data

Date: 21-Dec-18
Job # 12194

Figure:

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BRIGHAM YOUNG UNIVERSITY

Environmental Analytical Laboratory

1026 LSB

Provo, UT 84602

801-422-2147

Plant and Wildlife Sciences

Department

Name CMT Engineering Labs

Street 496 E 1750 N Suite B

Vineyard UT 84057

City State Zip

SOIL TEST REPORT AND RECOMMENDATIONS

Date: 19-Dec-18

Telephone: 801-910-2256

Work Order: 1733

Sample Identification	Crop to be grown	pH	% Sand	% Silt	% Clay	Soil Texture	Cation Exchange meq/100g	% Organic Matter
TP-3	Turf	6.8	58.9	21.1	20.0	Sandy Clay Loam		1.3

Test	Results	Very Low	Low	Medium	High	Very High	Recommendations
Nitrate-Nitrogen ppm N	2	X					apply 2.8 lbs of N/1000 sq ft
Phosphorus ppm P	22					X	no fertilizer needed
Potassium ppm K	167				X		no fertilizer needed
Salinity-ECe dS/m	0.6		X				no salinity problem
Iron ppm Fe	25					X	no fertilizer needed
SAR-Sodium Adsorption Ratio	0.8	X					no sodium hazard
Calcium-SAR ppm Ca	78						
Magnesium SAR ppm Mg	28						
Sodium SAR ppm Na	32						
Gravel >1/4" % gravel	4.1						
>2mm <1/4" % gravel	13.9						

Notes:

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Sample Identification	Crop to be grown	pH	% Sand	% Silt	% Clay	Soil Texture	Cation Exchange meq/100g	% Organic Matter
TP-7	Turf	7.0	50.9	29.1	20.0	Loam		2.4

Test	Results	Very Low	Low	Medium	High	Very High	Recommendations
Nitrate-Nitrogen ppm N	3	X					apply 2.8 lbs of N/1000 sq ft
Phosphorus ppm P	13			X			apply 2.1 lbs of P2O5/1000 sq ft
Potassium ppm K	281					X	no fertilizer needed
Salinity-ECe dS/m	0.4		X				no salinity problem
Iron ppm Fe	11				X		no fertilizer needed
SAR-Sodium Adsorption Ratio	0.5	X					no sodium hazard
Calcium-SAR ppm Ca	73						
Magnesium SAR ppm Mg	16						
Sodium SAR ppm Na	19						
Gravel >1/4" % gravel	14.3						
>2mm <1/4" % gravel	14.3						

Notes:

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Sample Identification	Crop to be grown	pH	% Sand	% Silt	% Clay	Soil Texture	Cation Exchange meq/100g	% Organic Matter
TP-9	Turf	7.5	62.9	21.1	16.0	Sandy Loam		1.4

Test	Results	Very Low	Low	Medium	High	Very High	Recommendations
Nitrate-Nitrogen ppm N	2	X					apply 2.8 lbs of N/1000 sq ft
Phosphorus ppm P	3	X					apply 4.1 lbs of P2O5/1000 sq ft
Potassium ppm K	166				X		no fertilizer needed
Salinity-ECe dS/m	0.5		X				no salinity problem
Iron ppm Fe	7.1			X			no fertilizer needed
SAR-Sodium Adsorption Ratio	0.3	X					no sodium hazard
Calcium-SAR ppm Ca	85						
Magnesium SAR ppm Mg	13						
Sodium SAR ppm Na	13						
Gravel >1/4" % gravel	7.9						
>2mm <1/4" % gravel	9.5						

Notes:

G. BROWN: DESIGN INC
SITE AND LANDSCAPE ARCHITECTS

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