

Norwalk-La Mirada Unified School District
La Mirada High School
New Football Stadium Project

13520 Adelfa Drive, La Mirada, CA 90638

DSA file No. 19-H51
DSA Application No. 03-120551

TECHNICAL SPECIFICATIONS

VOLUME 1 of 1

NAC | Architecture

Architect's Job No.
161-19015

August 26, 2020



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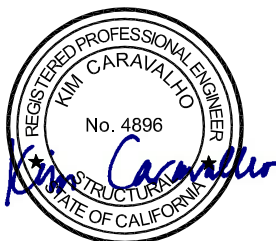
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ACRONYMS CONSULTANTS

ARCHITECT:	NAC ARCHITECTURE	NAC
CIVIL ENGINEER:	BRANDOW & JOHNSTON	B&J
DOOR HARDWARE:	ALLEGION	ALL
ELECTRICAL ENGINEER:	TURPIN & RATTAN	T&R
LANDSCAPE ARCHITECT:	CARTER ROMANEK	CR
MECHANICAL ENGINEER:	TURPIN & RATTAN	T&R
PLUMBING ENGINEER:	TURPIN & RATTAN	T&R
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STRUCTURAL ENGINEER:	BRANDOW & JOHNSTON	B&J

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DIVISION 01

GENERAL REQUIREMENTS

SECTION 01 17 00

OWNER-FURNISHED PRODUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes procedural requirements for the processing, installation, connection, testing and adjustment of Owner-furnished equipment to be installed by the Contractor.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling and sequencing: Deliver backing and embedments, including templates and instructions for their installation, to affected trades before affected construction begins.
- B. Coordination: Coordinate installation of OFCI items appliances with the work of related trades for necessary rough-in work, backing, supports and anchorage.

1.3 REFERENCES

- A. Definitions:
 - 1. Symbol definitions: "O" designates the Owner; "C" designates the Contractor.
 - 2. Symbol responsibility:
 - a. OFCI: Furnished by the Owner, installed by the Contractor.
 - b. OFOI: Furnished by the Owner, installed by Owner.
 - c. CFCl: Furnished by the Contractor, installed by the Contractor.

1.4 SUBMITTALS

- A. Obtain all necessary information from Owner, in a timely manner, as to manufacturer, model, required accessories, both those furnished by the Owner and those to be provided by the Contractor to complete the installation of each OFCI item.
- B. Shop Drawings:
 - 1. The Owner will furnish Shop Drawings showing dimensioned rough-in diagrams for each OFCI item requiring utility connections, dimensioned locations of backing plates required in walls and partitions, and details of connections to supports for all OFCI items. The Owner will furnish wiring diagrams where appropriate.
 - 2. It is the Contractor's responsibility to promptly notify the Owner of errors and discrepancies in the Shop Drawings.
- C. Closeout submittals: Include Owner-furnished operation, adjustment, care and maintenance instructions for each item of OFCI equipment installed.

1.5 HANDLING

- A. OFCI items will be delivered "tail-gate" FOB jobsite.
- B. Contractor shall receive and unload the OFCI items, place them in covered storage or enclosed building(s), and be responsible therefore after delivery. Contractor shall provide a written receipt at time of delivery, noting visible defects or omissions; refer to Paragraph D below for opening and uncrating of OFCI items.
- C. OFCI items that are damaged, abused, lost, or stolen while in Contractor's custody and control, or damaged or defaced during installation shall be repaired, replaced, or otherwise made good to the Owner's satisfaction at the Contractor's expense.

- D. Within 5 days after delivery of the OFCI items, open and uncrate the OFCI items for inspection.
 - 1. The Owner and Contractor shall inspect each item and maintain a written record of all damage, missing parts, and other defects disclosed, all of which will be made good by the Owner.
 - 2. After the inspection, Contractor shall be solely responsible for the equipment as specified above.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. General: Contractor is responsible for correct and properly located installation of the OFCI items in compliance with their manufacturers' specifications and instructions.
 - 1. If a conflict occurs between manufacturer's instructions and actual field conditions, do not install the affected items until the conflict is resolved. No additional payment will be made to the Contractor for correction of improper installation of OFCI items when reasonably adequate data and instructions for installation were furnished by the Owner or the OFCI item manufacturers.
 - 2. Contractor may request and receive from the Owner necessary additional information, such as specifications, templates, and like items from any of the manufacturers of the OFCI items. When specified, the Contractor shall request a manufacturer's representative to supervise installation of OFCI items, but at no additional cost to Owner.
- B. Installation materials: Provide attachments, fittings, fasteners, connectors, and other ancillary materials required to make complete, workable installations.
- C. Compatibility with space and service requirements:
 - 1. Space limitations, and mechanical and electrical services indicated and specified in other Sections are compatible with OFCI items.
 - 2. Modifications to OFCI items required to conform to space limitations or with utility services specified for rough-in shall not cause additional cost to the Owner.
- D. Provide mounting and utility rough-in for equipment where required.
 - 1. If the Owner substitutes items similar to those scheduled, there shall be no change in rough-in cost, unless substitution occurs after rough-in is completed or rough-in involves other mounting requirements, utilities or utilities different capacity from that required by item originally specified.
- E. Keep and store templates furnished by various OFCI item manufacturers at the site for reference. Make readily available to both the Owner and Architect. Deviations from manufacturers' templates are not acceptable.
- F. Contractor may request, and receive from the Owner, reasonable additional information, specifications, templates, and like items from the manufacturers of the OFCI items. The Contractor may request a manufacturer's representative to supervise installation of OFCI items, but at no additional cost to Owner.

1.7 OWNER'S RESPONSIBILITIES

- A. The Owner will furnish to the Contractor, manufacturer, model and type of each OFCI item to be furnished by the Owner.
- B. The Owner will purchase the OFCI items and arrange for their delivery at the job site as specified above.
- C. Owner will make available manufacturer's literature or information showing required mounting and rough-in information.
- D. The Owner will coordinate deliveries of OFCI items with the Contractor to coincide with construction schedule.

PART 2 - PRODUCTS

2.1 OFCI EQUIPMENT

- A. List: The list of OFCI items is as follows.
 - 1. Ice Machine (11 .001)
 - 2. Refrigerator (11.002)
 - 3. Toilet rooms:
 - a. Paper towel dispensers.
 - b. Liquid soap dispensers.
- B. Systems that are OFCI include the following:
 - 1. SBS Modified Bitumen Roofing and Roof Insulation (Section 07 52 16).
 - 2. Athletic Field Lighting (Section 26 56 68).
- C. Installation materials: Provide attachments, fittings, fasteners, connectors, and other ancillary materials required for installations but not usually furnished by the OFCI item manufacturers, of types approved or acceptable to the equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditions are satisfactory for the installation of equipment.
- B. Correct unsatisfactory conditions before starting installation.

3.2 INSTALLATION

- A. Comply with each OFCI item manufacturer's specifications, templates, and information, including the necessary assembling of components or sub-assemblies.
- B. Install OFCI items securely in place, plumb, level (where applicable), rigidly or flexibly mounted in compliance with their manufacturer's instructions and approved Shop Drawings, including the necessary assembling of components or sub-assemblies. Where so specified, install OFCI items under the supervision of the manufacturer's authorized representative.
- C. Make electrical and mechanical connections indicated and required.
- D. Touchup and restore damaged or defaced finishes.

3.3 ADJUSTING/CLEANING/PROTECTING

- A. Employ approved manufacturer's factory-trained service engineer to test equipment and make required adjustments for proper operation.
- B. Operate and test each operable OFCI item when installed and connected in the presence of the Owner and equipment manufacturer. If malfunction occurs through no fault of the Contractor, the Owner will make the defect good; otherwise, the Contractor shall make the necessary corrections, so the item operates properly and as intended, at the Contractor's expense.
- C. Repair or replace items not functioning properly or not acceptable to the Owner.
- D. Upon completion of installation, clean OFCI items in compliance with their manufacturer's printed instructions and the provisions of Section 01 71 00 and protect from damage until Substantial Completion.

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements for submittals required for the Work, including but not limited to; Shop Drawings, Product Data, Samples, material lists, and quality control items.
- B. Throughout the Contract Documents, the minimum acceptable quality of materials, fabrication, and execution have been defined by the name and catalog number of a manufacturer and by reference of recognized industry standards.
- C. To ensure that specified products are furnished and installed in accordance with the design intent, procedures have been established for submittal of design data and for its review by Architect, OAR and others.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 PROCEDURES

- A. Contractor is required to review and approve every submittal and shop drawing prior to transmittal and delivery to Architect. Should Contractor determine a submittal contains errors, or does not meet the requirements of the contract, Contractor shall immediately return the submittals and shop drawings to the producer and expedite the corrections prior to transmitting the submittal to Architect. Submittals shall not be used by Contractor to request clarifications or submit questions. Contractor will affix stamp to each submittal certifying Contractor has performed, at minimum, the following:
 - 1. Verified the submittal is complete in all respects and follows the requirements of the Contract Documents without variance.
 - 2. Confirmed that no substitutions have been included. If substitutions are included, Contractor shall eliminate them from the submittal and process them in accordance with Section 00 70 00 General Conditions Article 6.14.
 - 3. Identified any variances from the requirements of the Contract Documents and confirmed that the identified variance meets but does not exceed the allowable limitations or tolerances as defined in these specifications.
 - 4. Verified that all submitted materials, dimensions and tolerances are compatible with existing or planned conditions of the Work in order to erect, fabricate, or install the submitted assembly in conformance with the requirements of the Contract Documents.
 - 5. Coordinated and verified that the dimensions match Contractor measured field or installation conditions.
 - 6. Coordinated and verified that the products of separate manufacturers required within any field produced assembly are compatible in all respects for such assembly.
 - 7. Packaged together all related submittals or shop drawings where such is necessary for a comprehensive Architect review.
- B. Contractor shall package each submittal appropriately for transmittal and handling. Transmittal format shall be as required by Owner. Contractor shall transmit and deliver six sets of each submittal or re-submittal to Architect, two of which shall be returned to Contractor. Some specifications may require additional copies be provided. Contractor shall provide the Owner additional copies as specified or as requested by OAR. Architect will not accept submittals received from sources other than from Contractor.

- C. After Architect's review, Architect will transmit submittals to OAR and OAR shall further distribute to Contractor, Inspector and others as required. Work shall not commence, unless otherwise approved by OAR, until approved submittals are transmitted to Contractor.
- D. Contractor shall clearly identify any deviations from the Contract Documents on each submittal. Any deviation not so noted even though stamped reviewed is not acceptable.
- E. Contractor shall coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities requiring sequential activity.
- F. Timing of Submittals:
 - 1. In accordance with General Conditions, Contractor shall submit to Architect, with copy of transmittal to the OAR, those Shop Drawings, Product Data, diagrams, materials lists, Samples and other submittals required by the Contract Documents.
 - 2. The scheduling of submittals shall be sequenced to support the progress of the Work, and shall be:
 - a. Submitted sufficiently in advance of construction, fabrication or installation in order to allow time for transmittal, review, modification, correction, (and resubmission and re-review when required.)
 - b. Phased with adequate time between submittals in order to allow for proper review by the Architect without negative impact to the Milestones Schedule.
 - 3. Contractor shall coordinate submittal of related items and Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received by Architect.
 - 4. Contractor shall revise, update and submit submittal schedule to Architect and OAR on the first of each month, or as required by OAR.
 - 5. Contractor shall allow in the Construction Schedule, at least sixteen days for Architect review following Architect receipt of submittal. For mechanical, plumbing, electrical, low voltage, fire sprinklers, door and hardware, and other submittals requiring joint review with OAR, Contractor shall allow a minimum of eighteen days following Architect receipt of submittal. Deferred approval items shall be allowed additional time for DSA review.
 - 6. No adjustments to the Contract Time or Milestones will be authorized because of a failure to transmit submittals to Architect sufficiently in advance of the Work to permit review and processing or where Contractor fails to provide Architect submittals on related items.
 - 7. In case of product substitution, Shop Drawing preparation shall not commence until such time as Owner accepts or rejects the proposed substitution in accordance with the procedures described in the General Conditions.
- G. If required, resubmit submittals in a timely manner. Resubmit as specified for initial submittal but identify as such. Review times for re-submitted items shall be as per the time frames for initial submittal review.
- H. Shop Drawing preparation shall not commence until such time as Contractor receives Product Data acceptance.
- I. Architect will stamp each submittal with a uniform, action stamp. Architect will mark the stamp appropriately to indicate the action taken, as follows:
 - 1. Final Unrestricted Release: When Architect marks a submittal "Reviewed" the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
 - 2. Final-But-Restricted Release: When Architect, or authorized agent, marks a submittal "Reviewed as Noted," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
 - 3. Returned for Re-submittal: When Architect, or authorized agent, marks a submittal "Rejected, Revise and Resubmit," do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat as necessary to obtain different action mark. In case of multiple submittals covering same items of Work, Contractor is responsible for any time delays, schedule disruptions, out of sequence Work, or additional costs due to multiple

submissions of the same submittal item. Do not use, or allow others to use, submittals marked "Rejected, Revise and Resubmit" at the Project site or elsewhere where Work is in progress.

4. Other Action: Where a submittal is for information or record purposes or special processing or other activity, Architect, or authorized agent, will return the submittal marked "Action Not Required".

3.2 SHOP DRAWINGS

- A. Shop Drawings are original drawings prepared by Contractor, Sub-contractor, supplier, or distributor illustrating some portion of Work by showing fabrication, layout, setting, or erection and shall not be based on reproduced Contract Documents or copied standard information.
- B. Produce Shop Drawings to an accurate scale that is large enough to indicate all pertinent features and methods. Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 24 by 36 inches.
- C. Shop Drawings shall include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings. Include the following information:
 1. Dimensions.
 2. Identification of products and materials included by sheet and detail number.
 3. Compliance with specified standards.
 4. Notation of coordination requirements.
 5. Notation of dimensions established by field measurement.
- D. Provide a space of approximately 4 by 5 inches on the label or beside the title block on Shop Drawings to record Contractor and Architect review, and the action taken. Include the following information on the label for processing and recording action taken:
 1. Project name.
 2. Date.
 3. Name and address of Architect.
 4. Name and address of Contractor.
 5. Name and address of Subcontractor.
 6. Name and address of supplier.
 7. Name and address of manufacturer.
 8. Name and title of appropriate Specification section.
 9. Drawing number and detail references, as appropriate.
- E. Unless otherwise agreed to or indicated in individual Specification sections, submit a sufficient number of sets to allow for adequate distribution to Contractor, Sub-Contractor, supplier, manufacturer and fabricators plus four (4) sets (two sets to be retained by Architect, one set to the Inspector and one set to OAR).

3.3 PRODUCT DATA

- A. Collect Product Data into a single submittal for each element of Work or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, wiring diagrams, schedules, illustrations, or performance curves.
 1. Mark each copy to show or delineate pertinent materials, products, models, applicable choices, or options. Where Product Data includes information on several products that are not required, clearly mark copies to indicate the applicable information. Include the following information:
 - a. Manufacturer's printed recommendations.
 - b. Compliance with trade association standards.
 - c. Compliance with recognized testing agency standards.
 - d. Application of testing agency labels and seals.
 - e. Notation of dimensions verified by field measurement.
 - f. Notation of coordination requirements.
 - g. Notation of dimensions and required clearances.

- h. Indicate performance characteristics and capacities.
 - i. Indicate wiring diagrams and controls.
- 2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed by Contractor.

B. Required Copies and Distribution: Same as denoted in Article 3.02.E.

3.4 SAMPLES

A. Procedure:

- 1. Submit Samples of sufficient size, quantity, cured and finished and physically identical to the proposed product or material. Samples include partial or full sections or range of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches denoting color, texture, and/or pattern.
 - a. Mount or display Samples in the manner to facilitate review of qualities indicated. Include the following:
 - 1) Specification section number and reference.
 - 2) Generic description of the Sample.
 - 3) Sampling source.
 - 4) Product name or name of manufacturer.
 - 5) Compliance with recognized standards.
 - 6) Availability and delivery time.
- 2. Submit Samples for review of size, kind, color, pattern, and texture. Submit Samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
 - a. Where variations in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least three (3) multiple units that show the approximate limits of the variations.
 - b. Refer to other Specification sections for requirements for Samples that illustrate materials, fabrication techniques, assembly details, connections, operation, and similar construction characteristics.
 - c. Refer to other sections for Samples to be returned to Contractor for incorporation into the Work. Such Samples must be undamaged at time of installation. On the transmittal indicate special requests regarding disposition of Sample submittals.
 - d. Samples not incorporated into the Work, or otherwise not designated as Owner property, remain the property of Contractor and shall be removed from the Project site prior to Substantial Completion.
- 3. Color and Pattern: Whenever a choice of color or pattern is available in a specified product, submit accurate color chips and pattern charts to OAR for review and selection.
- 4. Number Required: Submit six, minimum, of each. Two will be returned to Contractor.

B. When specified, erect field Samples and mock-ups at the Project site to illustrate products, materials, fabrications, or execution and to establish standards by which completed Work shall be judged.

C. Maintain sets of Samples, as returned, at the Project site, for quality comparisons throughout the course of the Work. Sample sets may be used to obtain final acceptance of the Work associated with each set.

3.5 QUALITY CONTROL SUBMITTALS

- A. Submit quality control submittals, including design data, certifications, manufacturer's field reports, and other quality control submittals as required under other sections of the Contract Documents.
- B. When other sections of the Contract Documents require manufacturer's certification of a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements.
- C. Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the represented company.

- D. Requirements for submittal of inspection and test reports are specified in other sections of the Contract Documents.

END OF SECTION

SECTION 01 45 23

TESTING AND INSPECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Testing and inspection services to meet requirements of the California Building Code (CBC) and the Division of the State Architect (DSA).

1.2 ADMINISTRATIVE REQUIREMENTS

- B. Laboratories performing testing shall have DSA's Laboratory Evaluation and Acceptance Program approval prior to providing material testing or special inspection services.
- C. Tests of materials and inspections shall be in accordance to Section 4-213 through 4-219 of the California Building Standards Commission's, California Administrative Code.
- D. Required material testing, inspections and special inspections are indicated on the DSA approved DSA-103, Listing of Structural Tests & Special Inspections (T&I List). OAR will provide CONTRACTOR copy of DSA-103.

1.3 TESTS

- A. OWNER will contract with a DSA approved testing laboratory to perform the testing indicated on the Contract Documents, including the Tests and Special Inspections (T&I) list.
- B. Selection of material to be tested shall be by the Testing Laboratory and not by CONTRACTOR.
- C. Any material shipped from the source of supply prior to having satisfactorily passed such testing and inspection, or prior to the receipt of notice from Project Inspector such testing and inspection is not required, shall not be incorporated into the Work.
- D. OWNER will select, and directly reimburse, the Testing Laboratory for costs of all DSA required tests and inspections; however, the Testing Laboratory may be reimbursed by CONTRACTOR for such costs as specified or noted in related sections of the Contract Documents.
- E. The Testing Laboratory is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
- F. The Testing Laboratory shall not perform any duties of CONTRACTOR.
- G. CONTRACTOR shall provide an insulated curing box with the capacity for twenty concrete cylinders and will relocate said box and cylinders as rapidly as required in order to provide for progress of the Work.

1.4 TEST REPORTS

- A. Test reports shall include all tests performed, regardless of whether such tests indicate the material is satisfactory or unsatisfactory. Samples taken but not tested shall also be reported. Records of special sampling operations, when and as required, shall also be reported. Reports shall indicate the material (or materials) was sampled and tested in accordance with requirements of CBC, Title 24, Parts 1 and 2, as indicated on the Contract Documents. Test reports shall indicate specified design strength and specifically state whether or not the material (or materials) tested comply with the specified requirements.

1.5 VERIFICATION OF TEST REPORTS

- A. Each Testing Laboratory shall submit to the Division of the State Architect, in duplicate, a verified report covering all tests required to be performed by that agency during the progress of the Work. Such report, covering all required tests, shall be furnished prior to Substantial Completion and/or, when construction on the Work is suspended, covering all tests up to the time of Work suspension.

1.6 INSPECTION BY OWNER

- A. OWNER, and its representatives, shall have access, for purposes of inspection, at all times to all parts of the Work and to all shops wherein the Work is in preparation. CONTRACTOR shall, at all times, maintain proper facilities and provide safe access for such inspection.
- B. OAR shall have the right to reject materials and/or workmanship deemed defective Work and to require correction. Defective workmanship shall be corrected in a satisfactory manner and defective materials shall be removed from the premises and legally disposed of without charge to OWNER. If CONTRACTOR does not correct such defective Work within a reasonable time, fixed by written notice and in accordance with the terms and conditions of the Contract Documents, OWNER may correct such defective Work and proceed in accordance with related Articles of the Contract Documents.
- C. CONTRACTOR is responsible for compliance to all applicable local, state, and federal regulations regarding codes, regulations, ordinances, restrictions, and requirements.

1.7 PROJECT INSPECTOR

- A. A Project Inspector will be employed by OWNER in accordance with requirements of Title 24 of the California Code of Regulations with their duties specifically defined therein. Additional DSA Special Inspectors may be employed and assigned to the Work by OWNER in accordance with the requirements of the CBC and DSA.
- B. Inspection of Work shall not relieve CONTRACTOR from any obligation to fulfill all terms and conditions of the Contract Documents.
- C. CONTRACTOR shall be responsible for scheduling times of inspection, tests, sample taking, and similar activities of the Work.

1.8 STRUCTURAL TESTS AND SPECIAL INSPECTIONS

- A. Soils:
 - 1. General: Periodic inspection by Geotechnical Engineer for verification of the following construction activities in conformance to CBC Table 1705A.6:
 - a. Site has been prepared properly prior to placement of controlled fill and/or excavations for foundations.
 - b. Foundation excavations are extended to proper depth and have reached proper material.
 - c. Materials below footings are adequate to achieve the design bearing capacity.
 - 2. Compacted Fills: Testing and inspections shall be in conformance to Table 1705A.6:
 - a. Geotechnical Engineer will continuously verify the use of proper materials and inspect lift thicknesses, placement, and compaction during placement of fill.
 - b. Testing Laboratory under the supervision of the Geotechnical Engineer will:
 - 1) Perform qualification testing of fill materials.
 - 2) Test the compaction of fill.

3. Driven Deep Foundations (Piles): Testing and inspections shall be in conformance to Table 1705A.7:
 - a. Continuous inspections by Geotechnical Engineer:
 - 1) Verify pile materials, sizes and lengths comply with the requirements.
 - 2) Inspect driving operations and maintain complete and accurate records for each pile.
 - 3) Verify locations of piles and their plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and record any pile damage.
 - b. Testing Laboratory under the supervision of the Geotechnical Engineer will determine capacities of test piles and conduct additional load tests as required.
 - c. Steel piles: Tests and inspections will be as indicated on paragraphs below for structural steel.
 - d. Concrete piles and concrete filled piles: Tests and inspections will be as indicated on paragraphs below for concrete.
4. Cast-in-place Deep Foundations (Piers): Continuous inspections by Geotechnical Engineer in conformance to Table 1705A.8:
 - a. Inspect drilling operations and maintain complete and accurate records for each pier.
 - b. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, and embedment into bedrock (if applicable). Record concrete or grout volumes.
 - c. Confirm adequate end strata bearing capacity.
 - d. Concrete Piers: Tests and inspections will be as indicated on paragraphs below for concrete.
5. Retaining Walls:
 - a. Continuous inspections by Geotechnical Engineer:
 - 1) Placement, compaction and inspection of soil per CBC Section 1705A.6.1 for fills supporting foundations.
 - 2) Segmental retaining walls; inspect placement of units, dowels, connectors, etc.
 - b. Concrete Retaining Walls: Provide tests and inspections as indicated on paragraphs below for concrete.
 - c. Masonry Retaining Walls: Provide tests and inspections as indicated on paragraphs below for masonry.

B. Concrete:

1. Cast in Place Concrete: Inspection and testing in conformance to CBC Table 1705A.3:
 - a. Inspection of reinforcement, including prestressing tendons and verification of placement, per ACI 318, sections 25.2, 25.2, 25.5.1 through 26.5.3.
 - b. Reinforcing bar welding: Inspect per AWS D1.4, ACI 318 26.5.4.
 - 1) Verification of weldability of reinforcing bars other than ASTM A706.
 - 2) Inspect single-pass fillet welds, maximum 5/16".
 - 3) Inspect all other welds.
 - c. Inspect anchors cast in concrete per ACI 318, section 17.8.2.

- d. Inspect anchors post-installed in hardened concrete members:
 - 1) Continuous inspection of adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads, per ACI 318, section 17.8.2.4.
 - 2) Mechanical anchors and adhesive anchors, not defined in previous paragraph, per ACI 318, section 17.8.2.
 - e. Design Mix:
 - 1) Verify use of required mix, per ACI 318, chapter 19 and sections 26.4.3 and 26.4.4.
 - 2) Batch Plant Inspection: The quality and quantity of materials used in transit-mixed concrete and in batched aggregates shall be continuously inspected as required by CBC section 1705A.3.2. If approved by DSA, batch plant inspection may be reduced to periodic if plant complies with CBC section 1705A3.3.1, item 1, and requires first batch inspection, weightmaster, and batch tickets.
 - f. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete, per ASTM C172, ASTM C31, ACI 318, sections 26.4.5 and 26.12.
 - g. Inspect concrete and shotcrete placement for proper application techniques, per ACI 318, section 26.4.5.
 - h. Verify maintenance of specified curing temperature and techniques per ACI 318 sections 26.4.7 through 26.4.9 and CBC section 1908.9.
 - i. Inspect prestressed concrete for:
 - 1) Application of prestressing forces, per ACI 318 section 26.9.2.1
 - 2) Grouting of bonded prestressing tendons per ACI 318 section 26.9.2.3.
 - j. Inspection of erection of precast concrete members per ACI 318 chapter 26.8.
 - k. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs per ACI 318 section 26.10.1.b.
 - l. Sampling and testing of reinforcing steel per ASTM A370, DSA IR 17-10 and CBC section 1910A.2. CONTRACTOR shall submit mill certificate indicating compliance with requirements for reinforcement, anchors, ties, and metal accessories.
- 2. Post-installed Anchors:
 - a. Special Inspector will inspect installation of post-installed anchors in hardened concrete members as required by CBC table 1705A.3, item 4.
 - 1) Adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads, per ACI 318, section 17.8.2.4.
 - 2) Mechanical anchors and adhesive anchors not defined above, per ACI 318, section 17.8.2.
 - b. Testing Laboratory will test post-installed anchors in conformance to CBC section 1905A and ASTM E488.
- C. Structural Masonry:
- 1. Material Verification and Testing:
 - a. Sampling and testing of reinforcing steel per ASTM A370, DSA IR 17-10 and CBC section 1910A.2. CONTRACTOR shall submit mill certificate indicating compliance with requirements for reinforcement, anchors, ties, and metal accessories.

- b. Submit manufacturer's certificate of compliance for masonry units, mortar and grout materials. Test masonry units, mortar and grout (unit strength method).
- a. Testing Laboratory will test masonry prisms in conformance with ASTM C1314.
- b. Special Inspector will verify proportions of site-prepared, premixed or preblended mortar and grout, per ASTM C780.
- c. Testing Laboratory will test core-drilled samples in conformance with CBC 2114.6.2.

2. Inspection:

- a. Special Inspector will continuously inspect preparation of prisms per ASTM C1314.
- b. Special inspector will verify size, location and condition of dowels and construction supporting masonry.
- c. Special inspector will verify size specified size, grade and type of reinforcement.
- d. Special inspector will verify weldability of reinforcing bars other than ASTM A706. Special inspector to inspect reinforcing bar welding: Inspection to be in conformance with AWS D1.4, ACI 318 26.5.4.
- e. Special inspector will inspect placement of reinforcement, connectors, masonry units and construction of mortar joints.
- f. Special inspector will verify protection of masonry during cold weather temperature (temperature below 40° F) or hot weather (temperature above 90° F).
- g. Special inspector will inspect type, size and location of anchors and all other items to be embedded in masonry, including other details of anchorage of masonry to structural members, frames and other construction.
- h. Special inspector will inspect grout space prior to grouting and placement of grout.

3. Post-installed Anchors in Masonry:

- a. Special inspector will inspect anchors cast in concrete per ACI 318, section 17.8.2.
- b. Special inspector will inspect anchors post-installed in hardened concrete members:
 - 1) Continuous inspection of adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads, per ACI 318, section 17.8.2.4.
 - 2) Mechanical anchors and adhesive anchors, not defined in previous paragraph, per ACI 318, section 17.8.2.
- c. Testing Laboratory will test post-installed anchors in conformance to CBC section 1905A and ASTM E488.

D. Structural Steel:

- 1. Special inspector will verify that all materials are properly marked in conformance with AISC 360, Section 3.3 and applicable ASTM standards.
 - a. Mill certificates indicating material properties that comply with requirements.
 - b. Materials, sizes, types and grades complying with requirements.
- 2. Testing Laboratory will test unidentified materials in conformance with ASTM A370.
- 3. Special inspector will examine seam welds of HSS shapes in conformance with DSA IR-17-3.
- 4. Special inspections and non-destructive testing of structural steel elements shall be in conformance to CBC section 1705A.2.1.

E. High Strength Bolts:

1. Special inspector will verify identification markings and manufacturer's certificates of compliance conform to ASTM standards specified in the Contract Documents, per DSA IR 17-9.
2. Testing Laboratory will test high-strength bolts, nuts and washers in conformance with ASTM F606, ASTM A370 and DSA IR 17-8.
3. Special inspector will inspect bearing-type ("snug tight") bolt connections in conformance with AISC 360, section M2.5 and DSA IR 17-9.
4. Special inspector will inspect slip-critical bolt connections in conformance with AISC 360, section M2.5.

F. Welding:

1. Verification of Materials, Equipment and Welders:
 - a. Special inspector will verify weld filler material identification markings per AWS designation listed on the Contract Documents and the WPS.
 - b. Special inspector will verify material manufacturer's certificate of compliance.
 - c. Special inspector will verify WPS, welder qualifications and equipment in conformance to DSA IR 17-3.
2. Shop Welding: Special inspector will inspect the following, per CBC 1705A.2.1, AISC 360 (and AISC 341, as applicable) and DSA IR 17-3:
 - a. Groove, multi-pass fillet welds larger than 5/16", plug and slot welds.
 - b. Single-pass fillet welds equal or less than 5/16".
 - c. Inspect welding of stairs and railing systems.
 - d. Verification of reinforcing steel weldability.
 - e. Welding of reinforcing steel, per AWS D1.4.
3. Field Welding: Special inspector will inspect the following, per CBC 1705A.2.1, AISC 360 (and AISC 341, as applicable) and DSA IR 17-3:
 - a. Groove, multi-pass fillet welds larger than 5/16", plug and slot welds.
 - b. Single-pass fillet welds equal or less than 5/16".
 - c. End welded studs (ASTM A108) installation, including bend test.
 - d. Floor and roof deck welds.
 - e. Welding of structural cold-formed steel.
 - f. Welding of stairs and railing systems.
 - g. Verification of reinforcing steel weldability.
 - h. Inspect welding of reinforcing steel.
4. Non-Destructive Testing: Testing Laboratory will test perform ultrasonic and magnetic particle testing in conformance to AISC 360 section N5.5, AISC 341 appendix Q5.2, AWS D1.1, AWS D1.8, ASTM E543, ASTM E1444, ASTM E164 and DSA IR 17-2.

- G. Steel Joists and Trusses: Continuous inspection, special inspector will verify size, type and grade for all chord and web members as well as connectors and weld filler material, verify joist profile, dimensions and chamber (if applicable); verify all weld locations, lengths and profiles; mark or tag each joist, in conformance with CBC section 2207.1 and DSA IR 22-3.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

PART 4 TESTS AND INSPECTION REQUIREMENTS

TITLE 24, PART 2 (2016 CBC) - VOLUME 2	
TESTS AND INSPECTION REQUIREMENTS	CBC SECTION
FOUNDATIONS & RETAINING WALLS	
CHAPTER 18A	
1. INSPECTION:	
• PILES	1705A.7
• PIER FOUNDATIONS	1705A.8
CONCRETE	
CHAPTER 19A	
1. MATERIALS	
• PORTLAND CEMENT	1705A.3.2; 1910A.1
• CONCRETE AGGREGATES	1705A.3.2; 1903A.5
• SHOTCRETE AGGREGATES	1908A.3
• REINFORCING BARS	1705A.3.2; 1910A.2
• PRESTRESSING STEEL AND ANCHORAGE	1705A.3.2; 1910A.3
2. QUALITY	
• PROPORTIONS OF CONCRETE	1910A.1; Table 1705A.3, Item 5
• STRENGTH TESTS OF CONCRETE	1905A.1.16; Table 1705A.3 Item 6; ACI 318-14 Sec. 26.12
• SHOTCRETE PROPORTIONS	1908A.2
• SHOTCRETE CORES	1908A.5
• COMPOSITE CONSTRUCTION CORES	1910A.4
•	
•	
3. INSPECTION	
• BATCH PLANT	1705A.3.3
• WAIVER OF BATCH PLANT	1705A.3.3.1
• PREPLACEMENT AND PLACING	1705A.3.5; 1705A.3.6
• PRESTRESSED CONCRETE	1705A.3.4
• SHOTCRETE	1705A.19; 1908A
• POST-INSTALLED ANCHORS IN CONCRETE	1910A.5; Table 1705A.3, Items 4a & 4b
• REINFORCING BAR WELDING	1903A.8; 1705A.3.1; Table 1705A.3, Item 2; Table 1705A.2.1, Item 5b
ALUMINUM	
CHAPTER 20A	
1. MATERIALS	
• ALLOYS	2002.1
• IDENTIFICATION	2002.1

2. INSPECTION	2003.1
• WELDING	
MASONRY	
CHAPTER 21A	
1. MATERIALS	
• MASONRY UNITS	2103A.1
• PORTLAND CEMENT, LIME	2103A
• MORTAR AND GROUT AGGREGATES	2103A.2 ; 2103A.3
• REINFORCING BARS	2103A.4
2. QUALITY	
• PORTLAND CEMENT TESTS	1910A.1
• MORTAR AND GROUT TESTS	2105A.3
• MASONRY PRISM TESTS	2105A.2
• MASONRY CORE TESTS	2105A.4
• MASONRY UNIT TESTS	2105A.2; 2105A.3; 1705A.4
• REINFORCING BAR TESTS	1910A.2
3. INSPECTION	
• REINFORCED MASONRY	1705A.4
• REINFORCED BAR WELDING	1903A.8; 1705A.3.1; Table 1705A.3, Item 2; Table 1705A.2.1, Item 5b
• POST-INSTALLED ANCHORS IN MASONRY	1705A.4; 1910A.5; 1616A.1.19; Table 1705A.3, Items 4a & 4b
STEEL	
CHAPTER 22A	
1. MATERIALS	
• STRUCTURAL STEEL	2205A.1
• COLD FORMED STEEL	2210A.1
• IDENTIFICATION	2203A.1
2. QUALITY	
• TESTS OF STRUCTURAL AND COLD FORMED STEEL	2211A.1
• TESTS OF HIGH STRENGTH BOLTS, NUTS WASHERS	2213A.1
• TESTS OF END WELDED STUDS	2213A.2
• STEEL JOISTS	2207A; 1705A.2.3.1
• NON-DESTRUCTIVE WELD TESTS	1705A.2.1
3. INSPECTION	
• SHOP FABRICATION	1704A.2.5; 1705A.2

• WELDING	1705A.2.1
• NELSON STUD WELDING	1705A.2.1
• HIGH STRENGTH BOLT INSTALLATION	1705A.2.1; Table 1705A.2.1

WOOD	
CHAPTER 23	
1. MATERIALS	
• LUMBER AND PLYWOOD	2303.1
• GLUED LAMINATED MEMBERS	2303.1.3
2. INSPECTION	
• GLUED LAMINATED FABRICATION	1705A.5.4; 2303.1.3
• TIMBER CONNECTORS	1705A.5.6
• MANUFACTURED TRUSSES	1705A.5.2; 1705A.5.3; 2303.4.7

END OF SECTION

SECTION 01 50 00

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes Temporary utilities, construction facilities and controls to be provided, maintained, relocated, and removed by CONTRACTOR

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 QUALITY ASSURANCE

- A. CONTRACTOR shall comply with applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:
 - 1. Building Code requirements.
 - 2. Division of State Architect.
 - 3. Health and safety regulations.
 - 4. Utility company regulations.
 - 5. Police, fire department and rescue squad requirements.
 - 6. Environmental protection regulations.
- B. CONTRACTOR shall arrange for the inspection and testing of each temporary utility prior to use. Obtain required certifications and permits and transmit to OAR.
- C. CONTRACTOR provided facilities are to be in place and available for OWNER use and occupancy within 15 calendar days following the date of issue of the Notice to Proceed and shall remain in place and available for OWNER use and occupancy throughout the full term of the Contract.
- D. Interior Air Quality (IAQ) During Construction:
 - 1. Referenced Standards include:
 - a. ASHRAE 62.1 - 2004.
 - b. ASHRAE 52.2-1999.
 - c. CHPS Best Practices Manual- Volume III (Latest Edition).
 - 2. Interior Air Quality (IAQ) During Construction Plan: CONTRACTOR is required to develop and submit to the OWNER for review and approval a Construction Indoor Air Quality (IAQ) Plan using the blank form provided as Appendix A of this Specification. Plan shall be submitted within 30 days of NTP. Implementation of the approved (IAQ) Plan will be included in the project construction schedule.
 - 3. Construction Photos Requirement: CONTRACTOR shall submit photographs that demonstrate the Construction Ventilation, Preconditioning, Sequencing, and Protection measures taken during the project for complying with the IAQ plan, applicable specifications and referenced standards.

3.2 TEMPORARY UTILITIES

- A. CONTRACTOR shall submit to OAR reports of tests, inspections, meter readings and similar procedures performed on temporary utilities.

- B. CONTRACTOR shall coordinate with the appropriate utility company to install temporary services. Where the utility company provides only partial service, CONTRACTOR shall provide and install the remainder with matching compatible materials and equipment.
- C. Temporary Water:
1. CONTRACTOR shall furnish, install and pay for all necessary permits, inspections, move ins/out, temporary water lines, connections and fees, extensions and distribution, metering devices and use charges, deliveries/pick ups, rentals, storage, transportation, taxes, labor, insurance, bonds, material, equipment and all other miscellaneous items for the temporary water system, and upon Substantial Completion of the Work, removal of all such temporary water system devices and appurtenances.
 2. CONTRACTOR shall provide and maintain temporary water service, including water distribution piping and outlet devices of the size and required flow rates in order to provide service to all areas of the Project site.
 3. CONTRACTOR shall provide and pay for all potable water needed for construction and all other uses associated with the Work.
 4. CONTRACTOR shall at their expense and without limitation, remove, extend and/or relocate temporary water systems as rapidly as required in order to provide for progress of the Work.
- D. Temporary Electric:
1. CONTRACTOR shall furnish, install, maintain and pay for all necessary permits, inspections, temporary wiring, metering devices and use charges, move ins/outs, connections and fees, service, extension and distribution, deliveries/pickups, rentals, storage, transportation, taxes, labor, insurance, bonds, materials, equipment and all other required miscellaneous items for the temporary electric systems and upon Substantial Completion of Work, removal of all such temporary electric systems and appurtenances.
 2. CONTRACTOR shall furnish, install, maintain, extend and distribute temporary electric area distribution boxes, so located that individual trades can obtain adequate power and artificial lighting, at all points required for the Work, for inspection and for safety.
 3. CONTRACTOR shall provide temporary electric for construction, temporary facilities, and connections for construction equipment requiring power or lighting, at all points required for the Work, for inspection and safety.
 4. CONTRACTOR shall provide 20 foot candles minimum lighting levels inside building(s) and 5 foot candles outside for safety and security.
 5. CONTRACTOR shall ensure welding equipment is supplied by electrical generators.
 6. CONTRACTOR shall at their expense and without limitation remove, extend and/or relocate temporary electric systems as rapidly as required in order to provide for progress of the Work.
- E. Temporary Gas:
1. CONTRACTOR shall furnish, install, maintain and pay for all necessary permits, inspections, metering devices and use charges, move ins/out, extension and distribution, deliveries/pickups, rentals, storage, transportation, equipment and piping, rentals, taxes, labor, material, insurance, bonds, and all other required miscellaneous items for the temporary gas systems necessary to perform the Work, and upon Substantial Completion of the Work, removal of all such temporary gas system devices and appurtenances.
 2. CONTRACTOR shall at their expense and without limitation remove, extend and/or relocate temporary gas systems as rapidly as required in order to provide for progress of the Work.
- F. Temporary Heating, Ventilation and Air Conditioning:
1. CONTRACTOR shall furnish, install, maintain, and pay for all necessary permits, inspections, move ins/out, extensions and distribution, connections and fees, use charges, metering devices and use charges, equipment, rentals, deliveries/pick ups, storage, transportation, taxes, labor, insurance, bonds, material, equipment and all other required miscellaneous items for temporary heat and ventilation needed for proper installation of the Work and to protect materials and finishes from damage due to weather. Upon Substantial Completion of the Work, CONTRACTOR shall remove all such temporary heating and ventilating system devices and appurtenances.

2. CONTRACTOR shall provide, maintain and pay for all temporary ventilation of enclosed Work areas to cure materials, disperse humidity, remove fumes, and to prevent accumulation of dust, irritants, or gases.
3. OWNER will not accept utilization of the permanent HVAC system for temporary HVAC until Substantial Completion.
4. CONTRACTOR shall maintain manufacturer required levels of room and/or space temperature, humidity and ventilation necessary to install products, materials and/or systems of the Work.
5. CONTRACTOR shall at their expense and without limitation, remove, extend and/or relocate temporary heating and ventilating systems as rapidly as required in order to provide for progress of the Work.

G. Temporary Telephone and Data:

1. CONTRACTOR shall furnish, install, maintain and pay for all necessary permits, inspections, move ins/outs, extensions and distribution, devices, connections and fees, use charges, rentals, deliveries/pickups, storage, transportation, taxes, labor, insurance, bonds, material, equipment and all other required miscellaneous items for temporary phone, data service and distribution to Project site temporary offices as required by this Section and Article 3.03.
2. CONTRACTOR shall arrange for the supply, installation, and maintenance of one Project site exterior pay phone booth and/or equivalent facility.
3. CONTRACTOR shall at their expense and without limitation, remove, extend and/or relocate temporary phone service and distribution as rapidly as required in order to provide for progress of the Work.
4. Upon Substantial Completion of the Work, CONTRACTOR shall remove all such temporary phone service, distribution, devices and appurtenances.

3.3 CONTRACTOR PROVIDED FACILITIES

A. Provide temporary offices, utilities, storage units, fencing, barricades, chutes, elevators, hoists, scaffolds, railings and other facilities or services as required. CONTRACTOR shall be responsible for providing, installation, maintenance, supplying, and all use charges for the items provided under this Section.

B. Temporary Offices:

1. In addition to Project site temporary office facilities CONTRACTOR provides for use of CONTRACTOR, CONTRACTOR shall provide and maintain a minimum of one 12' x 40' new (or as approved by OAR) construction trailer on the Project site for use by OWNER for the duration of the Work. Construction trailer shall be accessible by OWNER and/or INSPECTOR on a 7 day a week 24-hour basis. CONTRACTOR shall provide the necessary materials and labor to provide the trailer with disable access on request by the OAR. Trailer shall include, at a minimum, the following:
 - a. Conference room with a table and adequate seating for twelve;
 - b. One bathroom;
 - c. An open work area with devising partitions as required by OWNER and
 - d. Two enclosed, separate offices with windows and lockable doors.
2. Trailer shall be furnished with two exterior entrance doors with one located in a separate office. Each door shall be furnished with both a dead bolt and cylinder lock with six keys. Exterior doors and windows shall be provided with exterior mounted burglar bars. Windows shall be provided with operable window shades. Security of trailer and contents is a continuous obligation of CONTRACTOR and shall be equipped with local sounding security system.
3. Trailer shall have ample headroom, 8-foot minimum, and shall be lighted, heated, ventilated, and air-conditioned. Provide an electrically chilled bottled water fountain of 5-gallon capacity. Purified water shall be supplied in 5-gallon containers, delivered weekly, with four spares on hand after each re-supply visit.
4. The separate offices shall each be approximately 120 square feet in size and shall be furnished with a minimum of four 120 volt single phase convenience outlets with one

- telephone jack and one data/LAN outlet. The conference room shall be approximately 32 square feet in size and shall be furnished with a minimum of eight single phase convenience outlets with one telephone jack and one data/LAN outlet.
5. CONTRACTOR shall coordinate floor plan and location of electrical, telephone, data outlets with OAR prior to ordering and delivering the trailer.
 6. CONTRACTOR will provide furnishings in the following quantities, to be set in rooms and position as directed by OWNER upon delivery:
 - a. 2 rolling mid-back task chairs, with arms, Global or equal. (Similar to Staples Cat.# 396503)
 - b. 2 double pedestal metal desks, 29 by 72 by 36 inches, HON or equal. (Similar to Staples Cat.# 791368)
 - c. 2 metal bookcases, three shelf, 41 by 34 by 12 inches (Similar to Staples Cat.# 793638)
 - d. 4 resin folding tables, 29 by 30 by 72 inches (Similar to Staples Cat.# 392331)
 - e. 12 padded meeting chairs, Global or equal. (Similar to Staples Cat.# 709501)
 - f. 2 four drawer, legal size lateral files. HON 500 series or equal. (Similar to Staples Cat.# 465245)
 - g. Provide and install 1 "Plan-Hold" wall-mounted 42-inch wide plan racks with 36 individual plan holders each.
 - h. Provide and install 1 large white board in one conference room, 48 by 72 inches (Similar to Staples Cat.# 789834)
 - i. Provide and install 1 large tack board in the other conference room, 48 by 72 inches (Similar to Staples Cat.# 789842)
 7. CONTRACTOR shall provide phone, data transmission lines, related appurtenances, services, and equipment for use by OAR as specified below:
 - a. Provide LAN and phone connectivity to all equipment specified below from the point of connection (POC) to equipment, including, but not limited to all cabling, jacks, patch panel, and patch cables as required to connect all of the equipment listed in this section to the LAN. Cabling shall be CAT 6 or better;
 - b. Provide 2 separate phone lines, one dedicated fax line and 2 phone instruments each with speakerphone, intercom, conference call, flash, redial, call hold and voice mail. Each phone instruments shall have a 4- line or more capacity/selectivity. Provide supporting terminal blocks and any required switch, router, power supplies, and amplifiers.
 - c. Provide business class T1 data service with minimum 1.5 Mbps upload and download (or maximum available, but not less than 1.5 Mbps upload and download),
 - d. Where business class T1 service with minimum 1.5 Mbps upload and download is not available, provide a comparable broadband internet connection such as a Fiber Optic (FIOS) line or business class cable, with the same bandwidth and SLA requirements as the T1 line.
 - e. Provide, install, and maintain the following specified equipment:
 - 1) Cisco 1841 Integrated Services Router capable of providing Internet access. If a Fiber Optic or Cable line is installed, provide Netgear Model FR328SNA, Netgear Cable/DSL ProSafe Firewall Router w/back up port.
 - 2) If number of network connections required exceeds seven, provide a Netgear Model FS108, 8 port 10/100 Mbps fast Ethernet switch, If required connections exceeds fifteen provide a comparable Netgear 10/100 Mbps switch capable of supporting all required connections.
 - f. Provide, install, configure and maintain for network connectivity one **LaserJet 4200TN** Series printer with the following features and accessories:
 - 1) 300 MHz processor;
 - 2) 2 paper trays;
 - 3) 64 MB memory;
 - 4) Network capable
 - 5) 2 spare toner cartridges. Replace as necessary to maintain two spares;

- g. Provide, install, configure and maintain one HP Scanjet 8250 digital scanner, with Hi-Speed USB interface.
- h. Provide HP fax 1220 Fax machine with the following features and accessories:
 - 1) 150 sheet paper tray;
 - 2) 4 mb of memory with 270 pages of out of paper reception;
 - 3) 100 number auto-dial;
 - 4) 2 spare toner cartridges.
- i. Provide one digital copier (Toshiba e-Studio 35, Konica 7035 or equal.) with the following features and accessories:
 - 1) 100 Sheet RADF, lift-top, document feeder;
 - 2) Finisher with collation and one position stapling;
 - 3) Three paper trays integral with the equipment including 8-1/2 by 11-inch, 8-1/2 by 14 and 11 by 17.
 - 4) Additional 550 sheet paper feed pedestal or drawer;
 - 5) 32 MB Image Memory, 20 GB hard disk drive;
 - 6) 35 PPM Digital Imaging, 600 by 600 dpi;
 - 7) Zoom, Reduction and enlargement from 25 percent to 400 percent;
 - 8) Embedded Print Controller with minimum 166 Mhz processor and 10/100 BaseT Network Interface Card;
 - 9) Connect to jobsite LAN and configure as a printer option for all workstations, in addition to the HP4200;
 - 10) Two spare toner cartridges. Replace as necessary to maintain two spares;
 - 11) 24 hour on-call maintenance, including toner and repairs/parts;
- C. CONTRACTOR shall be responsible for maintaining all transmission lines, equipment and related devices. If equipment and/or transmission equipment becomes inoperable and downtime exceeds two days, CONTRACTOR shall replace and/or provide equivalent interim equipment
- D. Trailer, furniture, equipment, and related ancillary devices shall remain property of CONTRACTOR. CONTRACTOR shall remove such property upon Substantial Completion of Work or as otherwise determined in writing by OAR
- E. CONTRACTOR shall employ an experienced and qualified MCSE certified Network Administrator, who shall be responsible to set up and service the LAN equipment and appurtenances provided in OWNER trailer, so as to maintain the equipment in continuous operation. Service response shall be within one day of incident
- F. At CONTRACTOR'S expense and without limitation remove and/or relocate temporary office(s) and related facilities as rapidly as required in order to provide for progress of the Work.
- G. Electronic/office equipment to be new at the commencement of the project
- H. Trailer, furniture, equipment, and related ancillary devices shall remain property of CONTRACTOR
- I. CONTRACTOR shall remove waste bin trash from OAR'S trailer, vacuum OAR'S trailer floors and/or mop OAR'S trailer floors once per week. Provide trailer with bathroom paper goods, soap, broom, mop, door mats etcetera.
- J. Temporary Storage Units:
 - 1. CONTRACTOR shall provide secure and waterproof storage units for the temporary storage of furniture, equipment and other items requiring protection.
 - 2. Walls, roof and doors shall be a minimum of 16-gauge steel with floors of 1 inch tongue and groove hardwood or 3/4 inch minimum exterior type plywood. The undercarriage shall be designed to accommodate forklift blades 42-inch to 60- inch long. There shall be doublewide swing out lockable doors at one end equipped with waterproof gaskets.
 - 3. CONTRACTOR shall be responsible for delivery charges and will install the storage unit in an appropriate area.
 - 4. CONTRACTOR shall remove the storage unit from the Project site when the storage unit is no longer required for the Work or upon Substantial Completion of the Work.

5. CONTRACTOR shall at their expense and without limitation remove and/ or relocate storage units as rapidly as required in order to provide for progress of the Work.

K. Temporary Sanitary Facilities:

1. CONTRACTOR shall provide portable chemical toilet facilities. Quantity of portable chemical toilet facilities shall be based on total number of workers and shall be in accordance with CAUOSHA standards.
2. Portable chemical toilet facilities shall be maintained with adequate supplies and in a clean and sanitary condition and shall be removed from the Project site upon Substantial Completion of the Work. CONTRACTOR shall always keep both OWNER chemical toilet facilities and OWNER trailer restroom clean and operational.
3. CONTRACTOR employees shall not use school toilet facilities.
4. At CONTRACTOR'S expense and without limitation remove and/or relocate portable chemical toilet facilities as rapidly as required in order to provide for progress of the Work.
5. CONTRACTOR will contain their breaks and lunch periods to the areas designated by OAR or any public area outside the Project site. CONTRACTOR shall provide a suitable container within the break/lunch area for the placement of trash. Areas used for break/lunch must be maintained clean and orderly. Once finish flooring has been installed in a particular area, no food or beverages will be permitted in that area.

L. Temporary Security Fence/Barricade:

1. CONTRACTOR shall install temporary Project site security barricade(s) indicated on Drawings or as required for safety and as specified herein. New or used material may be furnished. Security of Project site and contents is a continuous obligation of CONTRACTOR.
2. Unless otherwise indicated or specified, security fence shall be constructed of 8- foot high chain link fencing with a 8-foot high windscreen. Space posts not to exceed ten feet on centers. Posts shall be of following nominal pipe dimensions: terminal, corner, and gatepost 2 Y.-inch, line posts 2-inch. Chain link fence shall be not less than #13 gauge, 2-inch mesh, and in one width. Posts, fence and accessories shall be galvanized and as follows:
 - a. Shall be set in the earth a depth of 30-inch with soil firmly compacted around post, unless required otherwise in writing by OAR.
 - b. Fence fabric shall be attached to posts with #14-gauge tie wire at 16 inches on center. A #6-gauge steel tension wire with turnbuckles shall be installed at top and bottom of barricade fencing. Wire tie fabric to tension wires at 18" centers.
 - c. Windscreen shall be attached to fence fabric and steel tension wires at 18-inch centers with a minimum of #14-gauge tie wire. Windscreen shall be maintained and all rips, tears, missing sections shall be corrected upon notification by OAR.
 - d. Chain link fencing shall be free from barbs, icicles or other projections resulting from galvanizing process. Fence having such defects will be replaced even if it has been installed.
 - e. Gates shall be fabricated of steel pipe with welded corners and bracing as required. Fence and fabric to be attached to frame at 12-inch centers. Provide all gate hardware of a strength and quality to perform satisfactorily until barricade is removed upon Substantial Completion of the Work. Each gate shall have a chain and padlock. Provide two gate keys to OAR. At Substantial Completion of the Work, remove barricade from Project site, backfill and compact fence footing holes. Existing surface paving that is cut into or removed shall be patched and sealed to match surrounding areas.
 - f. At CONTRACTOR'S expense and without limitation remove or relocate fencing, fabric and barricades or other security and protection facilities as rapidly as required in order to provide for progress of the Work.

M. Other Temporary Enclosures and Barricades:

1. Provide lockable, temporary weather-tight enclosures at openings in exterior walls to create acceptable working conditions, to allow for temporary heating and for security.
2. Provide protective barriers around trees, plants and other improvements designated to remain.
3. Temporary partitions shall be installed at all openings where additions connect to existing buildings, and where to protect areas, spaces, property, personnel, students and faculty and

to separate and control dust, debris, noise, access, sight, fire areas, safety and security. Temporary partitions shall be as designated on the Drawings or as specified by ARCHITECT. At CONTRACTOR'S expense and without limitation remove and/or relocate enclosures, barriers and temporary partitions as rapidly as required in order to provide for progress of the Work.

4. Since the Work of this Project may be immediately adjacent to existing occupied structures and vehicular and pedestrian right of ways, CONTRACTOR shall, in his sole judgment and in accordance with applicable safety standards, provide temporary facilities, additional barricades, protection and care to protect existing structures, occupants, property, pedestrians and vehicular traffic. CONTRACTOR is responsible for any damage, which may occur to the property and occupants of the property of OWNER or adjacent private or public properties which in any way results from the acts or neglect of CONTRACTOR.
5. CONTRACTOR shall be responsible for cleaning up all areas adjacent to the construction site which have been affected by the construction; and for restoring them to at least their original condition- including landscaping; planting of trees, sod, and shrubs damaged by construction; and raking and disposal of debris such as roofing shingles, paper, nails, glass sheet metal, bricks, and waste concrete. Construction debris shall be removed and properly disposed of. Culverts and drainage ditches with sediment from the construction area shall be cleared routinely to maintain proper drainage and re-cleaned prior to completion of the contract.
6. CONTRACTOR shall ensure sediment does not block storm drains. CONTRACTOR shall be responsible for cleaning storm drains blocked due to erosion or sediment from the work area.

N. Temporary Storage Yards:

1. CONTRACTOR shall fence and maintain storage yards in an orderly manner.
2. Provide storage units for materials that cannot be stored outside.
3. At CONTRACTOR'S expense and without limitation remove and/or relocate storage yards and units as rapidly as required in order to provide for progress of the Work.

O. Temporary De-watering Facilities and Drainage:

1. For temporary drainage and de-watering facilities and operations not directly associated with construction activities included under individual sections, comply with de-watering requirements of applicable Division 01 sections. CONTRACTOR shall maintain the Work, Project site and related areas free of water.
2. For temporary drainage and de-watering facilities and operations directly associated with new buildings, additions or other construction activities, comply with Divisions 01 and 31 Sections. CONTRACTOR shall be responsible for, but not limited to, de-watering of excavations, trenches and below grade areas of buildings, structures, the Project site and related areas.

P. Temporary Protection Facilities Installation:

1. CONTRACTOR shall not change over from using temporary facilities and controls to permanent facilities until Substantial Completion, except as permitted by OAR
2. Until permanent fire protection needs are supplied and approved by authorities having jurisdiction, CONTRACTOR shall provide, install and maintain temporary fire protection facilities of the types needed in order to adequately protect against fire loss. CONTRACTOR shall adequately supervise welding operations, combustion type temporary heating and similar sources of fire ignition.
3. CONTRACTOR shall provide, install and maintain substantial temporary enclosures of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security. Where materials, tools and equipment are stored within the Work area, CONTRACTOR shall provide secure lock up to protect against vandalism, theft and similar violations of security. OWNER accepts no financial responsibility for loss, damage, vandalism or theft.
4. CONTRACTOR operations shall not block, hinder, impede or otherwise inhibit the use of required exits and/or emergency exits to the public way, except as approved by OAR. CONTRACTOR shall maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fire fighting equipment and/or personnel.

5. With approval of OAR and at the earliest feasible date in each area of the Work, complete installation of the permanent fire protection facilities including connected services and place into operation and use. Instruct OWNER personnel in use of permanent fire protection facilities.
6. In the event of an emergency drill or an actual emergency, designated by the sounding of the fire alarm and/or other sounding device, all construction activities must cease. CONTRACTOR shall evacuate the Work area and remain outside the Work area until permitted to return. No Work shall be conducted during the evacuation of a building or during an emergency.

Q. Temporary Security and Safety Measures:

1. During performance of the Work in existing facilities and/or on a Project Site occupied by students, CONTRACTOR shall provide, install and maintain substantial temporary barriers and/or partitions separating all Work areas from areas occupied by students, faculty and/or administrative staff.
2. During performance of the Work in existing facilities or on a Project site occupied by students and where temporary barriers or partitions are not physically feasible, CONTRACTOR shall provide an employee meeting the requirements of Education Code Section 45125.2.(2) to continually supervise and monitor all employees of CONTRACTOR and Subcontractor. For the purposes of this Section, CONTRACTOR employee shall be someone whom the Department of Justice has ascertained has not been convicted of a violent or serious felony as listed in Penal Code Section 667.5(c) and/or Penal Code Section 1192.7(c). To comply with this Section, CONTRACTOR shall have his employee submit his or her fingerprints to the Department of Justice pursuant to Education Code Section 45125.1(a).
3. Penal Code Sections 290 and 290.4 commonly known as "Megan's Law", require, among other things, individuals convicted of sexually oriented crimes, to register with the chief of police where the convicted individual resides or with a county sheriff or other law enforcement officials. CONTRACTOR shall check its own employees and require each Subcontractor to check its employees and report to CONTRACTOR if any such employees are registered sex offenders. CONTRACTOR shall check monthly during the life of the Contract to ascertain this information and report same to OAR. Before starting the Work, and monthly thereafter during the life of Contract, CONTRACTOR shall notify OWNER in writing if any of its employees and/or if any Subcontractor's employees are a registered sex offender. If so, CONTRACTOR shall proceed in accordance with Section 01 5000.3.03 R.2 above.
4. CONTRACTOR shall employ and maintain sufficient security and safety measures to effectively prevent vandalism, vagrancy, theft, arson, and all other such negative impacts to the Work. Any impacts to the progress of the Work of CONTRACTOR, OWNER, or OWNER'S forces, due to loss from inadequate security, will be the responsibility of CONTRACTOR.

R. Temporary Access Roads and Staging Areas:

1. Due to the limited amount of on and off Project site space for the parking of staff and school visitor's vehicles there will be no parking of CONTRACTOR vehicles in areas designated for school use only. CONTRACTOR shall provide legal access to and maintain CONTRACTOR designated areas for the legal parking, loading, off-loading and delivery of all vehicles associated with the Work.. CONTRACTOR shall be solely responsible for providing and maintaining these requirements whether on or off the Project site. CONTRACTOR shall provide and maintain ample on-site parking spaces designated for the exclusive use of OWNER. CONTRACTOR shall erect signs as required by OWNER each of these spaces and prevent all unauthorized vehicles from parking in the OWNER- reserved spaces.
2. Temporary access roads are to be installed and maintained by CONTRACTOR to all areas of the Project site.
3. CONTRACTOR will be permitted to utilize existing facility campus roads as designated by OAR. CONTRACTOR shall only utilize those entrances and exits as designated by OAR and CONTRACTOR shall observe all traffic regulations of OWNER.
4. CONTRACTOR shall maintain roads and walkways in a clean condition including removal of debris and/or other deleterious material on a daily basis.

3.4 PROJECT SIGNAGE

1. CONTRACTOR shall furnish and install two Project signs on the Project site at a location established by OAR. OAR will provide the information to be posted on the sign. A draft of the proposed sign shall be submitted within 30 days to NTP for OAR to review before fabrication.
- B. Sign construction shall be 10 feet wide by six feet high with six-inch square posts and 1 inch exterior grade plywood, bolted to posts.
- C. Sign lettering shall be painted as indicated on Appendix B, by a professional sign painter, in accordance with details reviewed by ARCHITECT. The following shall be listed on sign:
 1. OWNER- Norwalk- La Mirada Unified School District.
 2. District Office.
 3. Name of NLMUSD School Superintendent.
 4. Name of School Board member from District in which project is located.
 5. Alphabetical listing of other Board Members.
 6. Name of the Architect/Engineer.
 7. Name of Contractor.
 8. Source of funding: "Your School Bond Funds at Work".
- D. No other signs shall be displayed without approval of OAR. At CONTRACTOR'S expense and without limitation remove and/or relocate Project signage and related facilities as rapidly as required in order to provide for progress of the Work.
- E. CONTRACTOR shall remove Project signage at Substantial Completion of the Work.
- F. Until Substantial Completion of the Work, CONTRACTOR shall employ appropriate means to remove all graffiti from buildings, equipment, fences and all other temporary and/or permanent improvements on the Project site within twenty-four (24) hours from the date of report or forty-eight (48) hours of each occurrence.
- G. CONTRACTOR shall provide and install signage to provide directional, identification, and contact information to construction personnel and visitors as follows and as reviewed by OAR.
 1. For construction traffic control/flow at entrances/exits, and as designated by OAR.
 2. To direct visitors.
 3. For construction parking.
 4. To direct deliveries.
 5. For Warning Signs as required.
 6. In accordance with CAUOSHA standards as necessary.
 7. For trailer identification and Project site address.
 8. For "No Smoking" safe work site at designated locations.
 9. Emergency contact information and phone number of CONTRACTOR.
 10. Emergency contact information and phone number of local police, fire, and emergency personnel.
 11. For Labor Compliance Program (LCP) as required under the General Conditions (Prevailing wage rates and Notice of LCP)
 12. Employee benefits payments paid to trust funds are required under the General Conditions.
- H. OWNER has established a program authorizing vendors to post advertisements and billboards along the perimeter of project site. CONTRACTOR shall provide access and shall allow advertising signage to be placed on top of temporary, perimeter, security barricade and/or fences.

3.5 TRENCHES

- A. Open trenches for installation of utility lines (water, gas, electrical and similar utilities) and open pits outside barricaded working areas shall be barricaded at all times in a legal manner determined by CONTRACTOR. Trenches shall be backfilled and patch-paved within twenty-four (24) hours after approval of installation by authorities having jurisdiction or shall have "trench plates" installed. Required access to buildings shall be provided and maintained. CONTRACTOR shall comply with all applicable statutes, codes and regulations regarding trenching and trenching operations. Open

trenches deeper than 3'- 6", and not located within a public street access, shall be enclosed within an 8'-0" high chain-link fence.

3.6 DUST CONTROL

- A. CONTRACTOR is responsible for dust control on and off the Project site. When Work operations produce dust the Project site and/or streets shall be sprinkled with water to minimize the generation of dust. CONTRACTOR shall clean all soils and debris from construction vehicles and cover both earth and debris loads prior to leaving the Project site. CONTRACTOR shall, on a daily basis, clean all streets and/or public improvements within the right of way of any and all debris, dirt, mud and/or other materials attributable to operations of CONTRACTOR.

3.7 WASH OUT

- A. CONTRACTOR shall provide and maintain a minimum of four (4) wash out boxes of sufficient size and strength to provide for concrete mixer wash out. CONTRACTOR shall locate and relocate both the wash out boxes and wash out areas in order to accommodate the progression of the Work. The wash out area shall be located as to minimize the amount of potential run off onto adjacent private and/or public property. CONTRACTOR shall legally dispose of the contents of the wash out boxes and area on an as needed basis or as required by OAR.

3.8 WASTE DISPOSAL

- A. CONTRACTOR shall provide and maintain trash bins on the Project site. Trash bins shall be serviced on an as needed basis and CONTRACTOR is responsible for the transportation of and the legal disposal of all contents.

3.9 ADVERSE WEATHER CONDITIONS

- A. Should warnings of adverse weather conditions such as heavy rain and/or high winds be forecasted, CONTRACTOR shall provide every practical precaution to prevent damage to the Work, Project site and adjacent property. CONTRACTOR precautions shall include, but not be limited to, enclosing all openings, removing and/or securing loose materials, tools, equipment and scaffolding.
- B. CONTRACTOR shall provide and maintain drainage away from buildings and structures.
- C. CONTRACTOR shall implement all required storm water mitigation measures as required under related Division 01 Sections.

3.10 DAILY AND MONTHLY REPORTS

- A. CONTRACTOR shall provide and maintain in the Project site office of CONTRACTOR, a daily sign in sheet for use by all employees of CONTRACTOR and all Subcontractors at whatever tier. At the beginning of each work day, the foreman, project manager, superintendent of CONTRACTOR and/or Subcontractors shall visit the site office of CONTRACTOR and shall enter onto the daily sign in sheet: all employee names; trade classification; and represented company. The completed sign in sheet shall serve as the basis of and shall be submitted with the daily construction report as set forth in Section 101.05.
- B. By the end of each workday, CONTRACTOR shall submit to OAR and INSPECTOR a daily construction report denoting the daily manpower counts and a brief description/location of the workday activities. Manpower shall be broken down by trade classification such as foreman, journeyman or apprentice. The report shall also note the date, day of the week, weather conditions, deliveries, equipment on the Project site whether active and/or idle, visitors, inspections, accidents and unusual events, meetings, stoppages, losses, delays, shortages, strikes, orders and requests of governing agencies, Construction Directive and/or Change Orders received and implemented, services disconnected and/or connected, equipment start up or tests and partial use and/or occupancies. CONTRACTOR shall also include on the daily construction report the above information for all Subcontractors at whatever tier.

3.11 FIELD OFFICE SUPPLIES

- A. CONTRACTOR shall provide the initial supply of field office supplies to OAR in the quantities listed as set forth below in Table A. If specified in **Section 01 2100** - Allowances, CONTRACTOR shall provide additional supplies as required by OAR. CONTRACTOR shall not deduct the costs of the Initial Field Office Supplies (as shown in Table A) from the Allowance for the monthly replenishment of OWNER field office supplies listed in **Section 01 2100- Allowances**. CONTRACTOR shall deliver all of the initial field office supplies to OWNER Field Offices within fourteen days from the date established in the Notice to Proceed.
- B. CONTRACTOR may utilize different suppliers as the specified information is only to establish the required quantities and minimum levels of quality.
- C. Replenishment of Field Office Supplies: If an Allowance is identified in Section 01 2100- Allowances for the periodic replenishment of OWNER field office supplies. OWNER shall submit requests for replenishment of field office supplies to CONTRACTOR from those listed in Table 'A' below. CONTRACTOR shall provide a monthly accounting of items being requested, cumulative cost of replenishment of Field Office supplies previously ordered, and balance of allowance remaining. Upon Substantial Completion of the Work, CONTRACTOR shall file a Change Order Proposal crediting OWNER for any remaining balance or unspent portion of the Allowance. This Allowance specifically excludes the initial supplies listed in Table 'A' below and is to be used exclusively for the monthly replenishment of OWNER field office supplies. Supplies are to be delivered to OWNER'S trailer within twenty-four hours of OWNER'S request.
- D. Postage and Delivery Costs: CONTRACTOR shall provide postage and delivery services for OWNER generated materials in quantities and/or frequencies as requested by OWNER. The cost for these services shall be deducted from the Allowance identified in Section 01 2100 - Allowances. for the periodic replenishment of OWNER field office supplies. This allowance is for the OWNER'S use only. Postage and delivery costs for CONTRACTOR generated materials are the responsibility of the CONTRACTOR and shall not be charged to this allowance, regardless of whether the postage and/or delivery of CONTRACTOR generated materials resulted from a request and/or direction from OWNER.
- E. Other expendable field office support items specified elsewhere, including, but not limited to, furnishing toner cartridges, equipment maintenance, and bottled water, are to be supplied and paid for by CONTRACTOR. These costs are not to be deducted from the Allowance for the periodic replenishment of OWNER field office supplies identified in Section 01 2100.

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Table A

ITEM	DESCRIPTION	UNIT	QUANTITY	SUPPLIER/ITEM NUMBER
Wastebasket	N/A	Each	2	Staples / 125039-54
Surge Strippers	N/A	Each	2	Staples /481841-64
First Aid Kit	N/A	Each	1	Staples / 503979-54
Pencils (blue, green and red)	N/A	12/Lot	1	Staples /441884-64
Pencils	N/A	48/Lot	1	Staples / 711382-54
Pencil Sharpener	1900	1	1	Staples / 330250-54
Wall Calendar	PM233-28	Each	2	Staples / 527861-54
Steno Pad	N/A	12/Lot	1	Staples /163485-64
Post Its	N/A	12/Lot	2	Staples /130005-64
File Folders- 8-1/2 by 11	N/A	50/Lot	2	Staples / 831099-54
Tape / Dispenser	N/A	Each	2	Staples /211540-54
Highlighters	N/A	12/Lot	2	Staples /479156-54
Rubber Bands	N/A	Each	2	Staples /363150-54
Push Pins	N/A	Each	2	Staples / 480118-54
Dry Erase Board	S537	Each	2	Staples / 518928-54
Binder Clip- Medium	N/A	24/Lot	2	Staples / 831602-54
Binder Clip - Large	N/A	12/Lot	2	Staples /831610-54
Stapler	818	Each	2	Staples / 395059-54
Heavy Duty Stapler	415	Each	1	Staples /386312-54
Heavy Duty Staples	SW1-35312	Each	1	Staples /504191-54
Paper Clips	N/A	Each	2	Staples / 480108-54
Broom	N/A	Each	1	Staples / 428881-54
Fire Extinguisher	First Alert	Each	2	Staples / 238774-54
Copy Paper	8-1/2x11	5000/Case	1	Staples / 122374-69
Copy Paper	11 X 17	500/Ream	2	Staples / 238105-69
Hardhats	White	Each	2	Fiber Metal Model E-2
Safety Glasses	Clear and/or Tinted	Each	2	Crews Storm Series
Safety Vests, Zipper	Fluorescent Green	Each	2	Aramak Wearguard Model

END OF SECTION

SECTION 01 74 16

STORM WATER POLLUTION PREVENTION PLAN (FOR SITES WITH LAND DISTURBANCE OF ONE ACRE OR MORE)

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Storm water permitting and certification in compliance with state and local regulations, including payment of application and annual fees and electronic filing, through SMARTS website.
2. Preparation, implementation, upkeep and monitoring of Storm Water Pollution Prevention Plan (SWPPP).
3. Control runoff and pollutants from the site during construction activities.

B. Related Requirements:

1. Division 01 – General Requirements.
2. Section 33 4000 – Storm Drainage Utilities.

1.02 ACRONYMS AND DEFINITIONS

BMP	Best Management Practice.
CAN	Corrective Action Notice.
CASQA	California Stormwater Quality Association.
COI	Change of Information.
DWQ	Division of Water Quality.
CGP	NPDES General Permit for Storm Water Discharges Associated with Construction Activities.
ELAP	Environmental Laboratory Accreditation Program.
LARWQCB	Los Angeles Regional Water Quality Control Board.
LRP	Legally Responsible Person (OWNER).
NOI	Notice of Intent.
NOT	Notice of Termination.
NPDES	National Pollutant Discharge Elimination System.
OEHS	LAUSD Office of Environmental Health and Safety.
PRDs	Permit Registration Documents, including NOI, Risk Assessment, Site Map, SWPPP, Annual Fee, Signed Certification Statements.

REAP	Rain Event Action Plan.
RISK LEVEL	As defined by CGP.
QSD	Qualified SWPPP Developer.
QSP	Qualified SWPPP Practitioner.
QRE	Qualifying Rain Event, is an event that produces 0.5 inches of precipitation with a 48 hour or more period between rain events.
SMARTS	Storm Water Multiple Application and Report Tracking System (smarts.waterboard.ca.gov).
SWPPP	Storm Water Pollution Prevention Plan.
SWRCB	State Water Resources Control Board.
WPCD	Water Pollution Control Drawings.
WDID	Waste Discharge Identification Number.

1.03 SWPPP REQUIREMENTS

- A. CONTRACTOR shall assign a QSD and QSP, who shall be in responsible charge of Work of this Section.
- B. Prior to start of Construction, CONTRACTOR shall:
 1. Submit QSD and QSP qualifications.
 2. Incorporate SWPPP activities into the Project Schedule.
 3. Develop new SWPPP or update SWPPP provided by ARCHITECT to reflect CONTRACTOR's proposed construction staging, phasing, schedule and other construction activities. SWPPP shall be certified by QSD.
 4. Complete the following on the SMARTS website under project application started by OWNER LRP. CONTRACTOR shall provide SMARTS user name to OAR/LRP in order to be linked to the application.
 - a. NOI forms.
 - b. Upload SWPPP certified by QSD.
 - c. Risk Level Calculation.
 - d. Post Construction Water Balance Calculation provided by ARCHITECT (Attachment "B" Section 33 4000).
 5. Inform OAR/LRP to review and certify the NOI application and PRDs on SMARTS at least 10 days prior to soils disturbance.
 6. Submit NOI fee statement along with payment to SWRCB at least 7 days prior to start of construction to obtain a WDID number.
 7. Secure and pay for deposits, permits and inspection fees to the local governing jurisdiction, if needed.
 8. Inform CONTRACTOR and Subcontractors personnel on the BMP procedures to prevent pollutants from entering the storm drain system, before they start construction activities.
- C. During Construction:

1. Implement, install and maintain BMPs. Insure that BMPs are designed to protect all exposed portions of the site.
2. Retain copy of the SWPPP, monitoring records, and PRD on site until Substantial Completion.
3. Conduct and document storm water pollution prevention training of CONTRACTOR site personnel and provide records of training to OAR. See Attachment "D" for sample training log. Keep personnel informed of the SWPPP changes.
4. Monitor the Project Site per the CGP requirements.
 - a. Conduct site inspection of pollution prevention controls and provide Site Monitoring Reports per the CGP and SWPPP. Prepare and maintain, at the Project site, a log of each inspection using Site Monitoring Report forms (Attachment "A", at the end of this Section. Inspections shall include, at a minimum:
 - 1) At least weekly.
 - 2) Within 48 hours prior to a QRE.
 - 3) Within 48 hours after a QRE, conduct a post-storm event inspection to identify whether BMPs are adequately designed, implemented, and effective and identify any additional BMPs necessary and revise the SWPPP accordingly.
 - 4) At least once each 24 hours during extended storm events.
 - 5) Conduct quarterly non-storm water inspections (Attachment "C").
 - b. Conduct sampling and reporting as directed by CGP and outlined in the SWPPP Construction Site Monitoring Plan.
 - c. For Risk Level 2 and 3 sites only, prepare a REAP a minimum of 48 hours prior to a likely precipitation event with over a 50% or greater chance of producing precipitation on the project area.
 - d. Precipitation forecast information shall be obtained from the National Weather Service Forecast Office (<http://www.srh.noaa.gov/>).
5. Participate in quarterly SWPPP inspections with representative from OWNER's OEHS. Correct CAN items issued by OEHS.
6. Non-compliance with the CGP and Unauthorized Discharges shall be reported to OAR immediately, who will notify OEHS.
7. Provide verification annually that construction activities are in compliance with SWPPP. Submit Annual Report Compliance Certification (Attachment "B") to OAR and complete Annual Report on SMARTS by July 15 of each year, for review and certification. Annual Report will be certified by OWNER's LRP.
8. Maintain, Report, and update SWPPP and PRDs on the SMARTS website, including items listed below.
 - a. Upload SWPPP amendments.
 - b. Complete Ad-Hoc Reports for all sampling events. Non-Visible, Effluent Monitoring, and Exceedance Results must be reported electronically by deadlines per CGP.

- c. Provide COI in SMARTS to reflect changes to construction site area, schedule, and risk level. COI shall be submitted to OAR/LRP for certification.
 - 9. Pay annual fees related to the CGP up until the date of Substantial Completion.
 - 10. Pay fines and penalties from regulatory agencies against OWNER due to CONTRACTOR'S non-compliance with storm water regulations. OWNER shall recover costs of fines and penalties by appropriate OWNER assessment. Review of the SWPPP and inspection log by OAR shall not relieve CONTRACTOR from liabilities arising from non-compliance of storm water pollution regulations.
 - 11. Update Post Construction BMP Installation and Maintenance Log and complete Maintenance Plan, provided by ARCHITECT, to reflect 'actual products installed (See Attachment "A" Section 33 4000 Storm Drainage Utilities). Markup Site Plan, Appendix 2 of Attachment "A" of Section 33 4000 to reflect 'As-Built' conditions.
- D. At Substantial Completion:
- 1. Provide SWPPP, Site Monitoring Reports, and record documents to OAR.
 - 2. Handover the maintenance log and maintenance plan to OAR. OWNER will maintain prevention controls left in place.
 - 3. Conduct Post-Construction BMP training of OWNER personnel.
 - 4. Notify OAR to schedule a meeting with OEHS to confirm Substantial Completion of SWPPP.
 - 5. Submit to OAR Substantial Completion Certification that the Project has met all of the conditions of the CGP (Attachment "B"). Post-construction storm water operation and management plan as mentioned in the compliance certifications shall be in place at Substantial Completion.
 - 6. Prepare the final Annual Report and NOT to terminate permit coverage. Submit NOT electronically with required attachments through the SMARTS system. NOT will be certified by the OWNER's LRP.
 - 7. OWNER Maintenance and Operations will maintain prevention controls left in place after CONTRACTOR receives Substantial Completion.
- E. Project Inspector and OEHS Inspector will conduct inspection and examination of the SWPPP.

1.04 SUBMITTALS

- A. Submit the following:
- 1. Qualifications and experience of QSD and QSP for OWNER's review and acceptance.
 - 2. Two electronic copies (CDs) of SWPPP updated and certified by QSD.
 - 3. NOI application to OAR/LRP for review and certification through SMARTS.
 - 4. NOI fee statement along with payment to SWRCB.
 - 5. Documentation in accordance with CGP requirements for SWPPP, including:

- a. BMP material quality, grade, type as specified in the CASQA BMP Handbook.
 - b. Electronic Copies of weekly and quarterly inspections, annual reports, compliance certifications, and test results.
 - c. Proof of filing with the Water Board; copies of PRDs and all attachments.
 - d. Training records of CONTRACTOR site personnel.
 - e. BMP implementation schedule.
 - f. WPCD revisions.
- B. SWPPP Closeout Documents: At Substantial Completion provide one hard copy and two CD's with electronic files of the documents listed below to OAR. OAR will forward records electronically to OWNER Supervising Civil Engineer for retention period of three years.
 - 1. Copy of SWPPP and PRDs, including NOI, Monitoring Program, Inspection Records, Annual Reports, Compliance Certifications, and supporting documents.
 - 2. Updated and signed SWPPP amendments and amendment log.
 - 3. Storm and non-storm water sampling records and test results, including Noncompliance Reports, when limits are exceeded.
 - 4. Training Records for CONTRACTOR and OWNER personnel.
 - 5. Maintenance records for post construction BMP, per Appendix 4 of Attachment "A" of Section 33 4000.
 - 6. Updated Post-Construction Storm Water Management Plan to reflect 'As-Built' conditions.
 - 7. Notice of Termination.
 - 9. Signed Substantial Completion Certification that the Project has met all of the conditions of the CGP.

1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the following requirements:
 - 1. National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Lands Disturbance Activities; ORDER NO. 2009-0009-DWQ; NPDES NO. CAS000002, adopted by the State Water Resources Control Board.
 - 2. Regulations of the California Environmental Protection Agency, State Water Resources Control Board; Los Angeles Regional Water Control Board, and local ordinances.
 - 3. CASQA Stormwater Best Management Practice Handbook for Construction Activity (BMP Handbook), current adopted edition.
- B. Qualifications: CONTRACTOR's QSP/QSD shall meet the following qualifications:
 - 1. Current certification as a CASQA Qualified SWPPP Practitioner/Developer.
 - 2. Two years minimum experience in erosion and sediment control and knowledgeable in the requirements of SWPPP, Best Management Practices and GCP.

1.06 STORAGE AND PROTECTION

- A. Provide proper storage of materials and equipment to prevent rain and storm water runoff to come in contact with pollutants, such as soil stabilizers, paint or fluids from vehicles.

1.07 TRAINING OF OWNER PERSONNEL

- A. Training of Owner's personnel shall include 8 hours of on-site overview and maintenance of the following Post Construction BMPs, if applicable:
 - 1. Bioretention Facilities, Planter Boxes and Proprietary Biotreatment Devices.
 - 2. Vegetated Swales, Vegetated Filter Strips and Green Roofs.
 - 3. Sand Filters and Cartridge Media Filters.
 - 4. Infiltration Trenches, Dry Wells, Proprietary Infiltration Devices and Permeable Pavement.
 - 5. Hydrodynamic Devices and Catch Basin Inserts.
- B. Training of Owner's personnel on the Post Construction BMPs shall be per Section 33 4000, Storm Drainage Utilities.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide quality, grade and type of materials as specified in the CASQA BMP Handbook.
- B. Provide and have available on-site during construction activities a non-stormwater sampling kit suitable for obtaining storm water and non-stormwater quality grab samples. Kit shall include containers and preservatives appropriate for the pollutants known or expected to be in the stormwater. Required sampling equipment shall be adequate to capture and transport samples to a local ELAP State certified water testing lab.
- C. Provide a rain gauge on site to record readings during site inspections.

PART 3 – EXECUTION

3.01 IMPLEMENTATION

- A. Install perimeter controls prior to starting work at the Project site.
- B. Implement BMPs as specified in the SWPPP to contain on-site storm water on the Project site. Provide storm drain inlet protection. Do not drain on-site water directly into the storm drain without proper BMPs in place. If an Active Treatment System (ATS) is used, comply with the design storm specified in the CGP (10-year, 24-hour event)
- C. Prevent pollutant discharges into the storm drain system. Prevent storm water from coming into contact with pollutants, such as material spills, or leakage from storage tanks, waste containers or transfer areas. In the event contamination is found CONTRACTOR shall immediately notify OAR who will contact the OEHS.
- D. Protect exposed dirt, such as stockpiles, landscaping areas, and hillsides.
- E. Properly manage non-storm water discharges such as ground water, broken utility lines and fire hydrant testing per CGP requirements.

- F. Adjust BMP's locations and layouts in accordance to construction progress to assure compliance to regulations.
- G. Conduct inspections of pollution prevention controls and provide Site Monitoring Report to OAR immediately if pollutants are discharged into the site runoffs. CONTRACTOR shall sample and remediate contaminated water.
- H. Upon Substantial Completion: Maintain and leave post-construction storm water pollution prevention controls in place and remove those that are not needed as determined by the QSD and OAR.

3.02 SWPPP CLOSEOUT

- A. Verify the following prior to Substantial Completion of SWPPP:
 - 1. Elements of the SWPPP have been completed.
 - 2. Final stabilization of site, as defined by the GCP, has been demonstrated.
 - 3. There is no potential for construction related storm water pollutants to be discharged into site runoff.
 - 4. Construction related equipment and temporary BMPs have been removed from site.
 - 5. Rubbish, debris, and waste materials have been removed and legally disposed of off the Project site.
 - 6. OEHS CAN items have been closed and signed-off.
 - 7. Post-Construction BMP Maintenance Plan has been established.

END OF SECTION

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging, recycling, and disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Engage a preferred waste hauler that has been evaluated by third-party evaluators and is certified as reporting accurate, transparent, and reliable recovery, use and recycling rates according to the protocols and standards of the Recycling Certification Institute. Please refer to <https://www.recyclingcertification.org/certified-facilities/> for more information.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to University's Representative.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

- A. Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of a minimum of five (5) materials, including, but not limited to, the following:
 - 1. Demolition Waste:
 - a. Asphalt paving.
 - b. Concrete.
 - c. Concrete reinforcing steel.
 - d. Brick.
 - e. Concrete masonry units.
 - f. Wood studs.
 - g. Wood joists.
 - h. Plywood and oriented strand board.
 - i. Wood paneling.
 - j. Wood trim.
 - k. Structural and miscellaneous steel.
 - l. Rough hardware.
 - m. Roofing.
 - n. Insulation.

- o. Doors and frames.
- p. Door hardware.
- q. Windows.
- r. Glazing.
- s. Metal studs.
- t. Gypsum board.
- u. Acoustical tile and panels.
- v. Carpet.
- w. Carpet pad.
- x. Demountable partitions.
- y. Equipment.
- z. Cabinets.
- aa. Plumbing fixtures.
- bb. Piping.
- cc. Supports and hangers.
- dd. Valves.
- ee. Sprinklers.
- ff. Mechanical equipment.
- gg. Refrigerants.
- hh. Electrical conduit.
- ii. Copper wiring.
- jj. Lighting fixtures.
- kk. Lamps.
- ll. Ballasts.
- mm. Electrical devices.
- nn. Switchgear and panelboards.
- oo. Transformers

2. Construction Waste:

- a. Masonry and CMU.
- b. Lumber.
- c. Wood sheet materials.
- d. Wood trim.
- e. Metals.
- f. Roofing.
- g. Insulation.
- h. Carpet and pad.
- i. Gypsum board.
- j. Piping.
- k. Electrical conduit.
- l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Plastic pails.

1.4 SUBMITTALS

- A. Waste Management Plan: Submit plan within 15 days of date established for commencement of the Work.
- B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
 - 1. Material category.

2. Generation point of waste.
 3. Total quantity of waste to landfill, in tons.
 4. Quantity of actual waste salvaged, recycled or recovered in tons.
 5. Total quantity of waste diverted (salvaged plus recycled) as a percentage of total waste.
- C. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- D. Records of Donations and Sales: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations, or sold to individuals / organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of University's Representative.
- B. Waste Management Meeting: Conduct onsite meeting and review methods and procedures related to waste management including, but not limited to, the following:
1. Review and discuss waste management plan including responsibilities of waste management coordinator.
 2. Review requirements for documenting quantities of each type of waste and its disposition.
 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 5. Review waste management requirements for each trade.

1.5 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall include the following:
1. Waste Identification: Indicate anticipated (a minimum of) five (5) types and quantities of demolition and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
 2. Waste diversion goals for the project: estimate an approximate percentage of the overall project waste these materials represent.
 3. Management strategies identifying whether these materials will be separated or commingled, and describe the diversion strategies for these materials
 4. Identify hauler and final disposal site by facility name and address, including site coordinator.
- B. Waste Diversion Strategies: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.

2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. General: Implement approved Waste Management Plan.
 1. Establish on-site infrastructure, practices, and policies for on-site sorting, and develop a tracking system, as applicable.
 2. Identify at least five material streams that will be diverted.
 3. Track all the construction and demolition waste leaving the site.
 4. Retain waste hauler reports for documentation.
 5. Record weight or volume of materials that are reused on site or salvaged for reuse on other projects by subcontractors or vendors.
 6. Retain receipts and estimate weight or volume of materials donated to charities, reuse retailers, or other recipients that can verify and track incoming and outgoing materials.
 7. Furnish handling, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 8. Comply with operation, termination, and removal requirements in Section 015100 "Temporary Utilities".
 9. Furnish a final report detailing all major waste
 - a. Alternative daily cover (ADC) does not qualify as material diverted from disposal. Land-clearing debris is not considered construction, demolition, or renovation waste that can contribute to waste diversion.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 015100 "Temporary Utilities" for controlling dust and dirt, environmental protection, and noise control.

3.2 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to University's Representative.
 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Burning: Burning of waste materials is permitted only at designated areas on University's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.
- D. Disposal: Remove waste materials and dispose of at designated spoil areas on University's property.
- E. Disposal: Remove waste materials from University's property and legally dispose of them.

END OF SECTION

DIVISION 02

EXISTING CONDITIONS

SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Demolition, dismantling and cutting of existing building and site improvements as indicated, specified, and necessary for the completion of the Contract.
2. Capping active utilities.
3. Removing inactive utilities.
4. Protective measures.
5. Removing demolished materials from the site.

B. Related requirements:

1. Section 01 74 19 Construction Waste Management and Disposal.
2. Section 31 10 00 Site Clearing.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and Sequencing:

B. Pre-Installation Meeting: See Section 01 31 00 Project Management and Coordination for meeting requirements.

1.3 SUBMITTALS

A. Waste management Plan: See Section 01 74 19 and submit to authorities having jurisdiction.

B. Record documents: At completion of this work, submit record documents showing the actual, dimensioned locations of capped utilities referenced to permanent features surrounding the site.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 GENERAL

1. Protection: Do not begin demolition until temporary barricades, warning signs and other forms of protection are installed.
 - a. Protect trees, plants, utilities and existing improvements not to be removed from injury or damage resulting from the Contractor's operation. Replace damaged improvements and utilities in kind at no cost to the Owner.
 - b. Provide all safeguards, including warning signs and lights, barricades, and the like, for protection of the public, Contractor's employees and adjacent property during demolition.
2. Noise control: Exercise caution and care to prevent generation of unnecessary noise. Keep noise levels to the minimum possible.
3. Dust control: Control dust by frequent sprinkling with water or other methods acceptable to the Architect. Assume liability for all claims related to flying dust.
4. Water control: Control the use of water to prevent damage to the existing facilities and site improvements to remain.

5. Drainage: Prevent debris from blocking items including, but not limited to, surface drainage inlets and systems, which must remain in operation.

3.2 PREPARATION

- A. Mark location of utilities.
- B. Shut-off, disconnect, cap-off and seal plumbing, mechanical, and electrical services, in accordance with the requirements of the authorities having jurisdiction, before starting deconstruction. Place markers to indicate location of disconnected services. Identify service lines and capping on record drawings.

3.3 EXISTING CONDITIONS

- A. Intent of Drawings and other reference documents is to show existing conditions with information developed from field surveys and to generally show the extent and type of demolition required.
- B. Make a detailed survey of existing conditions prior to commencing demolition, and report discrepancies or conflicts between Drawings and actual conditions in writing to the Architect for clarifications and instructions.
- C. Do not proceed where such conflicts or discrepancies occur prior to receipt of Architect's instructions.

3.4 DEMOLITION

- A. Perform demolition in a systematic manner. Use such methods as required to complete work in compliance with governing regulations.
- B. Where applicable, such as in public right-of-way, remove existing construction only to the extent indicated or necessary for installation of new construction and junction with existing materials.
- C. Cut back finished surfaces to straight, plumb or level lines as required.

3.5 PATCHING

- A. Patch materials to remain when damaged by demolition at no cost to the Owner.
- B. Finish material and appearance of the patch or repair shall match the existing contiguous materials and finishes in all respects, as approved by the Architect.

3.6 TITLE TO MATERIALS

- A. Except where indicated or specified otherwise, materials and equipment removed shall become the property of the Contractor and shall be removed from the site.
- B. The Owner will not be responsible for the condition or loss of, or damage to, such property after Notice to Proceed.
- C. Material and equipment shall not be viewed by prospective purchasers or sold on the site.

3.7 CLEAN-UP/DISPOSAL

- A. Debris, waste, and removed materials are Contractor's property for legal disposal off the site.
- B. Continuously clean-up and remove these items and do not allow to accumulate on or adjacent to the site. Refer to Section 01 74 19 for additional requirements on this subject.

END OF SECTION

DIVISION 03

CONCRETE

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement.

1.3 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.
- C. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.
- D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

1.4 QUALITY ASSURANCE

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

1.5 PRECONSTRUCTION TESTING

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

1.6 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1.
 - 1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301.
 - 2. ACI 117.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- D. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.
- E. Galvanized-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from galvanized-steel wire into flat sheets.
- F. 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."

2.4 CONCRETE MATERIALS

A. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, Type II or Type V.
2. Fly Ash: ASTM C 618, Class F.

B. Normal-Weight Aggregates: ASTM C 33/C 33M, graded.

1. Maximum Coarse-Aggregate Size: As noted on plans.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Air-Entraining Admixture: ASTM C 260/C 260M.

D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

E. Water: ASTM C 94/C 94M and potable.

2.5 VAPOR RETARDERS

A. Refer to Section 07 26 00.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering].

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering].

- H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.

2.8 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).
- B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Normal-Weight Concrete:
 - 1. Minimum Compressive Strength: As indicated at 28 days on structural drawings.
 - 2. Maximum W/C Ratio: As indicated on structural drawings.
 - 3. Slump Limit: 4 inches plus or minus 1 inch.

2.10 FABRICATING REINFORCEMENT

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

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- 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. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 FORMWORK REMOVAL

- A. Forms shall not be removed until concrete has sufficiently hydrated to maintain its integrity and not be damaged by form removal operations. Unless noted otherwise, forms shall not be removed in less than five days. In no case shall shoring be removed until member has acquired sufficient strength to support its weight, load upon it, and added load of construction.

3.3 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.4 VAPOR-RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.5 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
 - 2. Reinforcement shall be bent cold prior to placement.

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.
- 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. 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 wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3.8 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.9 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. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
1. Apply scratch finish to surfaces indicated
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system
 2. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 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 lbs/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. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. 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.
 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, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 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.

3.12 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION 033000

DIVISION 04

MASONRY

CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Reinforcing steel.
3. Mortar, grout and grouting.
4. Bolts, anchors, hardware, metal frames, and other insert items.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 45 23 - Testing and Inspection.
3. Section 03 30 00 - Cast-In-Place Concrete.
4. Section 05 10 00 - Structural Steel Framing.
5. Section 08 1113 - Hollow Metal Doors and Frames.

1.2 REFERENCES

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

1. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
2. ASTM C90 - Standard Specification for Load Bearing Concrete Masonry Units.
3. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
4. ASTM C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
5. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
8. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
9. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
10. ASTM C426 - Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.
11. ASTM C476 - Standard Specification for Grout for Masonry.
12. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
13. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.
14. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
15. ASTM C1586 - Standard Guide for Quality Assurance of Mortars.

B. Masonry Standards Joint Committee (MSJC), the Masonry Society (TMS), American Concrete Institute (ACI) and American Society of Civil Engineers (ASCE).

1. TMS 602/ACI 530.1/ASCE 6 - Specification for Masonry Structures.
2. TMS 402/ACI 530/ASCE 5 - Building Code Requirements for Masonry Structures.

1.3 SUBMITTALS

A. Mix Design: Submit grout and mortar mix designs. Mix designs shall be signed and sealed by a Civil or Structural Engineer registered in the State of California.

- B. Product Data: Submit manufacturer's Product Data for assembly components, materials, and accessories. Submit certificates and data assuring that the proposed materials meet the specified ASTM standards.
- C. Samples: Submit Samples for each type of required masonry unit, including reinforcement and accessories.
- D. Shop Drawings: Indicate wall reinforcement, splice locations and bending diagrams.
- E. Admixtures: Additives and admixtures to mortar and grout shall not be used unless approved by the enforcing agency. Submit product data for any proposed admixture.

1.4 REGULATORY REQUIREMENTS

- A. Perform the Work in accordance with CBC, Chapter 21A.
- B. Comply with requirements of TMS 602.

1.5 QUALITY ASSURANCE

- A. Comply with the requirements of Section 01 45 23 - Testing and Inspection.
- B. Concrete Masonry Units:
 - 1. Notify the testing laboratory a minimum of 45 days in advance of installing concrete unit masonry, to allow for preconstruction testing of the units.
 - a. Units will be sampled and tested in accordance with ASTM C140 for compressive strength, absorption and moisture content.
 - b. Units will be sampled and tested in accordance with ASTM C426 for linear drying shrinkage.
 - 2. The material testing laboratory shall receive concrete masonry unit specimens for testing from masonry unit manufacturer. Number of specimens shall be as indicated in referenced ASTM standard tests. Testing laboratory will perform and send test results to the ARCHITECT and Project Inspector.
- C. Portland Cement: Submit certification from the cement manufacturer that the cement proposed for use on the project has been manufactured in accordance with ASTM C150. Certification shall include test results made on cement samples during production.
- D. Mortar and Grout Tests: Prior to the beginning of masonry work, mortar and grout will be tested, unless prism tests will be performed as indicated below.
 - 1. Mortar: Shall conform to ASTM C270 Table 2 for Type S mortar.
 - a. Provide qualifications of mortar as meeting ASTM C270 at the beginning of the job and whenever mix design is changed.
 - b. Mortars will be evaluated during preconstruction and tested during construction for proportioning or compressive strength in accordance to ASTM C780.
 - 2. Grout: Shall conform to ASTM C476, and will be tested in accordance with ASTM C1019. Compressive strength shall equal or exceed specified compressive strength (f_m) at 28 days, but not less than 2,000 psi.
 - a. Ready-Mix Grout: Grout manufacturer shall furnish batch ticket information in accordance to ASTM C94.
- E. Prism Test: The compressive strength of concrete masonry will be determined by the prism test method prior to the start of construction and during construction.
- F. Masonry Core Testing: Core testing will be performed in accordance with CBC, Section 2105A.4.

- G. Inspection During Installation: A special inspector will continuously observe the installation of reinforced masonry. The Project Inspector shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.
 - H. OWNER will be responsible for the costs of original tests and inspection
- 1.6 DELIVERY, STORAGE AND HANDLING
- A. Store units above grade on level platforms or pallets, in a dry location.
 - B. Store cementitious materials and aggregates in such a manner as to prevent deterioration or intrusion of foreign matter or moisture.
 - C. Handle units on pallets or flat bed barrows. Free discharge from conveyor units or transportation in mortar trays is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete Unit Masonry: Modular **medium** weight conforming to ASTM C90, hollow load-bearing concrete unit masonry. Masonry units shall meet the minimum compressive strength requirements of ASTM C90, or as indicated on project drawings, whichever is greater.
 - 1. Concrete masonry unit sizes shall be as indicated on the drawings.
 - 2. Provide open-end units at walls to be fully grouted.
 - 3. Provide closed-end units at walls and at openings where ends will be exposed in finish Work; provide bond beam blocks where horizontal reinforcement is indicated.
 - 4. Provide special shapes and accessory units at locations indicated on Drawings.
 - 5. Provide units in colors and textures as indicated in the drawings.
 - 6. Masonry unit shall have been cured for a minimum of 28 days.
 - 7. Masonry unit shall have maximum liner shrinkage of 0.065 percent from saturated to oven dry.
- B. Portland Cement: ASTM C150, Type II, from one source.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Aggregates: ASTM C144 for mortar and ASTM C404 for grout.
- E. Mortar: ASTM C270, Type S, conforming to the property specifications of CBC Table 2103A.8 (2).
- F. Grout: ASTM C476.
- G. Admixture for Grout: Grout Aid, as manufactured by Sika Chemical Corp., or equal.
- H. Water: Clean, potable, free from substances deleterious to mortar, grout or reinforcement.
- I. Reinforcing Steel: Provide and install reinforcing steel in accordance with Section 03 2000 - Concrete Reinforcing.
- J. Cleaning Materials: S
- K. Pure Klean No. 600 detergent by ProSoCo.

- L. Miscellaneous Materials: As required to complete the Work.
- M. Anchor Bolts: Shall be hex headed bolts conforming to ASTM A307 Grade A with the dimensions of the hex head conforming to ANSI/ASME B18.2.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Discard units with cracks or other defects not complying with requirements of ASTM C 90.

3.2 CONSTRUCTION

- A. Construct per applicable provisions of CBC and TMS 602.
- B. Conform to TMS 602 for hot and cold weather masonry construction.

3.3 MORTAR AND GROUT MIXING

- A. Mortar: Shall provide a minimum strength of 1,800 psi.
- B. Grout: Shall provide a minimum strength of 2,500 psi or as indicated in the drawings, whichever is higher. Grout space requirements for coarse and fine grouts shall be per Table 7 of TMS 602. Add Sika Chemical Corp. Grout Aid per manufacturer's instructions.
- C. Measurements: Measure in calibrated devices that can be checked at any time.
 - 1. Add water for workable consistency.
 - 2. Shovel measurements are not permitted.
- D. Mixing: Mix in accordance to TMS 602.
 - 1. Mortar: Mix cementitious materials and aggregates between three and five minutes in a mechanically operated mixer. Mix dry ingredients with a sufficient amount of water to provide a workable mix. Batches of less than one sack of cement, and fractional sack batches are not permitted.
 - 2. Factory Blended Mortar: Mix in accordance with manufacturer's recommendations.
 - 3. Grout: Add sufficient water for a workable mix that will flow into all voids of the masonry without separation or segregation. Grout slump shall be between 8 and 11 inches.
- E. Re-tempering Time Limit: Use mortar within 2 ½ hours after mixing. Discard any mortar that has been mixed longer or that has begun to set. If necessary re-temper within this time limit, by replacing only water lost due to evaporation and by thoroughly remixing.

3.4 INSTALLATION OF MASONRY UNITS

- A. Workmanship: Install masonry plumb and true to line with straight level joints of uniform thickness. Comply with TMS 602 tolerances. Maintain masonry clean during and after installation.
 - 1. Lay-out and incorporate embedded hardware items.
 - 2. Assist other trades with built-in items, which require cutting and fitting of masonry.
 - 3. Cut block units with a diamond saw or carborundum wheel. Trowel or chisel cutting is not permitted.
 - 4. Keep cavities clear of droppings and debris. Remove droppings prior to grouting.
- B. Reinforcing Steel: Install as indicated on Drawings. Except as otherwise indicated, install reinforcement in accordance with standards of Concrete Reinforcing Steel Institute and to

requirements specified in Section 03 2000 - Concrete Reinforcing. Do not splice vertical reinforcement except where indicated on the Drawings.

- C. Shoring: Provide temporary shoring for lintels with sufficient strength to carry load without deflecting. Remove temporary shoring not less than 28 days after masonry has been installed.
- D. Block Installation: Clean dirt and dust from surfaces before installation. Do not wet masonry units.
 - 1. Foundation preparation: Clean top surface of concrete foundation of dirt, projections and laitance before starting masonry construction. Wet saw cutting of units immediately prior to laying is permitted.
 - 2. Install masonry with mortar to required joint thickness. Install blocks with 3/8-inch mortar bed. Fill head joints solid, install tightly to adjoining units. Provide 3/8-inch joint thickness.
 - a. Hold racking to a minimum.
 - b. No toothing is permitted.
 - c. If it becomes necessary to move a unit after it has been installed, remove the unit, discard the mortar, and install the unit in fresh mortar.
 - 3. Anchor Bolts: Provide 1/2-inch minimum grout space between bolts and masonry.
 - 4. Bond: Unless otherwise indicated, install units in common running bond.
 - 5. Finish Joint Treatment: Unless otherwise indicated, cut both interior and exterior joints flush, and tool slightly concave to a dense, uniform surface.
 - 6. Grouting: Unless noted otherwise on Drawings, completely fill cells with grout.
- E. Steel Door Frames:
 - 1. Locate door frames accurately, install plumb, Set frames to floor with powder driven or expansion anchors to floor surface and brace in position before start of masonry installation.
 - a. Frames are specified to be furnished with adjustable anchors.
 - b. Fill interior of frames solid with mortar or grout as walls are constructed.
 - 2. Provide temporary wood spreaders from jamb to jamb and from head to floor to ensure that jambs do not bow-in, distort from a straight line, or deflect from superimposed loads during construction.

3.5 GROUTING

- A. Prior to grouting all cells shall be cleaned so that all spaces to be filled with grout do not contain mortar projections greater than 1/4 inch, loose mortar or foreign material.
- B. Grout materials and water contents shall be controlled to provide adequate fluidity for placement without segregation of the constituents and shall be mixed thoroughly. Reinforcement shall be properly positioned and solidly embedded in the grout.
- C. The grouting of any section of wall shall be completed in one day with no interruptions greater than one hour.
- D. Between grout pours, a horizontal control joint shall be formed by stopping all wythes at the same elevation and with the grout stopping at 1 ½ inches below a mortar joint, except at the top of the wall. Where bond beams occur, the grout pour shall be stopped a minimum of ½ inch below the top of the masonry.

3.6 LOW-LIFT GROUTING FOR HOLLOW MASONRY UNITS

- A. Grouting shall meet the requirements of CBC Section 2104A.1.3.

- B. After mortar joints have set, cells are cleaned of mortar and debris, and reinforcement is installed and inspected, grout cells in 4-foot maximum lifts. Horizontal and vertical reinforcement shall be held in place within permitted tolerances by suitable devices.
- C. Grout may be installed by pump, tremie or bucket, using hoppers to avoid spilling on exposed surfaces.
- D. All grout shall be consolidated and reconsolidated with a mechanical vibrator after placing so as to completely fill all voids and to consolidate the grout. Grouted walls shall be solid and without voids.

3.7 HIGH-LIFT GROUTING OPTION FOR HOLLOW MASONRY UNITS

- A. Grouting shall meet the requirements of CBC Section 2104A.1.3 and DSA IR 21-2.
- B. High-lift grouting shall apply only to cell sizes available with 8 inch and wider block units. This method is subject to approval of the Division of the State Architect (DSA).
- C. Provide bond beam units, inverted for start course, and omit alternate blocks or remove entire face shell of every other unit to allow access to all cells on bottom course for cleanouts.
- D. Plug each cleanout by setting a face shell in mortar into opening and securely bracing it in place to prevent displacement. If masonry is not exposed in finish Work, cleanouts may be formed.
- E. Grouting: Grouting shall be done in a continuous pour in lifts not exceeding 8-foot in height. The grouting of any section of a wall between control barriers shall be completed in one day, with no interruptions greater than one hour.
- F. Consolidating: Grout shall be consolidated by mechanical vibration only and shall be reconsolidated after excess moisture has been absorbed, but before plasticity is lost. Vibrating of reinforcing steel is not permitted.

3.8 CURING

- A. Remove efflorescence, stains, debris, excess grout, and foreign matter.
- B. During curing, or for any other purpose, do not saturate masonry with water.

3.9 PARGE COAT

- A. Apply parge coat to the earth side of surfaces that are to receive waterproofing.
- B. A Portland cement and sand mix (1:3.5 by volume) or Type S mortar may be used for the parge coat.
- C. Parging should be applied to damp (not saturated) concrete masonry in two 1/4 inch thick layers. The first coat should be roughened when partially set, hardened for 24 hours, and then moistened before second coat is applied. The second coat should be trowelled to a smooth, dense surface.
- D. The parge coat should be beveled at the top to form a wash and thickened at the bottom to form a cove between the base of the wall and the top of footing.

3.10 CLEANING

- A. At completion of masonry Work, remove misplaced mortar, grout or other foreign substances, and clean surfaces which will be exposed in finish Work with specified cleaner, or with clean water and stiff fiber brushes.

- B. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.11 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

DIVISION 05

METALS

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Architecturally exposed structural steel.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 01 4523 - Testing and Inspection.
 - 3. Section 03 3000 - Cast-In-Place Concrete.
 - 4. Section 04 2200 - Concrete Unit Masonry.
 - 5. Section 05 0513 – Hot-Dip Galvanizing.
 - 6. Section 05 1000 – Metal Stairs and Railings.
 - 7. Section 05 3000 - Metal Decking.
 - 8. Section 05 5000 - Metal Fabrications.
 - 9. Section 07 8116 - Cementitious Fireproofing.
 - 10. Section 09 9000 - Paints and Coatings.

1.02 REFERENCES

- A. CBC Chapter 22A.
- B. American Institute of Steel Construction (AISC):
 - 1. AISC – Steel Construction Manual:
 - a. AISC 360 Specifications for Structural Steel Buildings.
 - b. AISC Code of Standard Practice for Steel Buildings and Bridges.
 - c. RCSC Specification for Structural Joints Using High Strength Bolts.
 - 2. AISC 341 - Seismic Provisions for Structural Steel Buildings.
 - 3. AISC 358 - Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications.
- C. ASTM International (ASTM):
 - 1. ASTM A36 – Standard Specification for Carbon Structural Steel.
 - 2. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 3. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - 4. ASTM A123 – Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
 - 5. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 6. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60000 PSI Tensile Strength.
 - 7. ASTM A435 - Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates.

8. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
9. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
10. ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
11. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
12. ASTM A673 - Standard Specification for Sampling Procedure for Impact Testing of Structural Steel.
13. ASTM A992 – Standard Specification for Structural Steel Shapes.
14. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
15. ASTM E23 - Standard Test Methods for Notched Bar Impact Testing of Metallic Materials.
16. ASTM E112 - Standard Test Methods for Determining Average Grain Size.
17. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
18. ASTM F436 – Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
19. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series.
20. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-Ksi Yield Strength.
21. ASTM F1852 – Standard Specification for Twist Off Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

D. American Welding Society (AWS):

1. AWS D1.1 – Structural Welding Code - Steel.
2. AWS D1.8 – Structural Welding Code – Seismic Supplement.
3. AWS A2.4 – Standard Symbols for Welding, Brazing, and Nondestructive Examination.
4. AWS B2.1 – Base Metal Grouping for Welding Procedure and Performance Qualification.

E. SSPC – Steel Structures Painting Council:

1. SSPC-SP2 - Hand Tool Cleaning.
2. SSPC-PA-1 - Shop, Field and Maintenance Coating of Metals.

1.03 REGULATORY REQUIREMENTS

- A. Structural steel shall conform to CBC requirements, except that steel manufactured by acid Bessemer process is not permitted for structural purposes.
- B. Sheet and strip steel other than those listed in CBC, if provided for structural purpose, shall comply with DSA requirements.

1.04 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings, including complete details and schedules for fabrication and shop assembly of members, and details, schedules, procedures and diagrams showing the sequence of erection. Fully detail minor connections and fastenings not shown or specified in the Contract Documents to meet required conditions using similar detailing as shown in the Contract Documents. Include a fully detailed, well controlled sequence and technique plan for shop and field welding that minimizes locked in stresses and distortion; submit sequence and technique plan for review by the ARCHITECT.

1. Include details of cuts, connections, camber, and holes in accordance with Figure 4.5 of AWS D1.1 or AISC Chapter J, weld position plan and other pertinent data. Indicate welds by standard AWS symbols, and show size, length and type of each weld.
 2. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed for Work specified in other sections.
 3. Erection and Bracing Plan and Erection Procedure: Submit an erection and framing plan, including columns, beams, and girders, signed and sealed by a Structural or Civil Engineer registered in the State of California in accordance with Title 8 California Code of Regulations, Section 1710, Structural Steel Erection. Maintain a copy at the Project site as required by the California Division of Industrial Safety.
 4. Submit a list of steel items to be galvanized.
 5. Include identification and details of Architecturally Exposed Structural Steel (AESS) members, if applicable.
- B. Product Data: Submit copies of fabricator's specifications and installation instructions for the following products. Include laboratory test reports and other data required demonstrating compliance with these Specifications:
1. Structural steel, each type; including certified copies of mill reports covering chemical and physical properties.
 2. Welding electrodes.
 3. Welding gas.
 4. Unfinished bolts and nuts.
 5. Structural steel primer paint.
 6. High-strength bolts, including nuts and washers.
- C. Manufacturer's Mill Certificate: Submit, certifying that products meet or exceed specified requirements.
- D. Mill Test Reports: Submit manufacturer's certificates, indicating structural yield and tensile strength, destructive and non-destructive test analysis.
1. Charpy-V-Notch (CVN) Impact Test for Base Metal: Moment frame columns and girders subjected to Charpy-V-Notch impact test in accordance with "Seismic Provisions for Structural Steel Buildings", Part I, Section 6.3, as modified by Supplement 1.
 2. Charpy-V-Notch test shall be performed by the manufacturer employing Test Frequency (P) in accordance with ASTM A673 and utilizing standard specimen sizes shown in Figure 6 of ASTM E23.
- E. Submit certified copies of tests by manufacturer for fine grain practice. Structural steel base material, as described above, shall be manufactured to be fully killed and fine grained having grain size number 5 or better as determined by ASTM E112.
- F. Welding Procedure Specifications (WPS): Submit weld procedures for all welding on project to OWNER's testing laboratory for approval. After approval by testing laboratory, submit to ARCHITECT for Record. Weld procedures shall be qualified as described in AWS D1.5, AISC 341 and AISC 358, as applicable. Weld procedures shall indicate joints details and tolerances, preheat and interpass temperature, post-heat treatment, single or multiple stringer passes, peening of stringer passes for groove welds except for the first and the last pass, electrode type and size, welding current, polarity and amperes and root treatment. The welding variables for each stringer pass shall be recorded and averaged; from these averages the weld heat input shall be calculated. Submit the manufacturer's product data sheet for all welding material used.
- G. Welder's Certificates: Field welders shall be Project certified in accordance with AWS D1.1 Shop welders shall be Project certified for FCAW in accordance with AWS D1.1.
- H. Test Reports: Submit reports of tests conducted on shop and field welded and bolted connections. Include data on type of test conducted and test results.

- I. Welding Material Certification: Provide certificate that welding material complies with specifications. Submit to OWNER's testing laboratory.

1.05 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement, except as otherwise indicated:
 - 1. American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges, modified as follows:
 - 2.
 - a. Replace "Structural Design Drawings" with "Contract Documents" throughout the document.
 - b. Paragraph 3.2 is hereby modified in its entirety as follows: "Contract Documents including but not limited to architectural, mechanical, plumbing, electrical, civil and kitchen design drawings and specifications shall be used as supplement to the structural plans to define configurations and construction information."
 - c. Delete Paragraph 3.3.
 - d. In Paragraph 4.4, delete the following sentence: "These drawings shall be returned to the Fabricator within 14 calendar days."
 - e. Delete Paragraph 4.4.1.(a) in its entirety.
 - f. Paragraph 4.4.2 is hereby modified in its entirety as follows: "No review action, implicit or explicit, shall be interpreted to authorize changes in the Contract Documents."
 - 3. Perform welding in accordance with AWS Standards, AWS D1.1, and California Building Code Section 2204A.1 and approved Weld Procedure Specifications (WPS).
- B. Shop fabrication shall be inspected in accordance with CBC.
- C. Erect mock-up panel of fabricated structural steel meeting Architecturally Exposed Structural Steel (AESS) tolerances for exposed areas. Approval by ARCHITECT is required. Mock-up to remain for comparison but may not be left as part of the work.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store structural steel above grade on platforms, skids or other supports.
- B. Protect steel from corrosion.
- C. Store welding electrodes in accordance with AWS D 12.1.
- D. Store other materials in a weather-tight and dry place until installed into the Work.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Stock Materials: Provide exact materials, sections, shapes, thickness, sizes, weights, and details of construction indicated on Drawings. Changes because of material stock or shop practices will be considered if net area of shape or section is not reduced thereby, if material and structural properties are at least equivalent, and if overall dimensions are not exceeded.
- B. Shapes, bars, plates, tubes and pipes shall be made of materials with at least 16 percent recycled content if produced from Basic Oxygen Furnace (BOF) or at least 67 percent recycled content if produced from Electric Arc Furnace (EAF).

2.02 MATERIALS

- A. Structural Steel: Wide flange shapes shall conform to ASTM A992 grade 50. Other steel shall conform to ASTM A36 or as indicated on the drawings.
- B. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular low carbon bolts and nuts.
- C. High-Strength Threaded Fasteners: ASTM A193 or ASTM F959 quenched and tempered, steel bolts, nuts and washers.
- D. Primers: Lead-free metal primer:
 - 1. SSPC-Paint 20, Zinc-Rich Coating Inorganic and Organic.
 - 2. SSPC-Paint 23, Latex Primer for Steel Surfaces.
- E. Steel Pipe: ASTM A53, Type E or S, Grade B.
- F. Structural Tubing:
 - 1. Cold-formed, ASTM A500, Grade B.
- G. Galvanizing: ASTM A123.
- H. Shear stud connectors: ASTM A108, Grade 1015 forged steel, headed, uncoated, granular flux filled shear connector or anchor studs by Nelson Stud Welding Division, or equal.
- I. Grout: ASTM C1107, non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing a minimum compressive strength of 7,000 psi at seven days; of consistency suitable for application and a 30-minute working time.
- J. Anchor Rods and Bolts: ASTM F1554

2.03 FABRICATION

- A. Fabricate in accordance to AISC Code of Standard Practice for Steel Buildings and Bridges and AISC 360.
- B. Cleaning and Straightening Materials: Materials being fabricated shall be thoroughly cleaned of scale and rust and straightened before fabrication. Cleaning and straightening methods shall not damage material. After punching or fabrication of component parts of a member, twists or bends shall be removed before parts are assembled.
- C. Cutting, Punching, Drilling and Tapping: Unless otherwise indicated or specified, structural steel fabricator shall perform the cutting, punching, drilling and tapping of Work so that Work of other trades will properly connect to steel Work.
- D. Milling: Compression joints depending on contact bearing shall be furnished with bearing surfaces prepared to a common plane by milling.
- E. Use of Burning Torch: Oxygen cutting of members shall be performed by machine. Gouges greater than 3/16 inch that remain from cutting shall be removed by grinding. Reentrant corners shall be shaped notch free to a radius of at least 1/2 inch. Gas cutting of holes for bolts or rivets is not permitted.
- F. Galvanizing: After fabrication, items indicated or specified to be galvanized shall be galvanized per Section 05 5013, Hot-Dip Galvanizing.
- G. Welding:
 - 1. Type of steel furnished in welded structures shall provide chemical properties suitable for welding as determined by chemical analysis. Welds shall conform to the verification

and inspection requirements of CBC Chapter 17A. Conform to AWS D1.1, and CBC Chapter 22A.

2. Materials and workmanship shall conform to the requirements specified herein and to CBC requirements, modified as follows:
 - a. No welded splices shall be permitted except those indicated on Drawings unless specifically reviewed by the ARCHITECT.
 - b. Drawings will designate joints in which it is important that welding sequence and technique be controlled to minimize shrinkage stresses and distortion.
 3. Welding shall be performed in accordance with requirements of the AWS Structural Welding Code.
 - a. Welded Joint Details: Comply with AISC 341, AISC 358 and drawing details.
 4. Architecturally Exposed Structural Steel: Verify that weld sizes, fabrication sequence, and equipment used for Architecturally Exposed Structural Steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds ½ inch and larger. Grind flush butt welds. Dress exposed welds.
 5. Remove erection bolts on welded, Architecturally Exposed Structural Steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- H. Shop Finish:
1. Notify the Project Inspector when Work is ready to receive shop prime coat. Work shall be inspected by the Project Inspector before installation of primer.
 2. Structural steel and fittings shall receive a coat of primer, except:
 - a. Surfaces that will be galvanized.
 - b. Surfaces that will be fireproofed.
 - c. Surfaces that will be field welded.
 - d. Surfaces in contact with concrete.
 - e. Surfaces high strength bolted.
 3. The primer specified shall be spray applied, filling joints and corners and covering surfaces with a smooth unbroken film. The minimum dry film thickness of the primer shall be 2.0 mils.
- I. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- J. Fabricate Architecturally Exposed Structural Steel with exposed surfaces smooth, square, and free of surfaces blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating and shop priming.
 2. Comply with fabrication requirements, including tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for Architecturally Exposed Structural Steel.
- K. Architecturally Exposed Structural Steel: use special care in unloading, handling and erecting the steel to avoid marking or distorting the steel members. Minimize damage to any shop paint when temporary braces or erection clips are used. Avoid unsightly surfaces upon removal. Grind smooth tack welds and holes filled with weld metal or body solder. Plan and execute all

operations in such a manner that the close fit and neat appearance of the structure will not be impaired.

2.04 SHOP AND FIELD QUALITY CONTROL

- A. A special inspector, approved by DSA to inspect the Work of this section, shall inspect high-strength bolted connections. OWNER will provide a DSA approved independent testing laboratory to perform tests and prepare test reports in accordance with CBC 1704A. The Project Inspector shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.
- B. An AWS certified welding inspector (CWI), approved by DSA to inspect the Work of this section, shall inspect welded connections in accordance with CBC 1705A.2.5. The OWNER will provide a DSA approved independent testing laboratory to perform tests and prepare test reports. The Project Inspector shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.
- C. The independent testing laboratory shall conduct and interpret test and state in each report whether test specimens comply with requirements, and specifically state any deviations there from.
- D. Provide access to all places where structural steel Work is being fabricated or produced so required inspection and testing can be performed.
- E. The independent testing laboratory may inspect or test structural steel at plant before shipment; however, ARCHITECT reserves the right at any time before Contract Completion to deem materials not in compliance with the specified requirements as defective Work.
- F. Correct defects in structural Work when inspections and laboratory test reports indicate noncompliance with specified requirements. Perform additional tests as may be required to reconfirm noncompliance of original Work, and as may be required to show demonstrate compliance of corrected Work.
- G. Inspection of Structural Tube Steel/Hollow Structural Sections (HSS): Structural tube steel members (round, square, rectangular), disregarding steel origin, will be inspected during shop fabrication per DSA Bulletin 07-03. Inspector will perform a visual examination of the seam weld area for visible discontinuities. When defects are suspected, non-destructive testing will be considered.
- H. Welding: Inspect and test during fabrication and erection of structural steel assemblies as follows:
 - 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in the Work. Record Work required and performed to correct deficiencies.
 - 2. Inspect welds. Welds shall be visually inspected before performing any non-destructive testing. Groove weld shall be inspected by ultrasonic or other approved non-destructive test methods. Testing shall be performed to AWS D1.1 Table 6.3 cyclically loaded non-tubular connections.
 - 3. Ultrasonic testing shall be performed by a specially trained and qualified technician who shall operate the equipment, examine welds, and maintain a record of welds examined, defects found, and disposition of each defect. Repair and test defective welds.
 - 4. Rate of Testing: Completed welds contained in joints and splices shall be tested 100 percent either by ultrasonic testing or by radiography.
 - 5. Welds, when installed in column splices, shall be tested by either ultrasonic testing or radiography.
 - 6. Base metal thicker than 1 ½-inch, when subjected to through-thickness weld shrinkage strains, shall be ultrasonically inspected by shear wave methods for discontinuities

- directly behind such welds. Tests shall be performed at least 48 hours after completed joint has cooled down to ambient air temperature.
7. Material discontinuities shall be reviewed based on the defect rating in accordance with the criteria of AWS D1.1 table 6.3 by the ARCHITECT and DSA.
 8. Other method of non-destructive testing and inspection, for example, liquid dye penetrate testing, magnetic particle inspection or radiographic inspection may be performed on weld if required.
 9. Lamellar Tearing: Lamellar-tearing resulting from welding is a crack (with zero tolerance) and shall be repaired in accordance with AWS D1.1.
 10. Lamination: The rejection criteria shall be based on ASTM A435.
 11. Where testing reveals lamination or conditions of lamellar tearing in base metal, the steel fabricator shall submit a proposed method of repair for review by the ARCHITECT. Test repaired areas as required.
 12. Magnetic Particle Testing: Magnetic particle testing when required shall be provided in accordance with AWS D1.1 for procedure and technique. The standards of acceptance shall be in accordance with AWS D1.1 – Qualification.
- I. Lamellar Tearing: Prior to welding plates 1 to 1-½ inch thick and greater and rolled shapes within the distance from 6 inches above the top of the joint to 6 inches below the bottom of the joint shall be checked by ultrasonic testing for laminations in base metal which may interfere with the inspection of the completed joint. Should these defects occur, members will be reviewed by the ARCHITECT and DSA. Welding procedure specifications in paragraph 1.04.G specify welding practices to minimize lamellar tearing.
 - J. Prior Testing of Base Material: Test material before fabrication.
 - K. Lines and levels of erected steel shall be certified by a State of California licensed surveyor as set forth in related Division 01 section.
 - L. Welded studs shall be tested and inspected by the special inspector in accordance with requirements of AWS D1.1 – Stud Welding.
 - M. Record Drawings: After steel has been erected, correct or revise Shop Drawings and erection diagrams to correspond with reviewed changes performed in the field.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify governing dimensions and conditions of the Work before commencing erection Work.
 1. Report discrepancies between drawings and field dimensions to ARCHITECT before commencing work.
 2. Beginning of installation means erector accepts existing conditions and surfaces underlying or adjacent to work of this section.
- B. Provide temporary shoring and bracing, and other support during performance of the Work. Remove after steel is in place and connected, and after cast-in-place concrete has reached its design strength.
- C. Coordinate prime coat repair and application with requirements of Section 09 9000.

3.02 ERECTION

- A. Install structural steel accurately in locations, to elevations indicated, and according to AISC specifications and CBC requirements.
- B. Clean surfaces of base plates and bearing plates.

1. Install base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims; cut off flush with edge of base or bearing plate before packing with grout.
- C. Maintain erection tolerances of structural steel within AISC Code of Standard Practice for Steel Buildings and Bridges.
1. Architecturally Exposed Structural Steel members and components, plumbed, leveled and aligned to a tolerance not to exceed one-half the amount permitted for structural steel. CONTRACTOR to provide adjustable connections between Architecturally Exposed Structural Steel and the structural steel frame or the masonry or concrete supports, in order to provide the erector with means for adjustment.
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact after assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
- E. Do not permit thermal cutting during erection of structural steel.
- F. Where indicated for field connections, provide standard bolts complying with ASTM A307.
- G. Install high strength steel bolts at locations indicated. Assembly and installation shall be in accordance with CBC requirements and AISC specifications.
1. Allowable hole sizes: 1/16 inch larger than bolt size.
 2. Use friction type connection with standard hardened steel circular, square or rectangular washer under bolt nut.
 3. Thoroughly clean area under bolt head, nut and washer. Remove all paint, lacquer, oil or other coatings except organic zinc-rich paints in accordance with SSPC, SP-2.
 4. Tighten bolts by power torque wrench or hand wrench until twist-off.
- H. CONTRACTOR shall be responsible for correcting detailing and fabrication errors and for correct fitting of all members and components.
- I. Erect structural steel plumb and level and to proper tolerances as set forth in the AISC Manual. Provide temporary bracing, supports or connections required for complete safety of structure until final permanent connections are installed.
- J. Install column bases within a tolerance of 1/8 inch of detailed centerlines, level at proper elevations. Support bases on double nuts and solidly fill spaces under bases with cement grout.
- K. Provide anchor bolts with templates and diagrams. CONTRACTOR shall be responsible for proper location and installation of bolts. Correct deficiencies and errors.

3.03

FITTING

- A. Closely fit members, finished true to line and in precise position, are required to allow accurate erection and proper joining in the field.
- B. Drilling to enlarge unfair holes will not be allowed. Allow only enough drifting during assembly to bring parts into position, but not enough to enlarge holes or distort the metal. Do not heat rolled sections, unless approved by ARCHITECT.

3.04 PUNCHING AND DRILLING

- A. Punch material 1/16 inch larger than nominal diameter of bolt, wherever thickness of metal is equal to or less than the diameter of the bolt plus 1/8 inch.
- B. Drill or sub-punch and ream where metal is equal to or more than the diameter of the bolt plus 1/8 inch. Make diameter for sub-punched and sub-drilled holes 1/16 inch larger than nominal diameter of bolt.
- C. Precisely locate holes to ensure passage of bolt through assembled materials without drifting. Enlarge holes when necessary to receive bolts by reaming; flame cutting to enlarge holes is not acceptable. Structural Steel members with poorly matched holes will be rejected.

3.05 FINISHING

- A. After erection, spots or surfaces where paint has been removed, damaged, or burned off, and field rivets, bolts, and other field connections shall be cleaned of dirt, oil, grease, and burned paint and furnished with a spot coat of the same primer installed during shop priming.
- B. Touchup:
 - 1. Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Install paint to exposed areas with the same material installed during shop painting. Install by brush or spray to provide a minimum dry film thickness of 1.5 mils.
 - 2. Galvanized Surfaces: Clean field welds, connections and damaged areas. Apply two coats of Carbomastic 15, by Carboline or equal product approved by OWNER's OEHS. Brush or roll to a 4 to 6 mil thickness.

3.06 FIELD QUALITY CONTROL

- A. OWNER will provide a special inspector and independent testing laboratory to perform field inspections and tests and to prepare test reports.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

3.07 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project Site.

3.08 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.09 HANDLING

- A. Both in shop and in the field, transport, handle and erect to prevent damage or overstressing of any component.

END OF SECTION

SECTION 05 30 00
METAL DECKING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Floor and roof metal decking.
2. Shear connector studs for composite decking construction.
3. Edge strips, closure strips and decking accessories.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4523 - Testing and Inspection.
3. Section 03 3000 – Cast-In-Place Concrete.
4. Section 05 1200 - Structural Steel Framing.
5. Section 07 6000 - Flashing and Sheet Metal.
6. Section 07 8116 - Cementitious Fireproofing.

1.02 REFERENCES

A. ASTM International (ASTM):

1. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
2. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
4. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
5. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.

B. American Welding Society (AWS):

1. AWS D1.1 - Structural Welding Code Sheet – Steel.
2. AWS D1.3 – Structural Welding Code Sheet – Sheet Steel.

C. American Iron and Steel Construction (AISI):

1. AISI – Specifications for the Design of Cold-Formed Steel Structural Members.

D. Underwriters Laboratory (UL):

1. UL – Fire Resistance Directory.

1.03 PERFORMANCE REQUIREMENTS

- A. Compute properties of deck sections on basis of effective design width as limited by provisions of the AISI specifications. Provide no less than deck section properties specified, including section modulus and moment of inertia per foot of width.

B. Regulatory Requirements:

1. Decking installed as part of a fire rated assembly shall meet the requirements of the applicable UL Fire Resistance Directory design number.
2. Work of this section shall be in accordance with CBC.

1.04 SUBMITTALS

- A. Shop Drawings: Drawings, sections and details indicate type of decking, location, finish, gage of metal, arrangement of sheets, necessary fabrication to incorporate decking into the Work, and relationship to openings and flashing.
- B. Product Data: For each type of decking specified, including structural properties, dimensions, profiles and finishes.
- C. Welder Certificates: Signed by CONTRACTOR certifying that welders comply with the requirements specified under Article "Quality Assurance".

1.05 QUALITY ASSURANCE

- A. General: Metal decking steel shall conform to requirements of strengths and properties of standards specified.
- B. Qualifications of Welders: Properly certified for the type of Work involved in compliance with CBC requirements.
- C. Continuous inspection of welding will be performed by a special inspector, approved by DSA to inspect the Work of this section. Refer to Section 01 4523 - Testing and Inspection. The Project Inspector will be responsible for monitoring the work of the special inspector to ensure that the inspection program is satisfactorily completed.
- D. Identification of metal decking steel shall conform to the standards specified in this section and the Drawings.
 1. Fabricator shall furnish sufficient evidence to the ARCHITECT attesting compliance with specified requirements.
 2. Conform to CBC requirements. Unclassified or unidentified decking is not permitted. Furnish deck manufacturer's certified mill analyses and test reports for each heat covering decking having a minimum F_y of 33 Ksi. In addition, for decking having F_y greater than 33 Ksi, testing laboratory shall perform one tension and elongation test and one bend or flattening test for each gage.
- E. Unidentifiable Steel: Steel which is not readily identifiable as to grade from markings and test records is not permitted to be provided as part of the Work of this section.
- F. Manufacturers shall be members of Steel Deck Institute (SDI).

1.06 DELIVERY, STORAGE AND HANDLING

- A. Protect steel deck from corrosion, deformation and other damage during delivery, storage and handling.
- B. Deck bundles shall be stored off the ground, with one end elevated to provide drainage. Bundles shall be protected against condensation with a ventilated waterproof covering.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. ASC Steel Deck. (IAPMO ER-329)
- B. Verco Manufacturing Co. (IAPMO ER-217)
- C. Epic Metals Corporation. (IAPMO ER-226)
- D. Equal.

2.02 MATERIALS

- A. Metal Decking:
 - 1. Roll-formed sheets conforming to ASTM A653, with G90 zinc coating.
 - 2. Section properties conforming to applicable provisions of latest edition of AISI - Specification for the Design of Cold-Formed Steel Structural Members.
- B. Flexible Closure Strips for Deck: Vulcanized, closed-cell, expanded chloroprene elastomer, complying with ASTM D1056, Grade SCE #41.
 - 1. Brittleness Temperature: Minus 40 degrees F, ASTM D746.
 - 2. Flammability Resistance: Self-extinguishing,
- C. Decking Accessories: Metal cover plates, sheet metal edging, metal closure strips, valley and ridge strips, seat angles, sump pans, flashings: 22 gage minimum, with ASTM A653, G90 zinc coating.
- D. Shear Connectors: Headed stud type, ASTM A108 Grade 1015, cold-finished carbon steel complying with AISC specifications.
- E. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035B and approved by the OWNER's Office of Environmental Health and Safety (OEHS).

2.03 FABRICATION

- A. Corrugated sheets or sections shall be designed to support required live load between supporting members.
- B. Provide decking in lengths to span over three or more supports.
- C. Except as detailed otherwise, provide decking with interlocking side laps, 2 ½-inch minimum end bearing, and 1 ½-inch minimum side bearing.
- D. Welding: Provide materials and methods in accordance with recommendations of steel decking manufacturer and reviewed submittals. Hold decking tight to the supporting elements with screws or other means for proper welding or crimping of the decking edges. Conform to AWS D1.3, and to the patterns and weld types indicated, with welds free from sharp edges and protrusions. Field coat welds and abraded surfaces at completion with an anodic type galvanizing repair paint. Omit the field paint coating where welds or abrasions are covered by concrete fill or sprayed fireproofing.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify supporting structure and existing conditions prior to starting work.

- B. Remove oil, dirt, paint, and rust from steel surfaces to which metal decking will be welded.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 OPENINGS

- A. Cut and reinforce units to provide openings which are located and dimensioned on the structural and mechanical Drawings.
- B. Provide openings, or other Work not indicated on the Drawings.

3.03 INSTALLATION

- A. Install metal decking in accordance with decking manufacturers' recommendations, requirements of Drawings, Shop Drawings, and Specifications.
- B. Install metal decking on supporting steel framework and adjust to final position before permanently fastening in place.
 - 1. Install each unit to proper bearing on supports.
 - 2. Install units in straight alignment for entire length of run of cells with close registration of cells of one unit with those of abutting unit.
- C. Fasten decking to steel framework at ends of units and at intermediate supports. Welding shall be as indicated on Drawings.
- D. Fasten side laps between supports as indicated on Drawings.
- E. Perform field cutting parallel with cells in area between cells, leaving sufficient horizontal material to permit welding to support steel.
- F. Weld shear connectors to supports thru decking units as required by Drawings. Weld only on clean, dry surfaces. Do not weld shear connectors thru two layers of decking units.

3.04 METAL FLASHINGS AND CLOSURES

- A. Furnish, install, and weld in position, sheet metal closure flashing, closure angles, closure plates, profile plates, and shear plates.
- B. Close open ends of cell runs at columns, openings, walls, similar interruptions and termination.

3.05 FIELD QUALITY CONTROL

- A. Install steel decking under continuous inspection according to CBC Section 1704A.
- B. Welding inspection for steel deck diaphragms shall conform to CBC Section 2204A.1.

3.06 CLEAN UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.07 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 05 41 00
STRUCTURAL METAL STUD FRAMING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Load-bearing metal stud systems.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4523 - Testing and Inspection.
3. Section 05 1200 - Structural Steel Framing.
4. Section 09 2216 - Non-Structural Metal Framing.

1.2 SUBMITTALS

- A. Shop Drawings: Submit drawings showing framing, connection details, accessories and anchorage. Indicate location of assemblies, size and spacing of framing components.
- B. Product Data: Submit manufacturer's catalog data for each item proposed for installation.
- C. Certificates: Furnish manufacturer's certification that materials meet or exceed Specification requirements.

1.3 QUALITY ASSURANCE

A. Comply with following as a minimum requirement:

1. AISI - Specifications for Design of Cold Formed Steel Structural Members.
2. Welds shall be performed by AWS certified welders. Welding shall be performed in accordance with requirements of American Welding Society (AWS) Structural Welding Code-Steel D1.1 and D1.3. Structural welding Code-Sheet Steel.
3. Welding shall be inspected by a special inspector, approved by DSA to inspect Work of this section. The Project Inspector shall be responsible for monitoring work of special inspector to ensure that inspection program is satisfactorily completed.
4. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by Hot Dip Process.
5. ASTM A924 – Standard Specification for General Requirements for Steel Sheet Metallic-Coated by Hot-Dip Process.
6. ASTM A1003 – Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
7. ASTM A1008 – Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability.
8. ASTM C954 – Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks) and Bracing or Bridging for Screw Application of Gypsum Panel Products and Plaster Bases.

9. ASTM C955 – Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
 10. ASTM C1007 – Standard Specification for Installation of Structural (Axial and Transverse) Steel Framing Members and Accessories.
 11. ASTM E488 – Standard Test Methods of Strength Anchors in Concrete and Masonry.
 12. ASTM E1190 – Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members.
 13. Manufacturer shall be a member of the Steel Stud Manufacturers Association (SSMA).
- B. Tolerances: Install walls and partitions on straight lines, plumb, free of twists or other defects, and contacting a 10-foot straight edge for its entire length at any location within a 1/8 inch tolerance. Install horizontal framing level within a tolerance of 1/8 inch in 12 feet in any direction.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered in their original unopened packages and stored protected from damage. Do not store material directly on grade. Provide adequate support to prevent bowing of material prior to installation.
- B. Store welding electrodes in accordance with AWS D12.1.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Provide studs, tracks, joists, header, and accessories manufactured by one of following:
- B.
1. ClarkWestern Building Systems. (IAPMO ER-145)
 2. Dietrich Industries, Inc. (IAPMO ER-145)
 4. Cemco.(ICC/ESR-3016)
 5. Equal.
- B. Special Connection Accessories: Products manufactured by The Steel Network, Inc., or equal.

2.2 MATERIALS

- A. Light Gage Metal Framing:
1. Metal framing shall be formed from corrosion resistant-steel conforming to requirements of ASTM A653, 50 ksi minimum.
 2. Metal framing shall be zinc coated in conformance to requirements of ASTM A926, G60.
 3. Metal framing shall be manufactured in conformance to ASTM C955.
 4. Install metal framing per ASTM C1007, Standard Specification for Installation of Load-Bearing (Transverse and Axial) Steel Studs and Related Accessories.
- B. Gages and properties of studs shall be as indicated on Drawings.
- C. Mechanical anchors to concrete and masonry shall be metal cinch at least 3/8 inch in diameter threaded bolt head type. Anchor bolts to be installed in concrete shall be hook type ½ inch diameter or more. Unless otherwise indicated.

- D. Mechanical anchors to metal framing shall be No. 10 self-tapping and self-drilling wafer-head screws.
- E. Accessories: Special top tracks, angles, fasteners, and strips of gypsum wallboard, as required for fire rating assembly required at each condition.
- F. Mineral Wool Safing Insulation: 4.0 pcf density. Thermafiber, Fibrex, or equal.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install plumb and true. Install necessary accessories for proper installation.
- B. Anchor top and bottom runner track to ceiling or roof structure overhead and to floor structure below.
- C. Install studs squarely in top and bottom runner track with firm abutment against track webs.
- D. Align and plumb studs and fasten to flanges of both top and bottom runner tracks.
- E. Provide three studs minimum at corners of stud walls. Locate so as to provide surfaces for attachment of interior and exterior facing materials.
- F. Members not indicated to be welded together shall be attached with manufacturer recommended screws with minimum one screw at each flange of stud to top and bottom track. Wire tying of framing members is not permitted.
- G. Provide lateral bracing and bridging in accordance with manufacturer's written recommendations or as required by CBC.
- H. Intersecting walls and partitions, whether load-bearing or not, shall be connected.
- I. Splices in axially loaded studs are not permitted.
- J. Splice or butt weld butt joints in runner tracks. No splices are permitted in tracks over lintels, diaphragm sheathing, or diagonal bracing.
- K. Weld connections by fillet welds or plug welds in accordance with AWS recommended procedures and practices.
- L. Touch-up field abrasions and welds with galvanizing touch-up material.
- M. Studs that frame door openings shall be clipped to floor with 14 gage angle clips. Each clip to have two fasteners into studs and two fasteners into floor.
- N. Provide additional joists or blocking adjacent to exterior and interior walls, openings and elsewhere as required to provide support for indicated ceiling construction.
- O. Provide an additional joist under parallel partitions where partition length exceeds $\frac{1}{2}$ joist span and around floor and roof openings which interrupt one or more spanning members.

3.2 CONNECTIONS TO METAL DECKING

- A. Provide premolded neoprene filler strips matching flute profile for non-fire-rated walls and partitions covered on one or both sides up to metal decking.
- B. Top runner track of fire-rated partitions shall be a minimum of 36 mils (20 gage), unless noted otherwise, and attached to metal deck with required fasteners at spacing required for fire rating, but in no case over 16 inches on center. Areas above runner shall be friction fit with a minimum depth of 2 ½ inches of 4 pounds per cubic foot density mineral wool insulation. A minimum of ½ inch of firestopping compound shall be installed to each side of mineral wool insulation for a one-hour system, and one inch of firestopping for a two-hour system. Install required special tracks, angles, fasteners and strips of gypsum wallboard to provide required fire resistance rating.
- C. Fire-rated top tracks shall be installed in accordance with manufacturer's recommendations and fire rating approval requirements.

3.3 QUALITY CONTROL

- A. Welding Inspection:
 - 1. Inspection of field welding operations shall be performed by special inspector.
 - 2. The special inspector shall inspect material, equipment, procedures, welds, and welder qualification.
 - 3. All welding shall be specially inspected by an AWS-CWI qualified inspector approved by DSA

3.4 CLEAN UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

3.5 PROTECTION

- A. Protect Work of this section until Substantial Completion.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes metal fabrications not classified as "structural steel", and not specified in other Sections.
- B. Related requirements:
 - 1. Division 03 for grouting and dry-packing other than required for the work of this Section.
 - 2. Divisions 05 and 09 for light-gage metal framing (studs, channels, etc.) for support of plaster and gypsum board, and backing plates for surface-applied items fastened to these materials.
 - 3. Division 08 for gate finish hardware.
 - 4. Division 09 for finish painting metal fabrications.
- C. Work installed but furnished in Division 32: Gate hardware.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling and sequencing: Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not comply with structural performance requirements.
- B. Deferred approval (delegated design): Certain metal assemblies require deferred approval from authorities having jurisdiction (AHJ) and shall be engineered by a California-licensed professional engineer paid by the Contractor or their manufacturer

1.3 SUBMITTALS

- A. Data:
 - 1. Specifications and installation instructions for manufactured items.
 - 2. Manufacturer's literature, including engineering data for anchors.
- B. Shop Drawings:
 - 1. Large scale, dimensioned Shop Drawings of metal fabrications indicating in detail methods of fabrication and assembly, weight, materials, holes, lugs, inserts, finishes and other pertinent data.
 - 2. For components to be embedded in concrete and masonry work, furnish templates supplemented by dimensioned Shop Drawings to trades placing those components in their work. Assist in location of these components where so requested by those trades.
- C. Samples: The following Samples, at least 6 inches long.
 - 1. Welded connection between the following components showing proposed weld quality and finish.
 - a. Pipe to pipe (railing).
 - b. Pipe to bar.
 - c. Tube to tube.
 - d. Tube and bar.

1.4 QUALITY ASSURANCE

- A. Qualifications for welding work:
 - 1. All welding shall be specifically inspected by an AWS-CWI qualified inspector approved by DSA.

1. Qualify welding procedures and welding operators in compliance with AWS "Qualification" requirements of AWS D1.1.
2. Examine that welders to be employed in this work have satisfactorily passed AWS qualification tests.
3. If recertification of welders is required, retesting shall be Contractor's responsibility.
4. Submit certificates of compliance to demonstrate compliance with the above requirement.
5. Costs for fabricator tests, inspections and quality control shall be borne by the Contractor.

B. Special inspections:

1. Except where otherwise specified, special inspections by Owner's testing laboratory, prescribed by Code, will not be required where work is performed on the premises of a licensed fabricator, registered and approved by authorities having jurisdiction to perform such work without special inspection.
2. Submit certificates of compliance to demonstrate compliance with the above requirement.
3. Costs for fabricator tests, inspections and quality control shall be borne by Contractor.

1.5 HANDLING

- A. Store metal fabrications above ground, under cover.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Provide railings and other load-bearing assemblies capable of safely withstanding the dead loads of the assemblies, plus the live loads prescribed by Code without exceeding allowable design working stress of materials involved, including anchors and connections. Apply each load to produce maximum stress in each component.
- B. Thermal movements: Provide exterior assemblies with expansion joints spaced so that no distortion or damage occurs when subjected to a surface temperature of plus 180 degrees and a temperature swing of 160 degrees (plus 20 to plus 180 degrees).
1. Make joints as small as possible but sufficiently wide to meet the design criteria.
 2. Show joint spacing on Shop Drawings.
 3. Space joints equally and symmetrically. Joint locations are subject to relocation at no additional cost to the Owner.
- C. Loads: In the absence of specific design loads on the Drawings and in the Specifications, the provisions of ASCE/SEI 7-10 "Minimum Design Loads for Buildings and Other Structures" apply to the work of this Section.
- D. Deflection: Limit deflection under uniform load to L/360; L/120 under concentrated load; or 1/4-inch maximum, whichever is more restrictive.

2.2 MATERIALS

- A. Metal surfaces - general: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and absence of surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.
- B. Steel plates, shapes, and bars: ASTM A 36.
- C. Steel tubing:
1. Cold-formed steel tubing: ASTM A 500, Grade A or B, as required for design loading, unless otherwise indicated.

- D. Steel pipe/tubing:
1. Handrails: One of the following.
 - a. Welded and Drawn Over Mandrel (DOM), ASTM A 513, Type S.
 - b. Cold Drawn Seamless (CDS), ASTM A 519.
 - c. Hot Finished Seamless (HFS), ASTM A 519, machined to match the finish of the DOM steel above.
 2. Elsewhere: ASTM A 53; finish, type, and weight class as follows.
 - a. Galvanized finish for exterior installations and where specified, black finish elsewhere.
 - b. Type S, Grade A, standard weight (schedule 40), unless another grade or weight or both required by design loading.
- E. Uncoated structural steel sheet: Product type (manufacturing method), quality, and grade, as follows.
1. Cold-rolled structural steel sheet: ASTM A 1008, Grade A, unless otherwise required by design loading.
 2. Hot-rolled structural steel sheet: ASTM A 1011, Grade 30, unless otherwise required by design loading.
- F. Uncoated steel sheet: Commercial quality, product type (method of manufacture) as follows.
1. Cold-rolled steel sheet: ASTM A 1008.
 2. Rolled steel floor plate (Checkered): ASTM A 786, Pattern No. 1, 4 or 5. Use same pattern throughout the Project.
 3. Hot-rolled steel sheet: ASTM A 1011.
- G. Galvanized steel sheet:
1. Structural quality: ASTM A 653 SQ, Grade 33, G90 designation, unless another grade required for design loading.
 2. Commercial quality: ASTM A 653 CQ, G90 coating designation.
- H. Concrete inserts:
1. Threaded or wedge type galvanized ferrous castings, either malleable iron complying with ASTM A 47, or cast steel complying with ASTM A 27.
 2. Provide bolts, washers, and shims as required, hot-dip galvanized in compliance with ASTM A 153.
- I. Welding rods and bare electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.
- J. Fasteners: Provide zinc-coated fasteners for exterior use or where built into exterior walls, elsewhere fasteners may be uncoated. Select fasteners for type, grade, and class required.
1. Bolts and nuts: Regular hexagon-head bolts, ASTM A 307, Grade A, Property Class 4.6; with hex nuts, ASTM A 563; and flat washers, unless otherwise indicated.
 2. Anchor bolts: ASTM F 1554, Grade 36.
 3. Machine screws: ASME B18.6.3, ASME B18.6.7M.
 4. Plain washers: Round, carbon steel, ASME B18.22.1.
 5. Lock washers: Helical, spring type, carbon steel, ASME B18.21.1.
 6. Drilled-in expansion anchors:
 - a. Expansion anchors complying with FS FF-S-325, Group VIII (anchors, expansion, [non-drilling]), Type I (internally threaded tubular expansion anchor); and machine bolts complying with FS FF-B-575, Grade S, by Hilti, Inc., or ITW Ramset/Red Head.
 - b. Select anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in masonry and equal to 4 times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E 488.
 7. Chemical anchors:

- a. Set by Simpson Strong-Tie Co., Inc., or HY-150 by Hilti, both used with machine bolts complying with FS FF-B-575, Grade S.
- b. Select drilled-in and chemical anchors to resist loads imposed thereon with a safety factor of 4 minimum for static loads, and 10 minimum for dynamic and overhead loads.

8. Lock washers: Helical spring type carbon steel, FS FF-W-84.

K. Grout: Pre-packaged, non-shrink, non-metallic grout, non-staining, nongaseous grout complying with ASTM C 1107.

L. Cement (expansive): Factory-prepared with accelerators quick-setting hydraulic cement complying with ASTM C 595.

M. Shop primer for ferrous metal:

- 1. Interior surfaces: Tnemec "10-99," or "Unibond" (basis of design), or equal fast-curing, lead-free, universal modified alkyd primer selected for compatibility with finish paint systems specified in Section 09 90 00, and complying with performance requirements equal to or better than the basis of design.
- 2. Exterior surfaces: As specified in Section 09 96 00.

N. Galvanizing repair (zinc-rich) paint: "94-H20 Hydro-Zinc" by Tnemec Co., or equal.

O. Bituminous paint: Cold-applied asphalt mastic complying with SSPC Paint 12 but containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 PREFABRICATED UNITS

A. Metal Bollards

- 1. Fabricate metal bollards from Schedule 80 steel pipe.
- 2. Cap bollards with 1/4-inch- thick steel plate.
- 3. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
- 4. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- 5. Fabricate bollards with 3/8-inch- thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
- 6. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- 7. Prime bollards with zinc-rich primer.
- 8. Cap bollards with 1/4-inch- thick steel plate.
- 9. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
- 10. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- 11. Bollard Cover: Equal to Bollard Covers by Innoplast, T-(440) 543-8660.
 - a. Material: Lo-Density Polyethylene.
 - b. Wall Thickness: 1/4-inch nominal.
 - c. Color: As selected by Architect from manufacturer's standard colors.

B. Unistrut framing:

- 1. Multipurpose steel profiles by Unistrut, Power-Strut, Famet, or equal, complete with manufacturer's standard steel fasteners and connectors, nuts integrally self-locking or fitted with locking devices. Provide galvanized steel members where embedded in concrete or masonry, and factory-primed items elsewhere.
- 2. Provide hanger rods, nuts, bolts, connectors, and anchors with electro-galvanized finish.

2.4 FABRICATION - GENERAL

- A. Comply with the reference standards and the following.
 - B. Engineer, fabricate and install exterior components to allow for expansion and contraction for a temperature range of 150-degree F without causing buckling, excessive opening of joints, and over-stressing of welds and fasteners.
 - C. Drill holes for bolts and screws. For screws exposed to view in finished surfaces use FHCS type with screw slots filled and finished flush and smooth with adjacent surfaces.
 - D. Form exposed work true to line and level with accurate angles and surfaces, and straight, sharp edges, so assembling can be done without filler pieces.
 - E. Shear and punch metals cleanly and accurately. Remove burrs.
 - F. Remove sharp or rough areas on exposed surfaces. Projecting edges are not permitted. Ease exposed edges to a radius of approximately 1/32-inch.
 - G. Weld corners and seams continuously to comply with AWS recommendations and the following:
 - 1. Do not use stitch, spot or tack welds on exposed surfaces.
 - 2. For work exposed to view, provide weld quality and finish equal to NOMMA Finish #1. Elsewhere provide weld quality and finish equal to NOMMA Finish #4.
 - 3. Use materials, methods and welding sequence that minimize distortion and develop strength and corrosion resistance of base metals.
 - 4. Obtain fusion without undercut or overlap.
 - 5. Remove welding flux immediately.
 - 6. At exposed connections, undercut edges of components to be welded, weld and finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
 - 7. Where welds will be exposed to the elements, weld connections between various pieces continuously to prevent water intrusion in the weld area, or seal welded parts, after weld is ground, with silicone sealant specified in Section 07 92 00.
 - H. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the strength of the material.
 - I. Form exposed connections with flush, hairline joints, using concealed fasteners wherever possible. Cope intersections of rails and posts, weld joints, and grind smooth; butt weld end-to-end joints of railings or use welding connectors.
 - J. Bend pipe without collapsing or deforming its walls, to produce a smooth, uniform curved section and to maintain uniform sectional shape.
 - K. Fabricate joints that will be exposed to the weather with weep holes where water or condensation may accumulate.
 - L. Fabricate items to be galvanized in accordance with ASTM A 385. Limit use of vent and drain holes and locate where concealed from view in the finish work.
 - M. Cut, reinforce, drill, punch, thread and tap metal work as required to receive finish hardware and similar items of work.
 - N. Fabricate items in the largest Sections practical to minimize field jointing.
 - O. Provide supplementary parts necessary to complete each item of metal fabrication even though such parts may not be shown or specified. Provide all anchors, brackets, and sleeves for securing metal work to adjacent construction.
 - P. Remove blemishes by grinding before cleaning, treating, and applying specified finishes.
- 2.5 PIPE RAILING FABRICATION
- A. General: Fabricate handrails and 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 handrails and 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.
- C. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Connect members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose when acceptable to the Architect. Weld connections continuously to match approved Samples.
- E. Brackets, flanges, fittings, and anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to connect handrail and railing members to other work, unless otherwise indicated.
 - 1. Provide inserts and other anchorage devices for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.
 - 2. For railing posts set in concrete, unless otherwise indicated, provide preset sleeves of steel not less than 6-inch long with inside dimensions not less than 1/2-inch greater than outside dimensions of post, and steel plate forming bottom closure.
- F. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.
- G. Fabricate joints to be exposed to weather to be watertight.
- H. Close exposed ends of handrail and railing members.
- I. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of railing and wall is 1/4-inch or less.
- J. Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.6 WELDING

- A. Weld shop and field connections continuously in compliance with AWS D1.1, Structural Welding Code - Steel, and AWS D1.3, Structural Welding Code - Sheet Steel, unless bolted connections are specifically shown.
- B. Grind welds that will remain exposed, smooth and flush to match and blend with parent metal surfaces. Match approved weld Samples.

2.7 FABRICATION TOLERANCES

- A. Squareness: 1/8-inch maximum difference in diagonal measurements.
- B. Maximum offset between components at joints: 1/16-inch except that at welded joints no offset is allowed.
- C. Maximum misalignment of adjacent members: 1/16-inch.
- D. Maximum bow: 1/8-inch in 48-inches.
- E. Maximum deviation from plane: 1/16-inch in 48-inches.

2.8 GALVANIZING

- A. Follow procedures outlined in ASTM A 143 to safeguard against and test for possible embrittlement.

1. Exterior: Steel cleaning and preparation followed by hot-dip galvanizing all in accordance with the American Galvanizers Association's recommendations and Section 09 96 00 in the Specifications.
 - B. Unless fabricated from galvanized materials, after fabrication hot-dip galvanize exterior ferrous metal items and items installed in exterior walls, which will be concealed when the work is completed and which are totally or partially exposed to the weather, in compliance with ASTM A 123 or A 153, as applicable
 - C. Excessive dross, rough surfaces, blisters, lumpiness, runs, edge tears, spikes, and chromate quenching are unacceptable.
 - D. Safeguard assemblies against steel embrittlement in compliance with ASTM A 143, and against distortion in compliance with ASTM A 384.
 - E. Coating weight shall conform to Table 1 of ASTM A 123, or ASTM A 153, as applicable.
 - F. Plug vent holes with lead or silicone sealant after galvanizing.
 - G. If necessary to prevent humid storage staining, quench freshly galvanized steel in a passivating solution.
- 2.9 SHOP PRIMING
- A. Do not shop prime galvanized surfaces.
 - B. Surfaces exposed in the Work comply with : SSPC SP6 followed by application of zinc-rich primer.
 - C. Surfaces concealed from view: SSPC SP3 followed by rust inhibitive shop primer.
 - D. Shop prime metal assemblies as follows, unless otherwise specified in Section 09 96 00:
 1. Prepare surfaces as specified above.
 2. Remove loose mill scale, rust, cutting and punching burrs, oil, grease and other deleterious materials before priming.
 3. Immediately after surface preparation, apply primer in compliance with its manufacturer's instructions to provide a uniform dry film thickness of not less than 1-1/2 mils per coat for rust-inhibitive primer and 3.5 to 3.5 mils for zinc-rich primer. Use painting methods that will result in full coverage of joints, corners, edges and all exposed surfaces.
 4. Apply primer to completely cover all exposed surfaces as well as surfaces concealed after assembly. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 5. Allow paint to dry thoroughly before handling.
 6. Apply one coat of primer to surfaces exposed in the finished work, and 2 coats to surfaces that will be inaccessible after their assembly or erection.
- 2.10 PROTECTIVE COATINGS
- A. Apply a heavy coat of bituminous paint to metal surfaces that will be in contact with cementitious materials. Do not apply on exposed surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and measurements affecting the work of this Section at site.
- B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

- A. Corrosion prevention: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials using heavy bituminous paint at least 10 DFT, hard plastic spacers, Teflon tape, or silicone or neoprene gaskets.

- B. Fastening:
1. Provide anchorage devices and fasteners required for attaching metal fabrications to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors required.
 2. Dry-pack metal fabrications supported on concrete and masonry as specified in Section 03 30 00 to provide firm, level bearing surfaces.
- C. Cutting, fitting and placing:
1. Perform all cutting, drilling and fitting required for installation of metal fabrications.
 2. Set items accurately in their proper location, alignment and elevation, plumb, level, true and free of rack as measured from established lines and levels.
 3. Provide temporary bracing or anchors for items to be built into concrete, masonry or similar construction.
 4. Fit exposed connections accurately to form flush, hairline joints.
 5. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and flush with parent metal.
- D. Field welding: Comply with AWS Code for procedures of manual shielded arc welding, appearance and quality of welds made, and methods used to correct faulty welds.
- E. Installing metal bollards.
1. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
 - a. Do not fill removable bollards with concrete.
 2. Anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.
 - a. Embed anchor bolts at least 4 inches in concrete.
 3. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
 4. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
 5. Fill bollards solidly with concrete, mounding top surface to shed water.
- F. Prefabricated units: Install as specified, and in compliance with their manufacturer's instructions.
- G. Gate hardware:
1. Drill and tap gate frames on the job as required for installation of hardware.
 2. Attach hardware accurately fitted to gates and frames with tamper-resistant or concealed means. Install ground-set items in concrete for anchorage.
 3. Adjust to operate smoothly and without sticking and binding.
 4. Gates shall close uniformly against frame. When open in any position, gates shall remain stationary, without drifting.
 5. Latch shall engage strike and keeper regardless of the degree of force with which gates are closed.
 6. Where so required for smooth and noiseless operation, lubricate hardware in compliance with its manufacturer instructions.
- H. Installation tolerances: Adjust metal fabrications for squareness, alignment, twist, levelness and plumbness to the following tolerances.
1. Squareness where applicable: Plus or minus 1/16-inch, measured on the diagonal.

2. Alignment: Plus or minus 1/16-inch where fabrications are separated by one inch or more; where components join or are separated by less than one inch, components shall be aligned; no deviations permitted.
3. Twist: Plus or minus 1/16-inch, except that deviation shall be such that joined panelized components are flush at joints; no deviations permitted.
4. Plumbness: Plus or minus 1/16-inch, except that deviation shall be such that joined panelized components are flush at joints; no deviations permitted.
5. Levelness: 1/8-inch from level, except where tighter tolerances are required for joining or alignment with adjacent work.
6. Deviation from theoretical location in plan: 1/4-inch, except where tighter tolerances are required for joining or alignment with adjacent work.

3.3 FIELD QUALITY CONTROL

- A. Extent and Testing Methodology: Owner's Testing agency may 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.
 1. 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.
 2. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- B. Touchup:
 1. General: Immediately after erection, clean field welds, bolted connections and abraded areas, and proceed as follows.
 2. Damaged primer: Clean the damaged area, sand smooth, re-clean and spot-prime with the same paint as that used for shop priming applied to the same dry film thickness as the undamaged primer; minimum thickness of 2 dry mils.
 3. Damaged zinc coating:
 - a. Clean abraded area in accordance with SSPC-SP11, "Power Tool Cleaning" to bare metal all welds and damaged zinc coating. Extend cleaning 2 inches past damaged area.
 - b. Spot prime damaged area with Tnemec "94-H2O Hydro-Zinc" applied at 2.5 to 3.5 Mils DFT.
 4. Where galvanized surface will remain exposed in the Work, repair damaged areas with zinc-based solder in accordance with ASTM A 780, regardless of the width of the abrasion (not limited to 3/16-inch).

END OF SECTION

DIVISION 06

WOOD AND COMPOSITES

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Rough carpentry Work.
2. Installation of glued laminated members, plywood web joists or wood chord metal web joists.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4523: Testing and Inspection.
3. Section 03 1000: Concrete Forming and Accessories.
4. Section 03 3000: Cast-In-Place Concrete.
5. Section 06 2000: Finish Carpentry.
6. Section 09 2900: Gypsum Board.

1.02 SYSTEM DESCRIPTION

A. Regulatory Requirements:

1. Work of this Section shall comply with CBC Chapter 23.

1.03 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:

1. Redwood structural and framing lumber shall be graded in accordance with Standard Specifications for Grades of California Redwood Lumber of the Redwood Inspection Service.
2. Douglas fir, larch or hemlock structural and framing lumber shall be graded in accordance with the Standard Grading Rules of the West Coast Lumber Inspection Bureau (WCLIB) or the Western Lumber Grading Rules of the Western Wood Products Association (WWPA).
3. Plywood shall conform to requirements of Product Standard PS 1 and shall be grade marked by a recognized grading agency (APA and PTL).

B. Lumber shall bear official grade mark of the association under whose rules it was graded or official grade mark of another recognized grading agency.

C. Structural and framing members 2-inch thick (nominal) and larger shall be air-dried to moisture content not to exceed 19 percent before installation.

D. Each piece of preservative treated lumber shall be identified by the Quality Mark of an approved inspection agency in accordance with CBC Chapter 23; refer to Section 01 4523: Testing and Inspection.

E. Lumber showing visible signs of mold growth:

1. Lumber showing visible signs of mold growth shall be removed from the project site or cleaned as outlined below.
2. The contractor is responsible for all costs associated with cleaning, post-cleaning testing, and reporting for lumber with mold.
 - a. Lumber that shows visible signs of mold growth prior to, or after installation, shall be cleaned pursuant to the current edition of USEPA's guidance publication "Mold Remediation in Schools and Commercial Buildings (EPA 402-K-01-001).
 - b. A minimum of 10 percent of the total locations cleaned must be sampled (tape lift method) post cleaning to ensure cleaning effort was successful. Cleaning will be considered acceptable when tape lift sample results evaluated by direct microscopic examination determine that the general abundance of mold is non-detect or rare (normal trapping to 1+).
 - c. A report prepared by a Certified Industrial Hygienist (CIH) that details the sampling and cleaning results shall be prepared and submitted to the OAR for review and approval of the LAUSD Office of Environmental Health and Safety.
 - d. Cleaned lumber shall not be installed or enclosed by finish materials until approval of test results. Cleaned lumber must meet moisture content requirements as required elsewhere in this specification prior to installation or application of finishes.

1.04 STORAGE, HANDLING AND PROTECTION

- A. The materials supplied as part of the Work of this section shall be protected from exposure to inclement weather before being covered by other Work.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Lumber: Structural and framing lumber shall be of following species and grades:

	<u>INSTALLATION</u>	<u>SPECIES</u>	<u>GRADE</u>
1.	Roof sheathing and ceiling furring	Douglas fir and larch	Construction Board, WCLIB; WWPA
2.	Joists, rafters, lintels, posts, mullions and members (2 to 4-inch thick, 2 to 4-inch wide)	Douglas fir and larch	No. 1 or better; Structural Light Framing, WCLIB;
3.	Other lumber (2 to 4-inch thick, 2 to 4-inch wide) not specified in subparagraph 5 above.	Douglas fir and larch	Construction Light Framing WCLIB; WWPA
4.	Sills or plates installed on concrete or masonry surfaces 6 inches or less above earth or finish grade.	Douglas fir and Larch Treated	Construction Light Framing WCLIB; WWPA.
5.	Miscellaneous nailing strips and blocks embedded in concrete or masonry.	Douglas fir and Larch treated	Construction Light Framing WCLIB; WWPA

- B. Plywood: Plywood furnished for structural purposes, when exposed outdoors, shall be exterior type plywood. Other plywood furnished for structural purposes shall be exterior type, or Exposure 1.

C. Preservative Treated Wood:

1. Wood and plywood specified; as treated wood shall be pressure treated wood in accordance with CBC requirements.
2. Seasoning: Treated lumber shall be air seasoned after treatment, for a minimum of two weeks before installation. Moisture content shall be 15 percent maximum.
3. Creosote or arsenic is not permitted for treating wood.
4. When treated wood member have been notched, dapped, drilled, or cut, such newly cut surfaces shall be painted with a heavy coat of the same preservative material originally provided for treatment of wood member.

D. Fire Retardant Protection: Wood and plywood specified as fire retardant protected wood shall be treated by approved methods and materials and shall be dried following treatment to maximum moisture content as follows:

1. Solid sawn lumber 2-inch thick or less: 19 percent.
2. Plywood: 15 percent.

E. Plywood Subflooring: Underlayment, Group 1, Exposure 1; of thickness indicated.

F. Mineral Fiber Panels: Asbestos-free, thickness as indicated.

G. Adhesive: Elastomeric adhesive – follow manufacturer's installation instructions. Product must be approved by OWNER Office of Environmental Health and Safety and conform to ASTM D 3498 or APA-AFG-01.

PART 3 – EXECUTION

3.01 FASTENINGS

A. Nails and Spikes:

1. Furnish only common wire nails or spikes whenever indicated, specified or required.
2. Whenever necessary to prevent splitting, holes shall be pre-drilled for nails and spikes.
3. Nails in plywood shall not be overdriven.
4. Machine Applied Nailing: Use of machine nailing is subject to a satisfactory Project site demonstration for each Project and approval by the Architect or structural engineer retained by the Architect as an Architect Consultant and DSA. Installation is subject to continued satisfactory performance. Machine nailing is not permitted for 5/16 inch plywood. Do not permit nail heads to penetrate outer ply. Maintain minimum allowable edge distances when installing nails.

B. Lag Screws:

1. When installing lag screws in a wood member, pre-drill hole as required by the CBC.
2. Lag screws, which bear on wood, shall be fitted with standard steel plate washers under head. Lag screws shall be screwed and not driven into place.

C. Bolts:

1. Lumber and timber to be fastened together with bolts shall be clamped together with holes for bolts bored true to line.
2. Bolts shall be fitted with steel plates or standard cut washers under heads and nuts. Bolts shall be tightened when installed and again before completion of the Work of this section.

- D. Wood Screws: When installing wood screws, pre-drill holes as required by the CBC.
- E. Metal Framing Devices: Framing anchors, joist hangers, ties, and other mechanical fastenings shall be galvanized or furnished with a rust inhibitive coating. Nails and fastenings shall be of the type recommended by manufacturer.

3.02 INSTALLATION

A. Roof and Ceiling Framing:

1. Wood joists shall be of the size and spacing indicated, installed with crown edge up, and shall have at least 4-inch bearing at supports. Provide 2-inch solid blocking, cut in between joists, same depth as joists, at ends and bearings, unless otherwise indicated.
2. Trimmer and header joists shall be doubled, when span of header exceeds 4 feet. Ends of header joists more than 6 feet long shall be supported by framing anchors or joist hangers unless bearing on a beam, partition, or wall. Tail joists over 12 feet long shall be supported at header by framing anchors or on ledger strips at least 2 by 4.
3. Provide solid blocking between rafters and ceiling joists over partitions and at end supports where indicated.

B. Roof Sheathing:

1. Plywood roof sheathing shall be Structural I, Grade C-D, Exposure 1, thickness as indicated.
2. Where exposed roof sheathing is indicated, area shall be sheathed solid with dressed and center matched, V-jointed boards of sizes indicated. Boards shall be installed perpendicular to supports.
3. Soffits of overhanging eaves, where indicated, shall be boxed-in using Group I, Exterior Type, Grade A-C, plywood, thickness as indicated.
4. Provide and install metal H-clips of required size, midway between rafters at unsupported edge joints of plywood roof sheathing where rafters are spaced at 24 inches on center. Clips shall be Plyclips, by Timber Fasteners Inc., Panel Clips by Simpson Co., USP Structural Connectors, or equal.

C. Furring: Where metal furring is not indicated or specified, provide wood furring at points indicated and required for concealing conduit, piping, structural framing or other unfinished materials. Wood furring shall be 2-by studs of required width. Vertical members contacting concrete or masonry shall be attached as specified for anchoring interior wood stud partitions.

D. Grounds:

1. Provide and set wood grounds at points where wood trim occurs and work is to be plastered. Grounds at 3/4 inch metal lath shall be 5/8 inch thick, net, 1 1/2-inch wide Douglas Fir, S1S. Grounds shall be doubled where trim member exceeds 5-inch width, or wherever indicated. Grounds shall be applied after lath has been installed set plumb, level and true to line.
2. Apply grounds over wood framed surfaces and lath and securely nail to wood backing at each stud or bearing. Grounds applied over steel channel studs and lath shall be securely nailed at each stud or bearing to nail-blocks provided and installed in metal studs.
3. Grounds applied to concrete surfaces shall be securely nailed to woodblocks provided and built into concrete.

E. Nailing Strips and Plates:

1. Provide wood nailing strips, plates and blocking indicated or required. Nailing strips in connection with metal work shall be bolted to metal. Wood nailing blocks for securing grounds shall be built into concrete, or masonry.
2. Nailing schedule shall comply with CBC requirements.
3. Treated wood nailing strips for lightweight insulated concrete roof decks at eaves, ridges, rakes, base of curbs and wherever else indicated, shall be provided and installed. Strips shall be treated Douglas fir, 4 inches (nominal) width by thickness of insulated concrete.

F. Wood Backing: Provide wood backing as indicated and as required to receive plumbing, electrical fixtures and equipment, cabinets, door stop plates and other fixed equipment.

3.03 CLEAN UP

A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.04 PROTECTION

A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 06 41 00

PLASTIC LAMINATE CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Plastic laminate-clad casework.
 - 2. Plastic laminate countertops.
 - 3. Hardware for the casework.
 - 4. Shelving.
 - 5. Structural supports incorporated into casework.
- B. Items associated or integral with architectural woodwork, including, but not limited to:
 - 1. Supports, reinforcement, and like components.
 - 2. Wood grounds and blocking other than those incorporated in walls and ceilings.
 - 3. Hardware and accessories.
 - 4. Plastic composite countertops.
 - 5. Concealed steel supports incorporated in architectural woodwork.
- C. Related requirements:
 - 1. Other Section of Division 06 for wood blocking or grounds inside finished walls or above finished ceilings.
 - 2. Division 12 for stainless steel countertops/drawers.
 - 3. Division 23 for plumbing fixtures and fittings installed in countertops.

1.2 REFERENCES

- A. Minimum standards for work in this Section shall conform to the North American Architectural Woodwork Standards (NAAWS) waste and those listed and referenced in the NAAWS.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate placement of backing plates and studs in walls to receive casework with the appropriate trades. Review, and annotate where required, their Shop Drawings before those are submitted to the Architect.

1.4 SUBMITTALS

- A. Shop drawings:
 - 1. The requirements of the NAAWS, and the following:
 - a. Show plan and elevation layout of each casework.
 - b. Show veneer match. Identify grain direction.
 - c. Detail joinery.
 - d. Identify core material and veneer species, cut and match.
 - e. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
 - 1. Indicate method of seismic construction by NAAWS-Seismic Test Codes Number, where relevant, or provide structural calculations signed and sealed by a California-licensed professional engineer.
 - 2. Furnish a WI "Certified Compliance Label" on the first page of the shop drawings.
- B. Samples: For each exposed product and for each color and texture specified, in manufacturer's or fabricator's standard size.

1. Corner Pieces:
 - a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
 - b. Miter joints for standing trim.
2. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.
- C. Quality Standard Compliance Certificates: WI Certified Compliance Program.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of products.
- C. Mockup:
 1. Provide a mockup consisting, as a minimum, of a full size base and wall cabinet, complete with one drawer and all hardware, constructed of same materials intended for use in the finished work.
 2. Install a countertop specified elsewhere in Decision 12.
 3. Modify or replace the mockup when the first one proves unacceptable to the Architect, until the Architect's approval is given.
 4. After approval, the mockup may remain a part of the Work if acceptable to Architect.
- D. Certified compliance:
 1. Before delivery to the jobsite the woodwork supplier shall provide a WI Certified Compliance Certificate indicating the millwork products being supplied and Certifying that these products meet the requirements of the Grade or Grades specified.
 2. Each piece of paneling shall bear a WI Certified Compliance Label.
 3. At completion of installation the woodwork installer shall provide a WI Certified Compliance Certificate indicating the products installed, and certifying that the installation of these products meets the requirements of the NAAWS custom Grade specified.
 4. Fees charged by the WI for their Certified Compliance program are the responsibility of the Contractor and shall be included in the bid.
- E. Single source responsibility: A single manufacturer shall provide and install the work of this Section.

1.6 HANDLING

- A. Deliver materials only when the Project is ready for installation and a clean storage area is available:
 1. Deliver millwork only when the area of operation is enclosed, plaster and concrete work is dry, and the area broom clean.
 2. Maintain indoor temperature and humidity within the range recommended by the NAAWS for the location of the Project.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 17 and 50 percent during the remainder of the construction period.
- C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.
- D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of cabinets indicated for construction, finishes, installation, and other requirements.
1. Provide inspections of fabrication and installation together with labels and certificates from WI certification program indicating that woodwork complies with requirements of grades specified.
 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.
- B. Grade: Custom.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.
1. Reveal Dimension: 1/4 inch.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
- F. Laminate Cladding for Exposed Surfaces:
1. Horizontal Surfaces: Grade HGS.
 2. Postformed Surfaces: Grade HGP.
 3. Vertical Surfaces: Grade HGS.
 4. Edges: Grade: PVC T-mold matching laminate in color, pattern, and finish.
 5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- G. Materials for Semi-exposed Surfaces:
1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC T-mold matching laminate in color, pattern, and finish.
 - b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 - c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
 2. Drawer Sides and Backs: Solid-hardwood lumber.
 3. Drawer Bottoms: Hardwood plywood.
- H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

- K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As indicated by laminate manufacturer's designations.
 - 2. Match Architect's sample.
 - 3. As selected by Architect from laminate manufacturer's full range of colors and textures and sheen.

2.2 WOOD MATERIALS

- A. Lumber: In accordance with the NAAWS Grade specified for the product being fabricated. Moisture content shall be 6 percent to 12 percent for boards up to 2-inch nominal thickness and shall not exceed 19 percent for thicker pieces.
 - 1. Lumber schedules to receive an opaque finish:
- B. Core MDF with no added urea formaldehyde meeting the requirements of NAAWS.
- C. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in [Section 08 71 00 "Door Hardware."] [Section 08 71 11 "Door Hardware (Descriptive Specification)."]
- B. Hardware:
 - 1. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter 2-1/2 inches deep. Trimco 562-4 4" Wire drawer pull or approved equal.
 - 2. Drawer Guides: full extension NAAWS-approved.
 - 3. Hinges: Concealed European style Grade II hinges minimum 120-degree opening Brand, Model, NAAWS-compliant.
 - 4. Shelf supports for adjustable shelves in wall-hung cabinets and the upper half of tall cabinets: Designed to prevent shelves from sliding forward in a seismic event.
 - 5. Locks: Provide the following with a minimum of 4 keys per lock.
 - a. Door locks: BHMA A156.11, E07121,
 - b. Drawer locks: BHMA A156.11, E07041.
 - 6. Door and Drawer Silencers: BHMA A156.16, L03011.

2.4 FABRICATION

- A. Plastic laminate casework:
 - 1. NAAWS Custom Grade.
 - 2. Exposed interior surfaces: Laminate matching exposed surfaces.
 - 3. Semi-exposed surfaces: Low-pressure melamine overlay.
 - 4. Doors, drawer fronts, and false fronts: Flush overlay.
 - 5. Edgeband at doors, drawer fronts, and false fronts: 3mm PVC.
- B. Drawers: Comply with the requirements of the NAAWS for the Grade specified.
- C. Laminated Plastic Countertops:
 - 1. Laminate: Refer to Finish Schedule for Manufacturer and pattern.
 - 2. Core material:
 - a. MDF at dry locations.
 - b. Exterior grade hardwood plywood with a non-telegraphing grain at wet environments.
 - 3. Back splashes: As detailed on drawings.
 - 4. Front edges: Self edge.

- D. Stainless Steel Countertops: See Division 12.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
- D. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify the adequacy and proper location of any required backing or support framing.
- B. Verify that mechanical, electrical, plumbing, and other building components affecting work in this Section are in place and ready.
- C. Correct unsuitable conditions before proceeding with installation.

3.2 INSTALLATION

- A. Install work in conformance with the NAAWS for the grade of the items being installed.
- B. Comply with NAAWS requirements for Grade of the items being installed, and Code for seismic attachment and bracing.
- C. Secure work in place, square, plumb, and level.
- D. Scribe to abutting building components.
- E. Countersink mechanical fasteners used at exposed and semi-exposed surfaces, excluding installation attachment screws and those securing cabinets end to end.
- F. Equipment cutouts indicated on the Drawings shall be cut by the installer.

3.3 FIELD QUALITY CONTROL

- A. Touchup: Field touchup is the responsibility of the installer and includes filling in of nail holes, refinishing of raw surfaces resulting from job fitting, repair of job inflicted scratches and mars, and final cleanup of the surfaces and cabinet interiors.
- B. Protection:
 - 1. Do not use the top of casework for storage.
 - 2. Do not store materials adjacent to casework unless same is protected against damage and staining.
 - 3. When painting or touching-up surfaces contiguous to casework, mask it with non-staining Kraft paper and tape.
- C. Replace millwork damaged beyond satisfactory field repair, as determined by the Architect, with satisfactory millwork.
- D. Before inspection for Substantial Completion, remove protective covering and clean interior and exterior surfaces using procedures and materials recommended by the manufacturer.

END OF SECTION

DIVISION 07

THERMAL & MOISTURE PROTECTION

SECTION 07 21 00

THERMAL BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes thermal insulation at locations specified below in and the following:
 - 1. Thermal insulation (batts) between studs in exterior walls.
 - 2. Thermal insulation (batts) in soffits where indicated.
- B. Insulation location: As a minimum, provide thermal insulation for the building envelope, as defined below
 - 1. Building envelope (all exterior walls but excluding roof insulation specified elsewhere, at parapets and openings in walls, including louvers (where no blank-off panels occur), vision glass and doors).
 - 2. Exterior soffits of air-conditioned spaces.
- C. Related requirements:
 - 1. Division 07 for roof insulation.
 - 2. Other Section of Division 07 for firestopping, including fire safing insulation.
 - 3. Other Section of Division 07 for insulation in roof hatch and vents.
 - 4. Division 22 for pipe and duct insulation.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Sequencing: Sequence and coordinate application of insulation with related work to comply with the following.
 - 1. Provide temporary enclosures to prevent deterioration of insulation exposed to unfavorable environmental conditions.
 - 2. After its application, avoid unnecessary exposure of insulation to damage during construction operations.
 - 3. Do not begin application of insulation under steel deck until clips, hangers, supports, sleeves, and other items penetrating insulation are in place.
 - 4. Defer installing ducts, piping, and other items that would interfere with the application of insulation until insulation installation is completed.
 - 5. Do not install enclosing or concealing construction until after insulation is installed, inspected, tested, and corrections are made to provide an uninterrupted thermal barrier.

1.3 SUBMITTALS

- A. Data: Manufacturer Product Data for materials specified.
- B. Shop Drawings:
 - 1. Show each type of insulation, indicating type and manufacturer, location, extent, material, insulating value, and method of attachment.
 - 2. Submit color-coded floor plans supplemented by elevations showing the location of each type of insulation. Identify material, manufacturer, thickness, R value, and method of fastening where applicable.
- C. Samples:

1. 24 inches square Samples of each type of insulation.
2. Twelve inches long Samples of tape.

1.4 HANDLING

- A. Packaging: In unopened containers and packages with labels bearing producer(s) name and source of product, date of manufacture, with UL classification on package, and R value.
- B. Storage:
 1. Keep insulation protected while stored; keep dry during and after installation.
 2. Outdoors, store off ground on pallets, protected with breathing type covers.
 3. Insulation shall be dry when installed.
 4. Remove insulation that becomes wet or damp immediately from the job site.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Install insulation in dry weather, unless building is enclosed and watertight.
- B. If insulation will be exposed to the elements after installation, cover with waterproof membrane each day; do not enclose wet insulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fiber glass batt insulation: One of the following, or equal.
 1. Owens Corning.
 2. CertainTeed.
 3. Knauf Insulation.
 4. Johns Manville.
- B. Mineral wool insulation: One of the following, or equal.
 1. Thermafiber (basis of design).
 2. Rockwool Group.
 3. Partek Insulations, Inc.
 4. Rock Wool Manufacturing Co.
 5. Fibrex Insulation, Inc.
 6. Industrial Insulation Group, LLC.
- C. Polyiso board insulation for use on above grade walls: One of the following Non-ODP, Low GWP and formaldehyde-free, complying with ASTM C578, Type XV..
 1. Glass-Fiber-Mat Faced: ASTM C1289, glass-fiber-mat faced, Type II, Class 2, Grade 2 (20 psi).
 - a. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 2. Manufacturers:
 - a. Enverge CI foil faced by Firestone.
 - b. Hunter Xci CG by Hunter Panels
 - c. EnergyShield CGF Pro by Atlas.
- D. Polystyrene board insulation for use on below grade walls: One of the following.
 1. Foamular 150 by Owens Corning

2. ThermaDRain Insulated Drainage Board.
3. Insulfoam a Carlisle Co.
4. Or equal rigid insulation that also serve as a protection/drainage board.

E. Foamed-in-place insulation: As specified below.

2.2 PERFORMANCE/DESIGN CRITERIA

- A. Comply with these Specifications for thermal resistance, and to the Drawings for maximum or minimum thickness of insulation required.
1. Provide the thermal resistance (R value) indicated to limit building thermal gains and losses.
 2. Select appropriate products from list of materials to provide (a) the specified thermal value for the building envelope, (b) compatibility when incorporated into finished system while ensuring substrate conditions as well as their ability to adhere components permanently, where applicable, in rigid manner, and (c) maintain flexibility where required in finished work.
 3. Provide insulation materials and their facings that do not support fungal growth when tested in accordance with ASTM C1338.

2.3 THERMAL INSULATION

- A. Thermal resistance ("R" value): Minimum of 13, except as noted.
- B. On soffits exposed to view (not concealed by a suspended ceiling): CertaPro Commercial Board by CertainTeed Corp. with a white kraft-scrim-foil (ASJ) facing adhered to the fiber glass board.
- C. Sprayed foam sealant: Fire-rated polyurethane foam insulation meeting ASTM E 84, one- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 pcf density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
1. Dow.
 2. Tiger Foam Insulation.
 3. Fomo Products, Inc., or equal.
- D. At all other locations:
1. Type: Glass fiber or mineral wool batt or blanket insulation complying with ASTM C 665, Type III, Class A, flame spread (FSK) 25 or less, formaldehyde-free by Johns Manville, Knauf, or equal.
 2. Width: Batt width shall match the stud spacing and be sized for a friction-fit to be self-supporting.

2.4 INSTALLATION MATERIALS

- A. Insulation supports for between rafters insulation: 13-gage steel, IS16 and IS24 (depending on wood framing spacing) by Silver Metal Products, Inc., Southeastern Wire, Moore Products, or equal.
- B. Adhesive used with impaling pins: Made, or approved by the clip manufacturer. Do not use "peel and press" hangers with self-adhesive back.
- C. Staples, zinc-coated wires and other devices for fastening insulation: As recommended by the insulation manufacturer.
- D. Insulation tape:
1. Polyethylene Adhesive Tape: "Scotch brand No. 483" by 3M.
 2. Foil Vapor Barrier Tape:
 - a. Pressure sensitive aluminum foil tape, 2 mils thick, 3-inch wide, "Scotch brand No. 425" by 3M.
 - b. "Dead Soft Aluminum Foil Tape" by Hanson Ltd.

- c. "FSK Copolymer" by Compac Corp.
- d. "General Purpose FSK Facing Tape" by Venture Tape.
- e. Or equal FSK-faced cold weather tape.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

- A. Examine conditions and measurements affecting the work of this Section at site.
- B. Correct detrimental conditions before proceeding with installation.
- C. Before installing insulation in stud walls, thoroughly vacuum space clean of dust and debris. Also clean spandrel cavities in the same manner.

3.2 INSTALLATION

- A. Install insulation where shown and specified. Cut to fit irregular spaces, butt edges into firm contact with each other and adjoining surfaces.
 - 1. Hand pack around pipes, ducts, conduits, electrical boxes, and other penetrations as required to thoroughly fill all voids and spaces between framing members and to form a continuous thermal barrier.
 - 2. Do not compress insulation more than 10 percent.
 - 3. Where door and window frames occur in insulated assemblies, cut additional strips of insulation and hand-pack in and around the frames or use foam insulation to fill all voids.
 - 4. Insulate boxed headers and studs in exterior walls.
 - 5. Use foam insulation for small spaces that are difficult to insulate otherwise. Fill space completely and trim insulation flush with face of wall when cured.
 - 6. Comply with the National Electrical Code (NEC) for installation in proximity to light fixtures. Do not install insulation closer than recommended by NEC.
 - 7. Where in-wall electrical conduit is parallel to the wall, slit the insulation halfway to bury the conduit in it. Where the conduit is perpendicular to the wall, do not oversize the penetration; tape the conduit to prevent heat leakage.
 - 8. Install foil-faced insulation with foil facing the building interior.
- B. Batt insulation in stud walls:
 - 1. Install wall insulation with aluminum foil facing interior of the building, with a friction fit to studs, short joints closely butted, and with joints square, straight without warp or twist.
 - 2. Cut and fit insulation to closely fit intersecting or penetrating surfaces.
 - 3. Leave no voids in completed installation.
 - 4. Provide insulation to meet the overall thermal resistance requirements of the exterior wall enclosure.
- C. Rigid insulation – under radiant floor heating system:
 - 1. Where more than one layer of insulation is required to achieve the thermal resistance specified, apply adhesive in ribbons 6 inches apart to insulation in accordance with the adhesive manufacturer's instructions so when in place, the boards are firmly adhered to each other. Adhere the bottom boards to a clean, dry substrate in the same manner. Stagger joints between boards.
 - 2. Protect board until the radiant system is installed and has been successfully tested. Prohibit non-essential foot traffic from exposed boards.
- D. Attach insulation to solid surfaces as follows:
 - 1. Provide insulation fasteners at typical spacing specified, or equivalent area for panels of a different size and for any cut panel sizes, except not less than 2 fasteners for any single piece.
 - 2. Offset intermediate end joints in adjacent panels not less than 48 inches.

- 3. For 24-inch wide units follow insulation manufacturer's instructions. Provide a minimum of 6 fasteners. Space edge fasteners no more than 3-inch from edges.
 - E. Between rafters, support insulation with insulation supports spaced at 16 inches o.c. maximum.
 - F. After installation is complete and before concealing, seal joints between insulation, between insulation and intersecting or penetrating surfaces and between insulation and perimeter surfaces with 4-inch wide vapor-proof aluminum colored tape applied on the aluminum foil facing side. Seal fastener punctures with aluminum colored vapor-proof mastic or use tape used for sealing joints.
- 3.3 FIELD QUALITY CONTROL
- A. Prior to closing-in of insulated assemblies, or prior to Substantial Completion for insulation that will remain exposed in the building, refit, reinstall and/or replace wet, damaged and displaced insulation.

END OF SECTION

SECTION 07 26 00
VAPOR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vapor barrier for below slab-on-grade.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 03 30 00: Cast-in-Place Concrete.
 - 3. Division 09: Finishes; flooring sections.

1.2 REFERENCES

- A. American Concrete Institute (ACI) Publication:
 - 1. ACI 302.2R - Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
- B. ASTM International (ASTM):
 - 1. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
 - 2. ASTM D1709 - Standard Test Methods of Impact Resistance of Plastic Film by the Free-Falling Dart Method.
 - 3. ASTM E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs.
 - 4. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
 - 5. ASTM E1643 - Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for vapor barrier and accessories.
- B. Samples:
 - 1. 12 inch by 12 inch vapor barrier samples.
 - 2. Pressure-Sensitive Tape: 12 inch long sample.
- C. Test Reports: Conducted by nationally recognized independent testing agency indicating conformance with specified performance requirements.

1.4 QUALITY ASSURANCE

- A. ASTM tests referenced in this Section shall be performed on a single production roll per ASTM E1745 Section 8.1. Submit third party documentation certifying this requirement.

- B. Pre-Installation Conference: Contractor shall coordinate and conduct pre-installation conference in accordance to Section 01 31 19, Project Meetings, to review the progress of construction activities and preparations for the installation of vapor barrier.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging with labels intact.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Multi-layer plastic extrusion manufactured with high grade prime, virgin, polyolefin resins. Thickness shall be 15 mils minimum.
 - 1. Stego Wrap by Stego Industries LLC.
 - 2. Perminator by W.R. Meadows.
 - 3. Ecoshield-E by Epro.
 - 4. Equal.
- B. Physical Properties:
 - 1. Maintain permeance of less than 0.01 Perms as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
 - 2. Class Rating per ASTM E1745: Class A.
 - 3. Puncture resistance per ASTM D 1709: 2200 g or higher.
 - 4. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1
- C. Accessories: Provide manufacturer recommended accessories for seams, penetrations and perimeter edges, including tapes, mastics, termination for a complete vapor barrier installation per ASTM E1643.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine subsoil and notify OAR of deficiencies detrimental to proper vapor barrier installation; do not proceed until corrected.

3.2 INSTALLATION

- A. Install vapor barrier in accordance ASTM E1643 and manufacturer's instructions.
 - 1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
 - 2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise, where obstructed by impediments, such as dowels, waterstops, or any other site condition requiring early termination of the vapor barrier. At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself using manufacturer ASTM

E1643 compliant accessory designed to adhere to concrete. Seam tape shall not be used for sealing the vapor barrier to the foundation wall, grade beam or slab.

3. Overlap joints 6 inches and seal with manufacturer's seam tape.
4. Seal vapor barrier penetrations per manufacturer's instructions.
5. Avoid the use of non-permanent stakes driven through the vapor barrier.

- B. Prior to concrete placement inspect vapor barrier for damage. Clean damaged areas and with vapor barrier material cut a minimum 6 inches larger than damaged area on all sides. Seal to main vapor barrier with continuous seam tape.

3.3 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.4 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 07 41 13

STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes pre-finished standing-seam metal roof panels.
- B. Related Sections:

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, , 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 plywood, purlins and rafters 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.
- B. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include standard construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include job specific 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.
 - 3. Indicate locations of field- and factory-applied sealant.
- C. Samples
 - 1. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
 - 2. Include similar Samples of trim and accessories involving color selection.
 - 3. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 4. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.
- D. Qualification Data: For Installer.

- E. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- F. Field quality-control reports.
- G. Sample Warranties: For special warranties.
- H. Closeout submittals:
 - 1. Maintenance Data: For metal panels to include in maintenance manuals.

1.4 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 field-forming: 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.
- D. Retain first subparagraph below for large-scale mockup. Indicate portion of roof represented by mockup on Drawings or draw mockup as separate element.

1.5 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.

1.6 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.

1.7 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.

1.8 WARRANTY

- A. Weathertight Performance Warranty: Manufacturer's standard warranty in which manufacturer agrees to repair or replace metal roof panel assemblies that fail to remain weather tight within 5 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. Architectural fluorocarbon finish:
 - a. Will be free of fading or color change in excess of 5 Hunter delta-E units as determined by ASTM D2244-02.
 - b. Will not chalk in excess of numerical rating of 8 when measured in accordance with standard procedures specified in ASTM D4214-98 method D659.

- c. Will not peel, crack, chip, or delaminate.
- 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for steep-slope roof products.
 - 1. Solar reflective index (SRI): Not less than 29 per ASTM E1980.
 - 2. Reflectance and Emissivity:
 - a. Solar Reflectance: Not less than 0.25 per ASTM test methods C1549 or E1918, or CRRC-1 Method #1.
 - 3. Thermal Emissivity: Not less than 0.75 per ASTM C1371.
- B. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:
 - 1. Three-year, aged solar reflectance of not less than and emissivity of not less than 0.75.
- C. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
 - 4. Test-Pressure Difference: 6.24 lbf/sq. ft.
- D. 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: 15.0 lbf/sq. ft.
- E. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
 - 2. Fire/Windstorm Classification: Class 1A- 90.
 - 3. Hail Resistance: MH.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- H. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
 - 1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.

2.2 STANDING-SEAM METAL ROOF PANELS

- A. Manufacturer:
 - 1. Basis of Design: MS-150 by Taylor Metal Products, 4566 Ridge Drive NE, Salem OR: 1-800-574-1388. ICC Report No. UL ER25913-01.
 - 2. AEP Span, a Division of ASC Profiles, Inc. IAPMO UES ER-309
 - 3. Or equal.

- B. Panels: 1.5" Mechanical Seam Metal Roof Panel
 - 1. Material: Steel.
 - 2. Thickness: 24 Gauge: minimum thickness of .0236 inches.
 - 3. Yield strength as required for performance indicated: ASTM A653: Steel Sheet, Zinc Coated (Galvanized) Class G90 by the Hot Dip Process. For projects with multiple profiles of varied combinations of profiles, rib patterns and finishes, show on drawing.
 - 4. Panel Width and Pattern: 16-inch.
 - 5. Profile: Accent ribs pattern.
 - 6. Panel Seam Height: 1.5".
- C. Clips: Two-piece floating to accommodate thermal movement.
 - 1. Material: 0.028-inch- nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
- D. Fasteners: As recommended by manufacturer for performance indicated.

2.3 UNDERLAYMENT

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: Stable after testing at 300 deg F; ASTM D 1970.
 - 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
 - 3. System based on Grace Ultra by GCP Applied Technologies, or equal.
- B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 ACCESSORIES

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- E. 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 wide and 1/8 inch 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. Field-applied sealant: Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel. Transverse seams are not allowed.
- 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. Seams
 - 1. Panel seams shall interlock entire length of seam.
 - 2. Design standing seam to lock up and resist joint disengagement during design wind uplift conditions as calculated according to local building codes.
 - 3. Provide pre-installed sealant within confines of panel's female leg to aid in resistance of leaks and provide panel-to-panel seal while allowing expansion and contraction movement.
 - 4. Seams shall be continuously locked or crimped together by mechanical means during installation. Seaming tools shall be sourced from manufacturer.
 - 5. Seam Sealant: Factory apply high-grade butyl mastic sealant within the confines of panel's female leg, designed to seal against adjacent male panel leg.
- F. 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 non-expansion, 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.

2.6 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 - 1. Exposed Finish: Polyvinylidene Fluoride, full 70 percent Kynar 500® consisting of a baked-on 0.15-0.20 mil corrosion resistant primer and a baked-on 0.70-0.80 mil finish coat with a specular gloss of 8 to 15 when tested in accordance with ASTM D523 at 60 degrees.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
3. Color: Choose from full range of manufacturer's standard colors.

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.
- B. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
- C. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.
- B. Apply over the roof area indicated below:
 1. Apply over entire roof surface.
- C. Slip Sheet: Apply slip sheet over protection board before installing metal roof panels.
- D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07 62 00 "Sheet Metal Flashing and Trim."

3.4 METAL PANEL INSTALLATION

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

- B. Fasteners:
1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
1. Install clips to supports with self-tapping fasteners.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 4. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
 - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
 5. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - a. 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.
- F. 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 with no joints allowed within 24 inches 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 deep, filled with mastic sealant (concealed within joints).
- G. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- H. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
1. Connect downspouts to underground drainage system indicated.
- 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 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

SECTION 07 52 16

SBS MODIFIED BITUMEN ROOFING AND ROOF INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide all labor, equipment, and materials to install modified bitumen roof system over the properly prepared substrate for Norwalk La Mirada Unified School District: District to provide materials under their CMAS authority as listed in the end of this specification. All materials and quantities not listed shall be contractor purchased and supplied.
- B. General Scope of Work:
 - 1. Provide and install red rosin sheet and mechanically fasten a Type II Base Sheet.
 - 2. Provide and install two plies modified roofing system consisting of smooth surface SBS modified membrane and a Granulated surfaced membrane in hot asphalt.
 - 3. Follow all procedures in this specification (written and drawn) for all conditions.
 - 4. Raise all curbs to reach 8 inches.
 - 5. Provide and install zinc flashings on all roof top penetrations
 - 6. Provide and install new redwood blocks & walk-pad under all metal pipes and conduit.
 - 7. Provide and install all new metal coping cap, counterflashing, and edge metal broken from supplied flat sheets per ANSI SPRI – ES1 wind uplift code.
 - 8. Indicated drains to be replaced and or sumped.
 - 9. Install flat and tapered insulation and crickets as indicated on drawings.
 - 10. AC Duct and indicated equipment cleaned, primed and coated with specified white-title 24 coating.
 - 11. Coat finished roofs with title 24 coating, combining polyurethane and elastomeric latex.
- C. Related Work Specified Elsewhere:
 - 1. Section 06 10 00 - Roof Related Wood Components
 - 2. Section 07 60 00 - Roof Related Metal Work

1.2 REQUIRED MEETINGS

- A. Pre-Application Conference:
 - 1. Prior to beginning work, a pre-application conference will be held at the job site. Those required to attend will be the Roofing Contractor, the Sheet Metal and other applicable Subcontractors, a Roofing Manufacturer Representative, and the Architect. A District Representative may also be present. Contractor will coordinate the date with the Architect and coordinate the Pre-Application Conference so that all required parties are in attendance.
 - 2. Attendees shall review all pertinent details and specifications, noting any potential problems and making any changes, deletions, or additions as deemed necessary. Also included in the discussion will be the following: nature and availability of roofing materials, guarantee and submittal requirements, scheduling and forecast of weather conditions, regulatory requirements, protection of building, building components, and completed roof system; proposed installation procedures, and any additional items related to the total roof system.
 - 3. Attendees shall tour representative roof areas and discuss roof construction and general conditions including roof slope, expansion joints, supports and penetrations, roof-top equipment, flashing conditions, material compatibility, etc.
 - 4. No roofing work shall commence, nor material delivered to the job site until after the Pre-Application Conference.

B. Final Inspection:

1. Upon completion of all specified work items, a Final Roof Inspection shall be performed with representative(s) from each of the following in attendance: Roofing Contractor, Roofing Consultant, Roofing Manufacturer and any applicable Subcontractors. Any discrepancies or incomplete work shall be documented in a "punch list" which will be issued to the Contractor.
2. A follow-up inspection shall be conducted if needed to confirm satisfactory completion of all punch list items. Ten percent (10%) retention will be withheld until completion and confirmation of all punch list items as well as all other outstanding project requirements.

1.3 SUBMITTALS

A. Submit at Least One Week Prior to Pre-Application Conference:

1. Product Data:
 - a. For insulation and roof system component fasteners.
 - b. Current product literature, installation instructions and details.
2. Shop Drawings:
 - a. Layout and thickness of insulation.
 - b. Base flashings and membrane terminations.
 - c. Flashing details at penetrations.
 - d. Tapered insulation, including slopes.
 - e. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
 - f. Crickets, saddles, and tapered edge strips, including slopes.
 - g. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
 - h. Tie-in with adjoining air barrier.
3. Samples.
 - a. Sheet membrane products.
 - b. Insulation products
 - c. Base sheet and insulation fasteners
 - d. Protection Pad material.
4. Copy of guarantee application submitted to and initially approved by the Manufacturer.
5. Material Safety Data Sheets (MSDS) for all products containing "Hazardous Materials" as defined on lists issued by both the Federal and State governments. Maintain copies of MSDS sheets at the job site.
6. Approved applicator certification letter(s) from Roofing Manufacturer documenting at least three (3) years of approval, including current approval for the specified project submitted with their bid.
7. Certification of roofing manufacturer's ISO 9001, 9002 or 9001: 2000 compliance.
8. Letter of certification from the primary Manufacturer stating that the system specified or proposed is appropriate for the geographical area and type deck, that the specified requirements are either acceptable or exceed their requirements for the specified guarantees, and that the systems comply with specified UL requirements. Any items not acceptable or detrimental to system performance shall be noted prior to bid for review and clarification.
9. Submit photo or video, and written record of any existing interior and/or exterior building damage, leakage and/or other pre-existing condition(s). Conditions not recorded will be subject to repair by contractor, to District's satisfaction, without additional cost.
10. Where roofing or flashing requirements vary from those described herein or on details, submit shop drawings and/or specifications to describe proposed modifications prior to job start.
11. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

B. Submit During Project:

1. Any shop drawings or other requested information.

C. Submit Upon Completion

1. Contractor's Guarantee Agreement
2. Manufacturer Guarantee
3. Letter of certification stating that the products and installation performed on the project comply with contract requirements, that any punch list items from the final inspection have been resolved and that the work is complete.

1.4 QUALITY ASSURANCE

- A. Contractor shall possess/maintain, on site, a copy of specifications, MSDS sheets, related documents, all pertinent drawings and any addendum information.
- B. Project quality control is the Contractor's responsibility and obligation. Nothing contained herein or stated shall imply any obligation by the District or his Representative(s) to Contractor by performing such field observation, nor shall field observation relieve Contractor of any responsibility under the terms of the contract.
- C. Comply with local, state and federal regulations, safety standards and codes. Use the strictest document when a conflict arises.
- D. The responsibility for proper installation of all components of the roofing system lies with the Contractor. The Contractor shall inform the Architect of any conditions detrimental to the quality of construction or long-term performance of the roofing system and shall not proceed with the work until the conditions are corrected.
- E. Contractor shall maintain internal quality control through instruction, supervisory inspection, and knowledgeable personnel for a proper installation without taking test cuts. This, however, does not limit the District's right to request cuts be taken by the Contractor and repaired as indicated by the Manufacturer and approved by the District.
- F. Contractor must maintain a full-time supervisor/foreman on the job site during times that roofing work is in progress. This person shall have a minimum of five (5) years' experience in roofing work similar in nature and scope to specified roofing. The same person shall continue on the project through final acceptance, unless the person's performance on the project is not acceptably adequate or impedes project productivity.
- G. Contractor shall be responsible for meeting fire regulations. A certified fire extinguisher of adequate size shall be located at the asphalt kettle, tanker, point of application and elsewhere as required.
- H. Whenever specification items found herein are less stringent than Manufacturers' requirements, Manufacturers' requirements shall be followed.
- I. Special precautions may be necessary when installing the roof system at temperatures below 45 degrees F to insure satisfactory application and performance.
- J. The Contractor selected for this work must have at least five (5) years experience in installation of comparable roofing systems to that proposed and shall have installed at least 100,000 square feet of proposed membrane in the past year. He shall have a minimum of three (3) years documented approval by the primary Roofing Manufacturer, capable of providing the specified guarantee(s) and contractor shall submit with their bid a letter from the manufacturer stating that they are an approved applicator for the specific project.
- K. Primary roofing manufacturer shall be a company specializing in manufacturing modified bitumen roofing products with minimum 12 years experience and shall have certification of ISO 9001, 9002 or 9001:2000 compliance.

1.5 PRODUCT HANDLING

- A. On packaged asphalt, all cartons shall be imprinted with Manufacturer's name, ASTM type, flash point, and EVT. For bulk asphalt, type, flash point, and EVT shall be included on bill of lading accessible at the job site. Asphalt delivered in bulk containers shall be stored at a temperature at least 25 degrees F below the Finished Blowing Temperature.
- B. Wet materials shall not be applied nor shall roofing application proceed during wet weather or when moisture is on roof deck.
- C. Deliver materials to jobsite on pallets in original, unopened packaging with legible labels. Package labels shall indicate product name, production date, product code and testing agency.
- D. Store materials in dry, protected areas in upright position. When stored outdoors, store on pallets above ground and cover top and all sides with suitable protective sheet or tarpaulin. Do not double-stack pallets on the job site. Shrink-wrap packaging is not intended for long-term jobsite storage and shall be removed upon arrival at jobsite and replaced with a watertight breathable covering.
- E. Select and handle materials and equipment in such a way as to avoid damage to materials, existing construction, or applied roofing.
- F. Do not load or permit any part of structure to be loaded with a weight that will endanger its safety or cause damage. Confine equipment, storage of materials and debris and the operations and movements of workmen within any limits as indicated by the District Representative.
- G. Wet, damaged or defective material shall be marked and removed from the job site by Contractor that same day. This material shall promptly be replaced at no cost to the District.
- H. Contractor shall take every precaution to prevent interior leakage, materials falling into the interior, or other such occurrences. Installation of materials shall be accomplished in such a manner as to eliminate infiltration of bitumen, dust or debris into the building.

1.6 PROTECTION

- A. Protect the building and the contents of the building from all risks resulting from the work. Contractor shall be sufficiently prepared to expediently install a temporary membrane to protect areas of torn-off or incomplete roofing in the event of rain.
- B. No staging of materials or equipment shall occur on finished roofing. Scheduling of work shall allow for commencement of roof installation at locations opposite roof access points, working in toward access/staging area, in order to accommodate this requirement.
- C. Special care shall be exercised when trafficking is necessary over newly installed roofing. Traffic over these roof areas shall be minimized whenever possible. Provide special protection measures when significant traffic is required over new roofing. The Contractor shall be responsible for patching of any existing surface or component not scheduled for replacement or alteration, which is damaged during any sequence of the work.
- D. Take every precaution to prevent interior leakage, tear-off materials and new materials from falling into the interior, or other such occurrences during both roof removal and application of new materials.
- E. The Contractor shall notify the District if any seriously deteriorated structural member is uncovered, prior to placement of new materials. Replacement of any deficient structural member, not specifically designated for replacement, will be at the decision and expense of the District.
- F. Existing materials designated to remain, which are damaged or defaced as a result of the work and are unsuitable for the use intended, shall be replaced at the Contractor's expense, to the satisfaction of the District.

1.7 GUARANTEE

A. Contractor's Guarantee Agreement:

1. For a five (5) year period from the date of completion and District's acceptance, Contractor agrees to inspect and make necessary repairs to defects or leaks in the roof and flashings. Emergency leaks will be attended to within twenty-four (24) hours from receipt of notice from the District. As soon as weather permits, Contractor will restore affected areas to standards of this contract and repair any damages from these leaks without cost to District, except for leaks caused by abuse to roof by others or by abnormal weather conditions such as lightning, severe hail, or other unusual climatic phenomena. This Guarantee must be submitted to the District in writing before final payment is released for the project.

B. Manufacturer Guarantee:

1. Submit to the District, Manufacturer's NDL (No Dollar Limit) guarantee covering any and all repairs/replacements to keep the roof, including the field and flashing, watertight for period of Thirty (30) years beginning at the time of the District's acceptance of final product. Cost of this guarantee shall be borne by the Contractor.
2. This guarantee shall be executed by the primary Roofing Manufacturer to cover any and all costs for repairs necessary to stop leaks which occur resultant of, but not limited to, the following:
 - a. Deterioration of the roofing membrane or base flashing system resulting from ordinary wear and tear by the elements.
 - b. Workmanship on the part of the approved Roofing Contractor in application of the roofing membrane or base flashing system.
 - c. Blisters, fishmouths, bare spots, ridges, or wrinkles in the roofing membrane.
 - d. Splits or cracks in the roofing membrane not caused by structural movement.
 - e. Slippage of the roofing membrane or base flashing.

- C. If, 24 hours after notification of roof leakage Contractor has not responded, District shall have the right, without invalidating his Guarantees and at the expense of the Contractor, to make any emergency temporary repairs that are required in order to protect the building and its contents from damage due to roof leakage.

D. Pre-Lapse Inspection

1. Prior to expiration of the Contractor's Guarantee, Contractor shall schedule an inspection of the guaranteed roof by the District's Representative. At this time, any defects noted shall be documented. Any defects falling within the Contractor's Guarantee liability shall be repaired by him prior to expiration of his Guarantee. Failure to make proper repairs within the guarantee period shall result in extension of the Contractor's Guarantee until acceptable completion of all applicable repair items.

- E. Manufacturer of District Furnished Materials to attend all pre-construction meetings, continuous construction meetings as related to roofing, supervise installation of all roofing, minimum 3 days per week and provide written weekly reports complete with photo documentation to the district, attend final job and punchlist walk, provide yearly maintenance for the life of the warranty, and bi-annual follow-ups.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

- A. Acceptable Manufacturer: Garland Company, Inc. (The), which is located at: 3800 E. 91st St.; Cleveland, OH 44105; Toll Free Tel: 800-321-9336; Tel: 216-641-7500;
- B. Requests for substitutions will be considered based on service and performance criteria as indicated in this specification.
- C. Substitutions to be submitted 10 days prior to bid opening.

2.2 ROOF INSULATION

- A. General: Preformed roof insulation boards, manufactured or approved by roof membrane manufacturer.
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 3, felt or glass-fiber mat facer on both major surfaces.
 - 1. Total minimum R-value: R-30.
 - 2. Compressive Strength: **25 psi**.
 - 3. Thickness:
 - a. Base Layer: 2-1/2 inches.
 - b. Upper Layer: 3-inches.
- C. Tapered Insulation: Provide factory-tapered insulation boards.
 - 1. Material: Match roof insulation.
 - 2. Minimum Thickness: 1/4 inch.
 - 3. Slope:
 - a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
 - b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.3 HOT APPLIED 2-PLY ASPHALT ROOFING

- A. Nailable Base Sheet: One ply fastened to the deck per wind uplift calculations.
- B. Base (Ply) SBS Modified Membrane: One ply Type II ASTM 6162 bonded to the prepared substrate with Interply Adhesive:
- C. Modified Cap (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive:
 - 1. Type II ASTM 6162 Fiberglass reinforced Cap sheet as approved by manufacturer.:
- D. Interply Adhesive: (1 and 2): Generic Type III or IV low odor Asphalt:
- E. Flashing Base Ply: One ply bonded to the prepared substrate with Interply Adhesive except for torch applied: FlexBase 80.
- F. Flashing Cap (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive except for torch applied:
 - 1. StressPly IV UV Mineral: curbs
 - 2. 60 mil KEE membrane: perimeter parapet walls over 2' in height.
- G. Surfacing:
 - 1. Surface Coatings
 - a. Title 24 2 part elastomeric coating
 - b. Title 24 White Knight Plus wc as indicated
- H. Perimeter parapet wall flashings: Fleeceback KEE Membrane, 60 mil, supplied and manufactured by membrane manufacturer, set in specified hot asphalt, heat welded seams, 3 course base onto field of roof with white knight plus and wrapped on top of nailer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Inspect and approve the deck condition, slopes and fastener backing if applicable, parapet walls, expansion joints, roof drains, stack vents, vent outlets, nailers and surfaces and elements.

- C. Verify that work penetrating the roof deck, or which may otherwise affect the roofing, has been properly completed.
- D. If substrate preparation and other conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. General: Clean surfaces thoroughly prior to installation.
 - 1. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
 - 2. Fill substrate surface voids that are greater than 1/4-inch-wide with an acceptable fill material.
 - 3. Roof surface to receive roofing system shall be smooth, clean, free from loose gravel, dirt and debris, dry and structurally sound.
 - 4. Wherever necessary, all surfaces to receive roofing materials shall be power broom and vacuumed to remove debris and loose matter prior to starting work.
 - 5. Do not apply roofing during inclement weather. Do not apply roofing membrane to damp, frozen, dirty, or dusty surfaces.
 - 6. Prime decks where required, in accordance with requirements and recommendations of the primer and deck manufacturer.

3.3 INSTALLATION - GENERAL

- A. Install modified bitumen membranes and flashings in accordance with manufacturer's instructions and with the recommendations provided by the National Roofing Contractors Association's Roofing & Waterproofing Manual, the Asphalt Roofing Manufacturers Association, and applicable codes.
- B. General: Avoid installation of modified bitumen membranes at temperatures lower than 40-45 degrees F. When work at such temperatures unavoidable use the following precautions:
 - 1. Take extra care during cold weather installation and when ambient temperatures are affected by wind or humidity, to ensure adequate bonding is achieved between the surfaces to be joined. Use extra care at material seam welds and where adhesion of the applied product to the appropriately prepared substrate as the substrate can be affected by such temperature constraints as well.
 - 2. Unrolling of cold materials, under low ambient conditions must be avoided to prevent the likelihood of unnecessary stress cracking. Rolls must be at least 40 degrees F at the time of application. If the membrane roll becomes stiff or difficult to install, it must be replaced with roll from a heated storage area.
- C. Commence installation of the roofing system at the lowest point of the roof (or roof area), working up the slope toward the highest point. Lap sheets shingle fashion so as to constantly shed water.
- D. Install tapered insulation and crickets with continuous straight lines, staggered 6" with consistent overlaps in all directions. Set each layer in 30 lbs of asphalt, walk boards to ensure full adhesion and install tapered edge to ensure full adhesion. Gaps and holes in insulation over 1/4 inch to be filled.

3.4 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 deg F (14 deg C).
- D. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows and with long joints continuous at right angle to flutes of decking.
 - a. Locate end joints over crests of decking.
 - b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
 - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).
 - 1) Trim insulation, so that water flow is unrestricted.
 - f. Fill gaps exceeding 1/4 inch with insulation.
 - g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - h. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
 - i. Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches from previous layer of insulation.
3. Staggered end joints within each layer not less than 24 inches in adjacent rows.
4. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
5. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
6. Make joints between adjacent insulation boards not more than 1/4 inch in width.
7. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches.
8. Trim insulation, so that water flow is unrestricted.
9. Fill gaps exceeding 1/4 inch with insulation.
10. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
11. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
12. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
13. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 INSTALLATION OF COVER BOARD

- A. Install cover boards over insulation with long joints in continuous straight lines, with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.
 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

2. At internal roof drains, conform to slope of drain sump.
 - a. Trim cover board, so that water flow is unrestricted.
 3. Cut and fit cover board tight to nailers, projections, and penetrations.
 4. Adhere cover board to substrate using adhesive as recommended by manufacturer.
- B. Install sheathing paper over cover board and immediately beneath roof membrane.

3.6 INSTALLATION HOT APPLIED ROOF SYSTEM

- A. Base Ply(s): Install modified base ply in twenty-five (25) lbs. per square of bitumen shingled uniformly to achieve one or more plies over the entire prepared substrate. Shingle in direction of slope of roof to shed water on each area of roof. Do not step on base rolls until asphalt has cooled, fish mouths should be cut and patched.
1. Lap ply sheet ends 8 inches. Stagger end laps 2 inches minimum.
 2. Install base flashing ply to all perimeter and projection details after membrane application.
 3. Extend plies 2 inches beyond top edges of cants at wall and projection bases.
 4. Install base flashing ply to all perimeter and projection details.
 5. Allow the one ply of base sheet to cure at least 30 minutes before installing the modified membrane. However, the modified membrane must be installed the same day as the base plies.
- B. Modified Cap Ply(s): Solidly bond the modified membrane to the base layers with specified material at the rate of 25 to thirty 30 lbs. per 100 square feet.
1. Roll must push a puddle of hot material in front of it with material slightly visible at all side laps. Use care to eliminate air entrapment under the membrane. Exercise care during application to eliminate air entrapment under the membrane.
 2. Apply pressure to all seams to ensure that the laps are solidly bonded to substrate.
 3. Install subsequent rolls of modified membrane as above with a minimum of 4 inch (101 mm) side laps and 8 inch (203 mm) end laps. Stagger end laps. Apply membrane in the same direction as the previous layers but stagger the laps so they do not coincide with the laps of the base layers.
 4. Apply hot material no more than 5 feet (1.5 m) ahead of each roll being embedded.
 5. Extend membrane 2 inches (50 mm) beyond top edge of all cants in full moppings of the specified hot material.
- C. Fibrous Cant Strips: Provide non-combustible perlite or glass fiber cant strips at all wall/curb detail treatments where angle changes are greater than 45 degrees. Cant may be set in approved cold adhesives, hot asphalt or mechanically attached with approved plates and fasteners.
- D. Wood Blocking, Nailers and Cant Strips: Provide wood blocking, nailers and cant strips as specified in Section 06114.
1. Provide nailers at all roof perimeters and penetrations for fastening membrane flashings and sheet metal components.
 2. Wood nailers should match the height of any insulation, providing a smooth and even transition between flashing and insulation areas.
 3. Nailer lengths should be spaced with a minimum 1/8-inch gap for expansion and contraction between each length or change of direction.
 4. Nailers and flashings should be fastened in accordance with Factory Mutual "Loss Prevention Data Sheet 1- 49, Perimeter Flashing" and be designed to be capable of resisting a minimum force of 200 lbs/lineal foot in any direction.
- E. Metal Work: Provide metal flashings, counter flashings, parapet coping caps and thru- wall flashings as specified in this document.
- F. Termination Bar: Provide a metal termination bar or approved top edge securement at the terminus of all flashing sheets at walls and curbs both vertical and horizontal. Fasten the bar a minimum of 8 inches (203 mm) o/c to achieve constant compression. Provide suitable, sealant at the top edge and butyl tape.

- G. Flashing Base Ply: Install flashing sheets by the same application method used for the base ply.
1. Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
 2. Prepare all walls, penetrations, expansion joints and surfaces to be flashed with required primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.
 3. Adhere to the underlying base flashing ply with specified hot material unless otherwise noted in these specifications. Nail off at a minimum of 8 inches (203 mm) o.c. from the finished roof at all vertical surfaces.
 4. Solidly adhere the entire sheet of flashing membrane to the substrate.
 5. Coordinate counter flashing, cap flashings, expansion joints, and similar work with modified bitumen roofing work as specified.
 6. Coordinate roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices with the roofing system work.
- H. Flashing Cap Ply: Install flashing cap sheets KEE Membrane as indicated below.
1. Seal curb, wall and parapet flashings
 2. Prepare all walls, penetrations, expansion joints and where shown on the Drawing. Adhere to the underlying base flashing ply with specified flashing ply adhesive unless otherwise specified. Nail off at a minimum of 8 inches (203 mm) o.c. from the finished roof at all vertical surfaces.
 3. Coordinate counter flashing, cap flashings, expansion joints and similar work with modified bitumen roofing work as specified.
 4. Coordinate roof accessories, miscellaneous sheet metal accessory items with the roofing system work.
 5. All stripping at angles shall be installed prior to flashing cap sheet installation.
 6. Heat and scrape granules when welding or adhering at cut areas and seams to granular surfaces at all flashings.
 7. Secure the top edge of the flashing sheet using a termination bar only when the wall surface above is waterproofed or nailed 4 inches on center and covered with an acceptable counter flashing.
- I. Surface Coatings: Apply roof coatings in strict conformance with the manufacturer's recommended procedures.
- J. Flashing Ply Perimeter
1. Install Kee membrane along perimeter parapet wall section as indicated on drawings and details with manufacturer supplied adhesive.
 2. Kee membrane to extend 8" onto field of roofing system. Install 6" polyester between membrane and cap sheet set in 4 gallons of White Knight plus wc.
- K. Roof Drains: Set 30-by-30-inch - 4-pound lead flashing in bed of asphaltic adhesive on completed roofing membrane.
1. Cover lead flashing with roofing cap-sheet stripping, and extend a minimum of 6 inches beyond edge of metal flashing onto field of roofing membrane.
 2. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
 3. Install stripping according to roofing system manufacturer's written instructions.

3.7 PROTECTION

- A. Provide traffic ways, erect barriers, fences, guards, rails, enclosures, chutes and the like to protect personnel, roofs and structures, vehicles and utilities.
- B. Protect exposed surfaces of finished walls with tarps to prevent damage.
- C. Plywood for traffic ways required for material movement over existing roofs shall be not less than 5/8 inch thick.

- D. Special permission shall be obtained from the Manufacturer before any traffic shall be permitted over new roofing.

3.8 FIELD QUALITY CONTROL

- A. Inspection: Provide manufacturer's field observations at start-up and as specified in this document with daily inspection reports forwarded to District.
 - 1. Warranty shall be issued upon manufacturer's acceptance of the installation.
 - 2. Field observations shall be performed by a Technical Representative employed full-time by the manufacturer and whose primary job description is to assist, inspect and approve membrane installations for the manufacturer.
 - 3. Provide observation reports from the Technical Representative indicating procedures followed, weather conditions and any discrepancies found during inspection.
 - 4. Provide a final report from the Technical Representative, certifying that the roofing system has been satisfactorily installed according to the project specifications, approved details and good general roofing practice.

END OF SECTION

SECTION 07 62 00

FLASHINGS AND SHEET METALWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Gutters, conductor heads and downspouts.
2. Copings.
3. All other flashings and sheet metal items shown or required to make the building weathertight and not specified in other Sections.

B. Related requirements:

1. Division 09 for finish painting flashings and sheet metalwork.
2. Division 23 for mechanical sheet metal work, and flashings and collars for mechanical and electrical work, except as specified herein for roof drains.

C. Definitions:

1. In general, flashings visible by the public shall be prefinished aluminum.
2. All other flashings shall be stainless steel.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:

B. Pre-installation meeting:

1. Prior to starting installation, arrange a pre-installation meeting between trades responsible for flashings and trades whose systems interface with flashings.
2. Attendees shall also include, but are not necessarily limited to the following:
 - a. Contractor.
 - b. Architect.
 - c. Roofing material manufacturer's technical representative.
3. Those present shall review the Drawings and Specifications, and typical flashing details.
4. Identify areas of concern and proposed remedial measures. Take photographs of the areas of concerns, before and after remedial measures are taken.
5. Record meeting minutes and distribute PDF copy to all concerned, including the Architect, within 48 hours of the meeting.

1.3 SUBMITTALS

A. Data: Manufacturer Product Data, specifications, installation instructions and general recommendations for installation of prefabricated assemblies.

B. Shop Drawings:

1. Show typical and atypical details, including, but not limited to sheet metal components as well as all transitional and interface flashings between the various roofing, waterproofing and exterior building envelope weatherproofing assemblies, such as wall cladding and fenestration. Include material weight, methods of joining and attachment, and relationship with adjacent materials and supports of all sheet metal assemblies.
2. Detail interface with adjacent materials. For interface between flashings with different profiles and conditions difficult to illustrate in 2-dimension, furnish isometric drawings. Key sheet metal components, transitional and interface flashings, and associated materials to the Drawings, and show typical locations and profiles.

- C. Samples: Assembled Samples of the following at least 6 inches long, except as otherwise specified. Mount on plywood and include all components to be installed under this Section for each Sample.
 - 1. Gutter including holding strap.
 - 2. Conductor head and downspout.
 - 3. Counterflashing with receiver.

1.4 QUALITY ASSURANCE

- A. Design criteria and performance requirements: Fabricate and install the work of this Section to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, excessive oil-canning, and fastener disengagement.
 - 1. Thermal movements:
 - a. 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.
 - b. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements.
 - c. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - d. Temperature change (range) of 120-degree F ambient; 180-degree F, material surfaces.
 - 2. Water infiltration: Provide sheet metalwork and flashings that do not allow water infiltration to building interior, and to damage materials, such as insulation, in exterior walls.

1.5 HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install copings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings.

2.2 MATERIALS

- A. Sheet steel: Commercial quality carbon steel sheets complying with ASTM A 653, lock-forming grade, galvanized with a G90 zinc coating, 24-gage (0.025 inch) minimum unless otherwise

indicated, known commercially as "Satincoat", or "Galvanneal." Steel sheet thicknesses specified are base metal thicknesses prior to galvanizing.

- B. Increase gage of galvanized sheet steel for larger sheet applications, such as gutters, curbs, etc.
- C. Stainless steel: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.
 - 1. Finish: ASTM A480/A480M, No. 2D (dull, cold rolled).
 - a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1) Run grain of directional finishes with long dimension of each piece.
 - 2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- D. Aluminum:
 - 1. Sheet aluminum: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface. (0 .03 inch thick.)
 - 2. Aluminum extrusions: ASTM B 229.
 - 3. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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[for seacoast and severe environments].
 - 4. Color: Match Architect's sample.
 - 5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.
- E. Nails:
 - 1. For attaching sheet steel to wood: Large flat head "stronghold" type roofing nails with barbed point, formed of stainlesssteel of sufficient length to penetrate a minimum of one-inch into the wood nailer.
 - 2. For attaching sheet steel to concrete: 1-1/4-inch by 8d hot-dip galvanized hardened steel nails with lead washers.
- F. Hot dip galvanized self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
 - 1. Fasteners for flashing and trim: Blind fasteners or self-drilling screws, gasketed with hex washer head.
 - 2. Blind fasteners: High-strength aluminum or stainless-steel rivets.
- G. Solder and flux:
 - 1. Galvanized sheet metal: 50-50 lead/tin solder complying with ASTM B 32, used with a non-corrosive flux.
 - 2. Stainless steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
- H. Sealing tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing.
 - 1. Provide permanently elastic, nonsag, non-toxic, non-staining tape.
 - 2. Tremco 440, Schnee-Morehead, Inc. SM5700, or equal.
- I. Expansion-joint sealant: For hooked-type expansion joints, which must be free to move, provide non-setting, non-hardening, non-migrating, heavy-bodied polyisobutylene sealant.
- J. Bituminous coating:

1. Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat.
2. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

K. Slip sheet: Building paper, minimum 5 lb./100 square feet, rosin-sized.

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

2.4 FLEXIBLE FLASHING

A. Flexible flashing materials installed under, or interface with sheet metal. Protect flexible flashing materials from UV exposure; do not leave uncovered in excess of the material manufacturer's published exposure limits.

B. Self-adhering waterproofing membrane materials shall be either manufactured by the Air and Water Barrier material manufacturer as part of their system or approved for use as being compatible with the Air and Water Barrier system specified in Section 07 27 26.

1. General: For use in high temperature environments (temperatures in excess of 225 degrees F.), provide flashing rated by the flexible flashing manufacturer as "high temperature resistant" and suitable for its intended use and application.
2. For use on exterior walls, where neither metal flashing, air and water barrier, or high-temperature flashings occur:
 - a. Perm-A-Barrier by GCP Applied Technologies.
 - b. Window and Door Flashing by Carlisle Coatings & Waterproofing.
 - c. Fast Flash by Protecto Wrap Co.
 - d. Sealtight Air-Shield by WR Meadows, Inc.
 - e. Seam Seal Tape by SafSeal Innovations.
 - f. TW Moisture Wrap by Tamko Waterproofing.
3. For use under copings and other sheet metal assemblies: Self-adhering (peel and stick) flexible high-temperature resistant, self-adhering waterproofing flashings by one of the following, and shall include primers, sealants and mastics, liquid membrane and accessories required for complete systems.
 - a. WIP 300HT-by Carlisle Coatings & Waterproofing.
 - b. PW 100/40 HT by Protecto Wrap Co.
 - c. Grace Ultra by GCP Applied Technologies.

Grace makes:

Ultra for roofs, Vycor Butyl for high temperature areas.

Vycor V 40, 40 mils thick. PREFABRICATED ASSEMBLIES

- A. Counterflashing assemblies: Formed of 24-gage galvanized sheet steel, of the profiles shown on the Drawings, complete with factory-formed internal and external corners, and end closures by one of the following.
 1. Basis of design is for Fry Reglet Corp. Type ST (stucco), CO (concrete), SM (surface mounted).]
 2. Keystone Flashing Co.
 3. CF Cheney Flashing Co.
 4. MM Systems Corp.
- B. Strainer units for conductor heads: Removable beehive design fabricated from 0.062-inch diameter galvanized steel wire or wire mesh with openings not more than 1/2-inch.
- C. Prefabricated expansion gutter joints: "Expansion Joint" by Wilco, or "T-Pren Expansion Joint" by Matthew Hebden.

2.6 FABRICATION

A. General:

1. Shop fabricate flashings and sheet metal work to comply with profiles and sizes indicated on the Drawings and standard Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) detail plates of the "Architectural Sheet Metal Manual" as follows, unless otherwise indicated.
 - a. Gravel stops and roof edging: Figure 2-5C.
 - b. Laps: J2.
 - c. Copings: Figure 3-4A. Miter and solder inside and outside corners continuously to make watertight; the use of sealant for that purpose is unacceptable.
 - d. Gutter: Style A. Butt expansion joint Figure 1-7.
 - e. Downspout: Figure 1-32A round; Figure 1-32B rectangular.
 - f. Downspout hanger: Figure 1-35 to match shape of gutters.
 - g. Scupper and conductor head: Figure 1-27A.
 2. Form sheet metal on bending brake with straight, sharp edges. Shape, trim, and hand seam sheet metal on bench; keep job site forming to a minimum.
 3. Comply with metal producers' recommendations for tinning, soldering, and cleaning flux from metal.
 4. Fabricate with joints and corners accurately machined, filed and fitted, and rigidly framed together and connected.
- B. Fabricate in as long length as possible to minimize field joints.
- C. Prefabricate intersections, including counterflashings, with mitered, riveted joints. Make corners and intersections with legs a minimum of 24-inch long extending in each direction.
- D. Tinning and soldering:
1. Tin edges on both sides of sheet steel to be soldered.
 2. Perform soldering slowly, thoroughly heating seams and completely sweating solder through full width of seams.
- E. Exposed edges: Neatly double back sheet metal 1/2-inch to stiffen edges and to provide a finished appearance.
- F. Provisions for attachment to structure: Furnish supports, hangers, bracing, anchors and other devices shown, specified or necessary for reinforcement and proper attachment of flashings and sheet metal to building.

2.7 FINISHES

- A. Galvanized Sheet Metal flashing: See Section 09 90 00.
- B. Exposed aluminum-fabricated copings and running flashing: 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.
1. Custom color and Gloss as selected by Architect. Finish to be non-reflective.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and measurements affecting the work of this Section at site.
- B. Correct detrimental conditions before proceeding with installation.

3.2 GENERAL REQUIREMENTS

- A. In addition to the assemblies listed above, provide required sheet metal flashings, counterflashings, transitional and interface flashings required to achieve a properly weatherproofed, flashed and

counterflashed building envelope, including sheet metal flashings in the angles formed where indicated and necessary to make the Work weatherproof.

- B. Comply with manufacturer's installation instructions where applicable, and applicable SMACNA and NRCA details, except as indicated and specified.
- C. Install counterflashing assemblies at a constant height above the roof.
 - 1. Anchor counterflashing securely into reglet by friction or provide lead wedges spaced 2-foot o.c. maximum.
 - 2. Use manufacturer standard splice plates and preformed corners for a weathertight assembly.
- D. Coordinate this work with other trades whose work penetrates, intersects and adjoins flashings and sheet metal work, to permit the correct sequencing and the watertightness of the assemblies.
- E. Isolate aluminum from cementitious materials and dissimilar metals.

3.3 INSTALLATION

A. General:

- 1. Install sheet metal work in accordance with the approved Shop Drawings.
- 2. Fasten coping on inside wall with hex head screws and bonded sealing washers through oversized holes in the back of the coping. Except as specified, lap and solder corners and angles; lapping and sealant method is not an acceptable substitute for coping corners; provide for thermal movement no more than 10 feet from corner.
- 3. Slope copings and sills with a minimum slope of 10 percent to drain away from walls and building interior. Slope gutters 1/4-inch per foot to drain.
- 4. Solder joints of window flashings (pans) and saddles.
- 5. Attach work securely to supporting construction, plumb, level, with tight, flush joints allowing for thermal movements.
- 6. Install work with lines, arises, and angles sharp and true.
- 7. Fold exposed edges neatly to form a 1/2-inch hem on the concealed side; hem all exposed edges, unless otherwise indicated.
- 8. Assemble work so that face of metal in contact has hairline joints, except where required for expansion or fitting. Provide back-up plates at joints.
- 9. Conceal fastenings and reinforcement where they would be visible by the public and the building occupants.
- 10. Finish work shall be straight, smooth and continuous, without dimples, dents and other damage.

B. Soldering:

- 1. Protect underlying waterproof membrane (flexible flashing) when soldering sheet metal.
- 2. Except as specified, solder all joints not intended for expansion and contraction.
- 3. Clean material and tin prior to soldering.
- 4. Solder slowly. Heat the seams thoroughly, and completely fill with solder.
- 5. Make exposed soldering on finish surfaces neatly, full flowing and smooth.
- 6. Wash acid flux with a soda solution after soldering and remove soldering flux on exposed surfaces.

C. Nailing:

- 1. Confine nailing of sheet metal generally to sheet metal having a maximum width of 18-inches. Nailing of flashings shall be confined to one edge only.
- 2. Space nails evenly not over 12-inches o.c., and approximately 2-inches from the edge.
- 3. Face nailing is not permitted. Do not nail sheet metal assemblies on horizontal surfaces.
- 4. Where sheet metal is applied to surfaces other than wood, furnish detailed Shop Drawings showing locations of required sleepers and nailing strips.

D. Cleats:

- 1. Provide cleats for sheet metal 18-inch and over in width. Space cleats evenly not over 12-inches o.c.

2. Make cleats not less than 2-inch wide by 3-inch long, and of the same material and thickness as the sheet metal being installed.
 3. Secure one end of the cleat with 2 nails and the cleat folded back over the nail heads. Lock the other end into the seam. Pre-tin cleats for soldered seams.
- E. Bolts, rivets, and screws:
1. Install bolts, rivets, and screws where required. Space equally and symmetrically.
 2. Use fastener sizes that penetrate [wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws] [substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance] <Insert size requirement>.
 3. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
 4. Provide compatible washers to protect surface of sheet metal and to provide a watertight connection.
- F. Dissimilar material protection:
1. Protect sheet metal in contact with dissimilar metals, concrete, masonry and plaster with a heavy coating of bituminous paint, approved separation tape, or building felt or paper.
 2. Set sheet metal assemblies supported by pressure-treated wood on building paper or felt attached to the wood nailer, except set copings on flexible flashing specified. Lap on vertical surfaces at least 2 inches.
- G. Seams - general: Make seams straight, uniform in width and height, with no solder showing on the face.
1. Flat-lock seams: Finish not less than 3/4-inch wide made in the direction of water flow.
 2. Lap seams: Finish soldered seams not less than one-inch wide. Overlap seams not soldered at least 3-inches.
 3. Loose-lock expansion seams: No less than 3 inches wide, designed to provide minimum one-inch movement within the joint. Fill joint completely with sealant applied at not less than 1/8-inch thick bed.
 4. Standing seams: Not less than one-inch high, double locked without solder.
- H. Expansion and contraction:
1. Provide for thermal and building movement without over-stressing the material, breaking connections or producing wrinkles and distortion in finished surfaces. Make sheet metal installations weathertight at all locations.
 2. Provide expansion and contraction joints at not more than 40-foot intervals, except that where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing, provide an additional joint. Where expansion and contraction joints are exposed to view, their location is subject to the Architect's approval.
 3. Exposed surfaces shall be free from visible wave, warp, and buckle.
- I. Flexible flashing: Install under all parapet caps. Lap joints 2-inches. Carry flexible flashing down wall as far as the edge of the coping; overlap wall weather barrier at least 2-inches.
- J. Completed flashings and sheet metal work shall be watertight, free of tool marks, dents, scratches and other damages, with joints and corners accurately machined, filed and fitted, and rigidly framed together and connected. Non-complying work shall either be repaired, when repairs are acceptable to the Architect, or replaced with new, undamaged flashings and sheet metal work.

END OF SECTION

SECTION 07 84 00

PENETRATIONS JOINTS AND PERIMETER FIRE BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: firestop systems consisting of a material, or combination of materials installed to maintain the integrity of the fire-resistance rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations, blank openings, construction joints, or at the gap created at the building perimeter of the horizontal fire resistance rated assembly and non-fire-resistance rated exterior wall and in or adjacent to either fire-resistance or non-fire-resistance rated barriers in accordance with Authorities Having Jurisdiction (AHJ) requirements. Use firestop systems at locations including, but not limited to, the following:
1. Protected openings including both empty openings and openings that contain penetrations.
 2. Penetrations through fire-resistance-rated wall assemblies including both empty openings and openings that contain penetrations.
 3. Membrane penetrations in fire-resistance-rated wall assemblies where items penetrate one side of the barrier.
 4. Joints in fire-resistance-rated assemblies that to allow independent movement.
 5. Perimeter of the horizontal fire-resistance rated assembly and exterior wall between a rated floor/roof and an exterior wall assembly that is not fire-resistance rated.
 6. Joints, through penetrations and membrane penetrations in Smoke Barriers, Smoke Partitions and those assemblies required to limit, restrict or retard the passage of smoke.
- B. Related requirements: Divisions 07 and 09 for all other sealants.

1.2 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement governs.
1. American Society for Testing and Materials (ASTM).
 - a. E 84 Test Method for Surface Burning Characteristics of Building Materials
 - b. E 119 Test Method for Fire Tests of Building Construction and Materials
 - c. E 136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750F
 - d. E 814 Fire Tests of Through-Penetration Fire Stops
 - e. E 1399 Cyclic Movement and Measuring Minimum and Maximum Joint Widths
 - f. E 1966 Test Method for Resistance of Building Joint
 - g. E 2174 Standard Practice for On-Site Inspection of Installed Fire Stops
 - h. E 2393 Standard Practice for On-Site Inspection of Installed Fire Stop Joint Systems
 - i. E 2307 Standard Test Method for Determining the Fire Endurance of Perimeter Fire Barrier Systems Using the Intermediate-Scale, Multi Story Test Apparatus (ISMA)
 - j. E 2837 Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies.
 2. Factory Mutual (FM) Approvals:
 - a. FM Approval Standard of Firestop Contractors – Class 4991
 - b. FM Firestop Exam

- c. FM Approvals Standard for Firestops – Class 4990
- 3. Firestop Contractors International Association (FCIA):
 - a. MOP – FCIA Firestop Manual of Practice
 - b. FCIA Recommended Professional Practice RPP-L-2018-1, for the Identification of Fire-Resistance Rated and Smoke Resistant Penetration and Joint Firestopping
 - c. International Accreditation Services: iAS Accreditation Criteria for Special Inspection Agencies AC-291.
- 4. International Firestop Council (IFC):
 - a. Ref. 1 Recommended IFC Guidelines for Evaluating Firestop Engineering Judgments
 - b. Ref. 2 Inspectors Field Pocket Guide
 - c. Ref. 3 IFC Recommended Guidelines for Performing Destructive Testing for Installed Penetration Firestop Systems, Fire Resistive Joint Systems, or Perimeter Fire Barrier Systems.
- 5. National Fire Protection Association (NFPA):
 - a. NFPA 1 – The Fire Code
 - b. NFPA 70 - National Electric Code
 - c. NFPA 101 - Life Safety Code
 - d. NFPA 221 - Fire Walls and Fire Barriers (preliminary to be released)
 - e. NFPA 251 - Fire Tests of Building Construction and Materials
- 6. Underwriters Laboratories, Inc. (UL):
 - a. UL Qualified Firestop Contractor Program
 - b. UL Firestop Exam
 - c. UL 263 Fire Tests of Building Construction and Materials
 - d. UL 723 Surface Burning Characteristics of Building Materials
 - e. UL 1479 Fire-Tests of Through-Penetration Fire Stops
 - f. UL 2079 Tests for Fire Resistance of Building Joint Systems

1.3 SUBMITTALS

- A. Data: Manufacturer Product Data and installation instructions for materials and prefabricated devices.
- B. Shop Drawings: Large scale Drawings indicating materials, installation methods, and interfaces with adjoining construction for each penetration firestop system.
 - 1. Include qualified testing and inspecting agency's penetration firestop design designation evidencing compliance with requirements for each condition indicated.
 - 2. Include qualified testing and inspecting agency's applicable illustrations showing each penetration firestop configuration at every construction assembly penetrated for each type of penetrating item.
 - 3. Where Project conditions require modification of qualified testing and inspecting agency's tested assembly to suit a particular penetration firestop condition, obtain acceptance of AHJ for the modification prior to submitting Shop Drawings.
- C. Test reports: Certified laboratory test report demonstrating the material or combination of materials proposed for use meets the requirements specified in ASTM E 814, are so classified in UL Building Materials Directory and are approved by the AHJ.
- D. Certificates: Product certificates signed by firestopping product manufacturers certifying their products comply with specified requirements.
- E. Documentation
 - 1. Provide details of installations, with Listed Systems and/or EJ/EFRA's and locations on Life Safety Drawings for restoring the fire resistance rating or smoke resistant properties

where a breach in an assembly occurs for a fire-resistance rated joint, penetration and/or safing slot, perimeter interior fire containment system.

2. Deliver such documentation as a binder, electronic or software application/program to the Architect at the end of construction.
3. Make this information part of the closeout documents.

1.4 QUALITY ASSURANCE

- A. Uniformity: Obtain firestopping materials and components from a single manufacturer for each kind of penetration and construction condition indicated. Do not mix manufacturer's materials in the same assembly
- B. Compatibility: Provide firestop systems compatible with one another, and with the assemblies into which they are installed.
- C. Regulatory requirements: Materials proposed for use shall be approved by the AHJ for their intended use.
- D. Installer's qualifications:
 1. FM-approved in accordance with FM 4991 – Standard for the Approval of Firestop Contractors, or.
 2. UL Qualified Firestop Contractor, and,
 3. Firestop Contractors International Association Contractor Member in good standing.
 4. Licensed by AHJ, where applicable.
 5. Shown to have successfully completed not less than 5 comparable scale projects
- E. Special Inspectors credentials: Special Inspectors with experience in the same type and complexity of work inspected. In addition, both with the competence and experience shall be acceptable to the AHJ.
- F. Repairs: Provide a narrative that lists materials to be used and clearly explains repairs procedures to maintain the safing capabilities of the assemblies.

1.5 HANDLING

- A. Store materials to prevent deterioration or damage.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE REQUIREMENTS

- A. Penetrations: Provide firestop products that when installed to the tested and listed system or engineering judgment (EJ)/equivalent fire-resistance rated assembly (EFRRRA) to become firestop systems or EJ/EFRRRA's produced to resist the spread of fire, and/or the passage of smoke through breaches, gaps, openings, in fire-resistance-rated and smoke-resistant assemblies according to requirements indicated, including but not limited to the following.
 1. Firestop all breaches made in fire-resistance rated assemblies for penetrating items passing through fire-resistance-rated wall and floor assemblies and other locations as indicated on the Drawings.
 2. Provide complete penetration firestopping systems tested and approved by a nationally recognized third-party testing agency to the listing and the manufacturers installation instructions.
 3. F - Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined through testing in accordance with ASTM E 814 or UL 1479, but not less than one hour or the no less than the fire-resistance rating of the construction assembly being penetrated by the penetrating item.
 4. T - Rated Through-Penetration Firestop Systems: Provide firestop systems with T (temperature) ratings, in addition to F ratings, as determined per ASTM E 814 or UL 1479, where indicated and required by the applicable Building Code. T-rated assemblies are required where the following conditions exist.

- a. Where firestop systems protect floor penetrations located outside of wall cavities.
 - b. Where firestop systems protect floor penetrations located outside fire-resistive shaft enclosures.
 - c. Where firestop systems protect penetrations located in fire-resistive construction that have doors required to have a temperature-rise rating.
 - d. Where firestop systems protect penetrating items larger than a 4-inch diameter nominal pipe or 16 square inches in overall cross-sectional area.
- 5. L – Rated Through-Penetration Firestop Systems: Provide firestop systems with Air Leakage (L) ratings, in addition to F and T ratings, as determined in accordance with UL 1479, where indicated.
- 6. Fire-resistive joint sealants: Provide joint sealants with a fire-resistance rating, determined in compliance with ASTM E 119, equaling or exceeding the fire-resistance rating of the construction penetrated but not less than one hour.
- B. For firestopping exposed to view, traffic, moisture, or physical damage: Provide products that will not deteriorate when exposed to these conditions.
 - 1. For plumbing and wet-pipe sprinkler system piping penetrations provide moisture-resistant penetration firestop systems.
 - 2. For floor penetrations with annular spaces exceeding 4 inches or more in any dimension, and for penetrations exposed to possible loading and traffic: Provide penetration firestop system capable of supporting the floor load involved without damage to the firestop system.
 - 3. For penetrations with insulated piping: Provide penetration firestop systems not requiring removal of piping insulation.
- C. For firestop exposed to view: Provide products with a flame-spread rating of 25 or less and a smoke-developed value of 450 or less, as determined in compliance with ASTM E 84.

2.2 MANUFACTURERS

- A. Provide materials from one or a combination of the following, as selected by the installer, depending on the condition of use:
 - 1. 3M Fire Protection Products.
 - 2. Graber Construction Products.
 - 3. Hilti Construction Chemicals, Inc.
 - 4. STI Firestop.
 - 5. Specified Technologies, Inc.
 - 6. Tremco Inc.
 - 7. Emseal Joint Systems Ltd.
 - 8. Rectorseal/CSW Industrials

2.3 MATERIALS

- A. Ceramic-fiber and mastic coating: Ceramic fibers in bulk form formulated for use with mastic coating, and ceramic fiber manufacturer's mastic coating.
- B. Ceramic-fiber sealant: Single-component formulation of ceramic fibers and inorganic binders.
- C. Endothermic, latex compound sealant: Single-component, endothermic, latex formulation.
- D. Intumescent, latex sealant: Single-component, intumescent, latex formulation.
- E. Intumescent putty: Non-hardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent wrap strips: Single-component, elastomeric sheet with aluminum foil on one side.
- G. Job-mixed vinyl compound: Prepackaged vinyl-based powder product for mixing with water at the Project site to produce a paintable compound, passing ASTM E 136, with flame-spread and smoke-developed ratings of zero per ASTM E 84.
- H. Mortar: Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at the Project site to form a non-shrinking, homogenous mortar.

- I. Pillows/bags: Re-usable, heat-expanding pillows/bags composed of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.
- J. Silicone foam: 2-component, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, non-shrinking foam.
- K. Silicone sealant: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealant.
- L. Solvent-release-curing intumescent sealant: Solvent release curing, single-component, synthetic polymer-based sealant.
- M. Color: Where firestopping/firesafing material is exposed to view, provide material color selected by the Architect from the manufacturer's palette, unless the material will be field painted.

2.4 ACCESSORIES

- A. Provide accessories as required to install fill materials and complying with the system description above.
 - 1. General: As specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistive assembly.
 - 2. Permanent forming/damming/backing materials:
 - a. Semi-refractory fiber (mineral wool) insulation.
 - b. Ceramic fiber.
 - c. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
 - d. Fire-rated form board.
 - e. Joint fillers for joint sealants.
 - 3. Temporary forming materials:
 - a. Substrate primers.
 - b. Collars.
 - c. Steel sleeves.

2.5 MIXING

- A. For products that require field mixing prior to application, comply with firestopping manufacturer's directions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions under which penetration firestop systems will be installed.
- B. Verify that surfaces to be in contact with firestopping materials are clean of dirt, grease, oil, loose materials, rust, and other substances that may affect proper fitting or the required fire resistance.
- C. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

- A. General: Install materials in conformance with their manufacturer's instructions and to comply with UL Fire Resistance Directory.
- B. Surface cleaning: Clean openings and joints immediately prior to installing firestopping in accordance with the recommendations of firestopping manufacturer and the following:
 - 1. Remove foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping materials.

2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form release agents from concrete.
- C. Priming: Prime substrates where recommended by the firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- D. Masking tape:
1. Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials.
 2. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

3.3 PENETRATION FIRESTOP SYSTEMS

- A. Forming/damming materials and accessories:
1. Install as required to support fill materials during their application to produce the cross-sectional shapes and depths required to achieve fire ratings of firestop systems.
 2. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- B. Install fill materials for penetration firestop systems to produce the following results:
1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIRE-RESISTIVE JOINT SEALANTS

- A. Install joint fillers to provide support of sealants during application, produce the cross sectional shapes and depths of installed sealants for optimum sealant movement capability, and develop fire-resistance rating required.
- B. Install sealants so they will directly contact and fully wet joint substrates. Completely fill recesses provided for each joint configuration, and provide uniform, cross-sectional shapes and depths relative to joint width. Install sealants at the same time joint fillers are installed.
- C. Tool non-sag sealants immediately after sealant application and before skinning or curing begins. Form smooth, uniform beads. Eliminate air pockets to ensure contact and adhesion of sealants with sides of joint.
1. Remove excess sealant from surfaces adjacent to joint.
 2. Do not use tooling agents that will discolor sealants or adjacent surfaces, or that are not approved by the sealant manufacturer.

3.5 FIELD QUALITY CONTROL

- A. Examine penetration firestop systems to ensure proper installation prior to concealing or enclosing firesafe and fire stopped areas.
- B. Repair damaged areas and restore the integrity of the assembly.
- C. Keep areas of work accessible until inspection and approval by applicable authorities having jurisdiction.

3.6 CLEANING

- A. Cleanup spills of liquid components.

- B. Cut and trim excess materials neatly, flush with adjacent surfaces.

END OF SECTION

SECTION 07 92 00

JOINT SEALERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements pertaining to all sealants required for the Project (except as specified below and becomes an integral part of all Sections containing references to this Section, as well as all locations where sealants are indicated on the Drawings and required to make the building weathertight.
- B. Section also includes sealants for interior joints in vertical applications, where required to close gap between different materials (paintable and non-paintable), and horizontal traffic surfaces as follows:
 - 1. Control and expansion joints on exposed interior surfaces of exterior walls.
 - 2. Perimeter joints of exterior openings.
 - 3. Tile control and expansion joints.
 - 4. Vertical control joints on exposed surfaces of interior unit masonry walls and partitions.
 - 5. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - 6. Perimeter joints of toilet fixtures.
 - 7. Other joints indicated.
- C. In addition, the work of this Section also includes air sealing to supplement and provide continuity of main and primary air barrier assemblies, including sealing and/or filling perimeter of door and window openings, crevices, gaps, cracks in walls, roof/wall connections, mechanical and electrical penetrations in walls, floors, roofs, exterior glazed assemblies mullions, beams, columns enclosures and similar locations with foam to provide air barrier integrity and a permanent barrier against air infiltration and loss.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation meeting:
 - 1. Prior to start of installation of exterior vertical sealants, arrange a pre-installation meeting between the sealant manufacturer authorized representative, the Contractor, the installer and the Architect to review conditions of surfaces to be sealed, as well as other conditions that would affect the quality of this work, the Drawings and Specifications, and the sealant manufacturer's data.
 - 2. If more than one trade will be responsible for the successful performance of the work of this Section, these trades shall attend the meeting.
 - 3. Review all typical and atypical details to verify the method of sealing joints that the Contractor will follow, as well as corrective actions that are required.
 - 4. Special conditions not specifically referenced or addressed by the Project Drawings, manufacturer's typical details, or the Shop Drawings, shall also be identified, reviewed and discussed.
 - 5. Take photographs and notes of unresolved conditions, if any, along with sketches of the same unresolved conditions so that a determination can be made of actions to be taken to assure an installation that will be acceptable, watertight and acceptable to the sealant material manufacturer for issuance of the warranty.
 - 6. Record meeting minutes and distribute PDF copy to all concerned, and the Architect, within 48 hours after the meeting.

1.3 DEFINITIONS

- A. Substrates:

1. M type substrates: Concrete, concrete masonry units, brick, mortar, natural stone. The term "masonry" means brick, stone, and concrete masonry work.
2. G type substrates: Glass and transparent plastic glazing sheets.
3. A type substrates: Metals, porcelain, glazed tile, and smooth plastics.
4. O type substrates: Wood, unglazed tile; substrates not included under other categories.

1.4 SUBMITTALS

- A. Data:
 1. Manufacturer Product Data and published instructions for each type of sealant, backing, bond breaker, and other accessory materials, together with statement that the proposed materials comply with these Specifications.
 2. Include manufacturers' recommendations for surface preparation and priming for all substrates to be in contact with sealant on the Project.
- B. Certification: Sealant manufacturer certification that sealants, backing rods, and other materials proposed for use in the application of sealants, are chemically compatible with the materials which will come in contact with the sealants and will not cause deterioration, premature aging and staining of adjacent materials, or the sealants.
- C. Samples: Cured Samples of the various types and colors of materials proposed for use, approximately 12 inches long, mounted on hardboard backing.

1.5 QUALITY ASSURANCE

- A. Uniformity: All sealants used in or on the exterior walls of the building(s) shall be made by the same manufacturer.
- B. Installer qualifications: Firm with a minimum 5 years of experience with joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.
- C. Color selection:
 1. Final color selection of sealants to be used for exterior locations will be made by the Architect from job-applied Samples on in-place materials.
 2. The Architect will select locations and extent of these Samples, but their lengths will not exceed 10 feet for vertical and horizontal joints of each sealant color.
- D. Quality control by sealant manufacturer:
 1. Submit statements on the manufacturer's letterhead, dated no earlier than one year prior to submittal, for tests listed below.
 2. Submit Samples of materials to be used for the Project to the manufacturer as required for tests.
 3. Include identification of any special substrate cleaning process and required adhesion promoter or primer.

1.6 HANDLING

- A. Store sealant containers in a protected location in compliance with their manufacturer's instructions until their use. Do not store at temperature higher than 80-degree F.

1.7 JOB CONDITIONS

- A. Do not install sealants under adverse weather conditions, or when temperatures are beyond manufacturer's recommended limits.
- B. Proceed with the installation only when forecasted weather conditions are favorable for proper sealant cure and development of early bond strength.

1.8 WARRANTY

- A. Warrant sealants against defective materials and workmanship for the following length of time after Substantial completion:
 - 1. Manufacturer:
 - a. Exterior vertical sealant: Manufacturer's 20-year weatherseal warranty, including non-staining warranty for Dowsil 795 and 756 SMS.
 - b. All other exterior locations: Manufacturer's 5 years weatherseal warranty.
 - 2. Installer: 5 years labor and material warranty.
- B. Warranty shall further state that installed sealants are warranted against the following:
 - 1. Water leakage through exterior sealed joints.
 - 2. Adhesive or cohesive failure of sealant.
 - 3. Staining of adjacent surfaces caused by migration of sealants or primer.
 - 4. Chalking or visible color change of the cured sealants.
- C. Make repairs during the 5-year warranty period at no cost to the Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Exterior joint sealants are required to establish and maintain airtight and waterproof continuous seals on a permanent basis, with recognized limitations of wear and aging as indicated for each application.

2.2 MANUFACTURER/TYPE - SEALANTS

- A. Colors: Match sealant color to color of adjacent materials as closely as possible using colors selected from the manufacturer's standard palette, as approved by the Architect.
- B. General:
 - 1. Do not mix multiple component materials until required for use.
 - 2. Use materials "as received" from manufacturer, without additions, deletions and adulterations of materials.
 - 3. Do not use sealants that have started to cure and those whose shelf life expired.
- C. Compatibility: Provide joint sealers, joint fillers and other related materials as follows:
 - 1. That will not cause staining, degradation and premature aging of the adjacent surfaces and the sealant itself, when in contact with these surfaces.
 - 2. Compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- D. Bulk sealants:
 - 1. Suitability for contact with food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
 - 2. For interior slabs where heavy wheeled traffic will occur: One of the following.
 - a. L&M:
 - 1) "Epoflex" (epoxy).
 - 2) "Joint Tite" (urea).
 - b. Atlas "Epoxy Joint Filler."
 - c. Nox-Crete:
 - 1) "Nox-Crete "Dynaflex 502."

- d. VersaFlex, Inc.: SL Series (polyurea) as recommended by the manufacturer after surveying the conditions at the site.
- 3. For interior and exterior horizontal application subject to pedestrian or vehicular traffic: Single component silicone sealant.
 - a. Type and grade: S (single component) SL (self-leveling).
 - b. Class: 25.
 - c. Use related to exposure: T (traffic).
 - d. Uses related to joint substrates: M, A, and, as applicable to joint substrates indicated, O.
 - e. Products:
 - 1) Dowsil; "888" or "SL Parking Structure Sealant" (basis of design).
 - 2) Pecora Corp.; "300 SL Pavement Sealant."
 - 3) Crafcro Inc.; "RoadSaver Silicone SL."
- 4. For all other exterior applications, except where stone occurs:
 - a. Type and grade: S (single component) and NS (nonsag), neutral- and basic-curing silicone sealant.
 - b. Class: 100/50.
 - c. Use related to exposure: NT (non-traffic).
 - d. Uses related to joint substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - e. Products:
 - 1) Dowsil "795" (basis of design).
 - 2) General Electric "Silpruf," "Silpruf LM," "Silpruf NB."
 - 3) Tremco "Spectrem 1."
- 5. For interior damp, wet and semi-wet locations, other than floors, such as toilet rooms where a mildew-resistant sealant is required: Provide white sealant, unless otherwise noted. Single-component mildew-resistant neutral-curing silicone sealant:
 - a. Type and Grade: S (single component) and NS (nonsag).
 - b. Class: 25.
 - c. Use related to exposure: NT (non-traffic).
 - d. Uses related to joint substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - e. Products:
 - 1) Dowsil. "786" basis of design.
 - 2) Pecora Corp. "898."
 - 3) General Electric Corp. "1700."
- 6. For all other interior applications (paintable sealant): Latex sealant complying with ASTM C 834, Type P, Grade NF.
 - a. Pecora Corp. "AC-20+."
 - b. Schnee-Morehead, Inc. "SM 8200."
 - c. Sonneborn, Division of ChemRex Inc. "Sonolac."
 - d. Tremco "Tremflex 834" or "Acrylic Latex 384."
- 7. Acoustical sealant:
 - a. Pecora Corp. "BA-98."
 - b. US Gypsum Co. "Sheetrock Acoustical Sealant."
 - c. Tremco, Inc. "Acoustical Sealant."
 - d. WW Henry Co. "Henry 313."
- 8.

- E. Tape sealants: American Saint-Gobain "Norseal 730" or "Norseal 770," or equal by Pres-On Tape & Gasket Corp. or Schnee-Morehead.

2.3 ACCESSORY MATERIALS

- A. Sprayed polyurethane foam sealant: One- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 pcf density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
- B. Joint cleaner, primer and sealer: As recommended by the sealant manufacturer, for the surfaces to be cleaned, primed or sealed.
- C. Bond breaker tape:
 - 1. Polyethylene or other plastic tape recommended by the sealant manufacturer to prevent 3-sided adhesion where backer rod cannot be used, except for non-moving joints.
 - 2. Use self-adhering tape wherever possible.
- D. Backer rod:
 - 1. General: Provide size, density and shape of rod which will control the joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back, and provide a highly compressible backer to minimize the possibility of sealant extrusion when joint is compressed.
 - 2. Type: ASTM C 1330, of type indicated below:
 - a. Type C: Closed-cell material with a surface skin, Nomaco "SOF ROD/Dual Rod," or equal.
 - b.
 - c. For sealant in vehicular traffic areas, provide solvent-resistant backer rods, Nomaco HBR/Green Rod, or equal.
 - d. For fillet and cove joints, Nomaco "HBR" 1/4-inch Round."
 - 3. In paving subject to traffic: Provide hard joint filler such as cork; prevent 3-sided adhesion by using bond breaker tape.
- E. Masking tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and measurements affecting the work of this Section at site.
- B. Correct detrimental conditions before proceeding with installation.

3.2 JOINT PREPARATION

- A. Clean-out joints immediately before installing sealants to comply with recommendations of joint sealant manufacturer and the following.
- B. Remove foreign material from joint substrates that could interfere with adhesion of sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), oil, grease, waterproofing, water-repellents, water, surface dirt, and frost.
- C. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.

1. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
- D. Remove laitance and form release agents from concrete.
- E. Clean metal, glass, glazed surfaces of ceramic tile, and other non-porous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- F. Do not proceed with sealant installation over surfaces that have been painted, waterproofed or treated with water-repellent or other coating unless specifically approved in writing by the sealant manufacturer.
- G. Use masking tape or other protection to limit coverage of sealant to joints to be sealed. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

- A. Comply with sealant manufacturer's instructions and ASTM C 1193, except where more stringent requirements are specified herein. At the Architect's option, ASTM C 1193 may also be used for rejection of unacceptable installations.
- B. Prime or seal surfaces when recommended by the sealant manufacturer; when the manufacturer's instructions on priming are optional, prime the surface. Do not allow primer/sealer to spill or migrate onto adjacent surfaces.
- C. Install backer rod for all sealants, except (1) for exterior sealants subject to traffic (verify that joint filler in paving is installed at the proper depth), (2) where the size of joint prevents the insertion of a backer rod, and (3) where recommended otherwise by the sealant manufacturer.
 1. Install backer rods with blunt or rounded tools to avoid puncturing the material.
 2. Do not twist, stretch or braid the backer rod.
- D. Install bond breaker tape where space limitation does not permit use of a backer rod.
- E. In no case shall sealant have 3-sided adhesion, except for non-moving joints.
- F. Employ only proven installation techniques that will ensure that sealants are installed in uniform, continuous ribbons without gaps or air pockets and with complete "wetting" of the rabbet surfaces equally on opposite sides.
 1. Fill concave joints to the configuration shown on Figure 8A of ASTM C 1193.
 2. Provide flush joints to the configuration shown on Figure 8B of ASTM C 1193.
 3. Provide recessed joints configuration as shown on Figure 8C of ASTM C 1193, unless otherwise indicated or required to match adjacent non-moving joint.
 4. Where horizontal joints occur between horizontal and vertical surfaces, fill joints to form a slight cove to prevent trapping moisture and dirt.
 5. Immediately after sealant application and prior to beginning of skinning or curing, tool sealant using tooling agents that will not discolor sealants or adjacent surfaces and are approved by sealant manufacturer.
- G. Do not allow sealant or other compound to overflow, spill or migrate into voids of adjacent construction.
- H. Remove excess sealant spillage promptly as this work progresses. Clean adjacent surfaces by recommended means to remove sealant, but not damage the surfaces.

3.4 CURING/PROTECTING

- A. Cure sealants in compliance with their manufacturer's instructions to obtain high early bond strength, internal cohesive strength and durability.
- B. Protect sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion.

END OF SECTION

DIVISION 08

OPENINGS

SECTION 08 11 13

STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Flush steel doors.
 - 2. Louvers in steel doors.
- B. Work furnished but installed in other Sections: Division 04 for building-in of anchors and grouting of frames in masonry.
- C. Work installed but furnished in other Sections: Division 08 for finish hardware.
- D. Related requirements: Division 09 for finish painting the work of this Section.

1.2 SUBMITTALS

- A. Shop Drawings: Show the following.
 - 1. Door and frame elevations, materials, construction, gage, finish, anchoring for each wall condition, conditions of openings, vision panel and louver sizes and locations, and accessories.
 - 2. Location and size of reinforcement for finish hardware.
 - 3. Use same reference numbers for openings and details as shown on Contract Drawings.
- B. Schedule: Door schedule indicating opening identification symbol, door and frame types, sizes, including thickness, swing, label requirements, louvers, and undercuts.
- C. Samples:
 - 1. Twenty-four-inch square Sample of door illustrating typical head, bottom and jamb conditions, cutouts for hinge, lock/latch, and 12-inch wide louver centered in sample.
 - 2. Frames showing profile, welded corner joint, welded hinge reinforcement, dust cover boxes, floor and wall anchors, and silencers.
- D. Data: Manufacturer or fabricator Product Data for doors, frames and shop primer, and louvers.

1.3 QUALITY ASSURANCE

- A. Uniformity: Provide all steel doors and frames for the Project made by a single firm, unless otherwise acceptable to the Architect.
- B. Regulatory requirements:
 - 1. Fire-rated doors shall be listed by a nationally recognized testing and certification agency acceptable to AHJ. The listed doors shall meet or exceed the requirements of UL10B, NFPA 252 and NFPA 80. Doors shall carry either a UL or ITS (Intertek Testing Services-Warnock Hersey) label.
 - 2. Comply with CBC requirements. Provide tested products that passed, as an assembly, the CBC Standard 7-2 positive pressure smoke testing requirements.
 - 3. Comply with ASTM E 2074, Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure on Side-Hinged and Pivoted Swinging Door Assemblies.
 - 4. Doors in exit enclosures shall bear an "S" label.

1.4 HANDLING

- A. Procedure: In accordance with SDI recommendations.

- B. Packing: Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage.
- C. Delivery:
 - 1. Inspect doors, frames, and accessories delivered to the site for damage. Unload and store, as specified, with a minimum of handling.
 - 2. During delivery, provide temporary steel spreaders securely fastened to the bottom of each frame.
 - 3. Replace doors and frames damaged before installation. Do not install damaged doors and frames.
- D. Storage:
 - 1. Store doors and frames carefully under cover. Provide a minimum of 1/2-inch space between doors. Do not stack doors and frames.
 - 2. The storage spaces shall be dry and accessible, adequately ventilated and free from dust or water, and shall permit easy access for inspection and handling.
 - 3. Do not use non-vented plastic or canvas shelters that create a humidity chamber.
 - 4. If doors are shipped with fiberboard wrapper and it becomes wet, remove it immediately.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. One of the following, or equal:
 - 1. Door Components, Inc.
 - 2. CECO.
 - 3. Curries Co.
 - 4. Security Metal Products.
 - 5. Steelcraft Manufacturing Co.
 - 6. Stiles Hollow Metal.

2.2 MATERIALS

- A. Cold rolled steel: ASTM A 1008, "Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability" and A 568, "Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for."
- B. Hot rolled, pickled and oiled steel: ASTM A 1011, "Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability" and A 568, "Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for."
- C. Hot dip zinc coated steel: Alloyed type complying with ASTM A 924, "Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process" and A 653, "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process." The coating weight shall meet or exceed the minimum requirements for coatings having 0.4 oz/ft² total both sides, i.e., A40 (ZF120). Comply also with SDI-112 "Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames".
 - 1. When zinc-coated steel is specified for anchors and accessories, and electrolytically deposited zinc coated steel is provided, it shall comply with ASTM A 591, "Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight [Mass] Applications." The minimum coating weight shall be a class "B", i.e., 0.075 oz/ft².
 - a. Coated steel sheets: ASTM A 653, QC classification, with a G90 or A90 zinc coating, mill phosphatized.

- D. Inserts, bolts and fasteners: Manufacturer standard units, except hot-dip galvanize all items in exterior walls.
- E. Paints:
 - 1. Shop primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints complying with ANSI A250.10, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames", and compatible with finish paint system specified in Section 09 90 00.
 - 2. For touchup of damaged galvanized surfaces: SSPC Paint No. 20, Type II (Organic) zinc-rich primer by Tnemec, Porter International, Valspar Corp., Ameron Protective Coatings or DuPont Co.
 - 3. For back-coating frames: 3M Undercoating Black 08881, or fibrous asphaltic compound.
- F. Door filler: In compliance with SDI 250.8, except use UL-listed materials in fire-rated doors.

2.3 FABRICATION - GENERAL

- A. Do not begin fabrication until the fabricator has received the hardware schedule approved by the Architect and submitted by the hardware supplier.
- B. Fabricate work to required profiles by roll-forming, brake-forming and welding to produce hollow metal work with straight and square edges, with surfaces free from warp, wave, buckle, oil-canning and other defects.
- C. Fabricate without grind marks, hollow or other out-of-plane areas, holes, burned-out spots, weld build-up and other defacing work. Fill to close cracks and to preserve shapes. Tightly fit loose stops, to hairline joints.
- D. Comply with SDI 250.8 and SDI 117, Manufacturing Tolerances Standard Steel Doors and Frames, except for the following:
 - 1. 0.005-inch in 3-inch span anywhere on the exposed surfaces. Fill depressions with Bondo or other automotive type filler. Sand bumps down, flush with adjacent surfaces.
- E. Conform to AWS standards for welding. Face weld frames with exposed welds ground flush and smooth with parent metal. Welded joints shall be invisible after assembly is painted.
- F. Fabricate doors, frames and louvers at the following locations from coated steel; in exterior walls and toilet rooms. Elsewhere, fabricate doors and frames from coated or uncoated steel.
- G. Finish hardware preparation:
 - 1. Prepare doors to receive finish hardware, including cutouts, reinforcement as specified below, mortising, drilling, and tapping in compliance with templates provided by hardware supplier.
 - 2. Reinforce doors to receive hardware; provide internal reinforcement of sufficient size to avoid the use of through bolts that are not permitted. Drilling and tapping for surface-applied hardware may be done at Project site.
 - 3. Provide 16-gage (0.053-inch) stainless steel reinforcement for pull plates and bars. Provide internal reinforcement for closers on all door frames. Thru bolts (Chicago fasteners) are not permitted.
 - 4. Locate finish hardware as accepted on final Shop Drawings.
- H. Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames. Surface-applied (adhesively-applied) stops are not allowed.
- I. Provide minimum 26-gage (0.0179-inch) steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.
- J. Steel members shall be pre-straightened, free of wind or twist. Factory-align to a diagonal tolerance of plus or minus 1/16-inch.

2.4 FLUSH DOORS

- A. Standards: Comply with the following, except as specified.
 - 1. SDI 250.8, Specifications for Standard Steel Doors and Frames (SDI-100).
 - 2. SDI 117, Manufacturing Tolerances for Standard Steel Doors and Frames.
 - 3. SDI 118, Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements.
- B. Steel doors:
 - 1. SDI Level 3 Extra Heavy Duty, Performance Level A, model 2 (Seamless), 16-gage (0.053-inch) for doors wider than 3 feet. Provide doors with seamless welded edges ground to be invisible from adjacent surfaces; do not use Bondo or similar material to close gap between face sheets at door edge.
 - 2. Close the top and bottom of doors with an inverted flush channel, minimum thickness of 0.042-inch thick.
 - 3. Close openings for louvers with an inverted flush channel, minimum thickness of 0.042-inch thick.
 - 4. Insulate exterior doors to provide a U factor of 0.24 BTU/hr. by square foot by degree F when tested in compliance with ASTM C 236.

2.5 FRAMES

- A. General:
 - 1. Fabricate frames to the dimensions and profiles indicated in compliance with SDI 250.8, Specifications for Standard Steel Doors and Frames (SDI-100), except as noted.
 - 2. Reinforce and miter corners, interlock and/or weld internally. Weld faces continuously and grind smooth.
- B. Stand alone door frames: Fabricate with coped or mitered, fully welded corners of steel 2-gage heavier than door face in same opening, minimum 16-gage (0.053-inch), corners reinforced, mitered, interlocked and/or welded, and visible joints continuously welded and ground smooth; non-welded joints visible in the finish work are not permitted.
- C. Mullions:
 - 1. Closed or tubular mullions where indicated.
 - 2. Join mullions at crossings and to jambs by butt-welding.
 - 3. Reinforce joints between frame members with concealed clip angles or sleeves of same metal and thickness as frame.
 - 4. Provide false head member to receive lower ceiling where frames extend to finish ceilings of different heights.

2.6 DOOR LOUVERS

- A. V, Y or Z shaped louver blades formed of 18-gage (0.042-inch) sheet steel welded to surrounding frame set flush with both sides of doors, by Air Louvers, Inc., Airlite Co., Anemostat Products Div/Dynamics Corp. of America, or Ventilouver Co. Provide same shape louver blade (V, Y or Z) throughout the Project.
- B. When installed in fire-rated doors provide UL labeled, spring-actuated louver blades activated by a fusible link, or Zero International "Advantage Intumescent AI" louvers.

2.7 SHOP PRIMING

- A. After assembly, clean and prepare steel surfaces by removing mill scale, rust, oil, grease, dirt, and other foreign materials before painting. For coated steel, comply with ASTM D 2092 and the primer manufacturer's instructions.
 - 1. Grind welds and fabrication marks flush and smooth with parent metal.
 - 2. Fill depressions with metal filler before applying the shop primer.

3. Apply one or more coats of epoxy mineral filler to conceal spot welds.
 4. Where zinc coating is damaged, touchup with zinc-rich primer.
- B. Acid-etch galvanized surfaces before pretreating.
 - C. Apply shop primer, within time limits recommended by pretreatment manufacturer, to provide a smooth coat of even consistency and to produce a dry film thickness of not less than 1-1/2 mils.
 - D. Assemblies with visible spot welds before or after application of finish paint will be unacceptable.

2.8 BACK COATING FRAMES

- A. For frames installed in concrete and CMU openings, and frames in contact with plaster, factory-coat surfaces that will be concealed after installation with the back-coating material specified applied in a uniform thickness, without holidays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine adjacent construction and supports.
- B. Verify that openings are within allowable tolerances, plumb, level, clean, and will provide a solid anchoring surface for frames.
- C. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLING FRAMES

- A. Set frames accurately in their scheduled locations, plumb, straight, square and rigid.
 1. Comply with these Specifications, the Drawings; ANSI/SDI A250.11, Recommended Erection Instructions for Steel Frames, the approved Shop Drawings and UL tested procedures and NFPA 80 for fire-rated openings. When in conflict, the most restrictive provision applies.
 2. Brace frames to prevent their displacement during erection of adjacent walls.
 3. Coordinate the installation of built-in anchors for wall and partition construction with related trades. Refer to Division 04 for frames in CMU walls.
 4. Provide 2 anchors at head of frames exceeding 42 inches in width for frames mounted in steel stud walls.
 5. Provide 3/8-inch by 2-inch vertical steel struts extending from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry, continuous boxed studs, or to other structural support at each jamb.
 - a. Bend top of struts to provide flush contact for securing to supporting construction above.
 - b. Provide adjustable wedged or bolted anchorage to frame jamb members in compliance with UL 63.
- B. Frame anchors: 18-gage (0.0478-inch) galvanized steel.
 1. CMU construction: Adjustable, flat, corrugated, or perforated, Tee-shaped to suit frame size, with leg not less than 2 inches wide by 10 inches long. Provide at least 3 anchors per jamb up to 7 feet high; 4 anchors up to 8 feet height; one additional anchor for each 24 inches or fraction thereof over 8-foot high.
 2. Stud partitions: Insert "bolt-on" type with notched clip to engage stud, welded to back of frames. Provide at least 4 anchors for each jamb for frames up to 90 inches high; 5 anchors up to 96 inches high; one additional anchor each 24 inches or fraction thereof over 96 inches. Attach jamb anchors to studs with a minimum of four 3/8-inch diameter self-tapping screws or bolts (2 per side).

- C. Provide UL-tested adjustable floor clips for all frames. Anchor clips to floor with powder-driven pins or bolts in expansion shields.
- D. Leave frame spreader bars intact, wherever possible, until frames are set perfectly square and plumb and all anchors are securely attached and grouted where required.
- E. Installation tolerances: Adjust door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - 1. Squareness: Plus or minus 1/16-inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16-inch, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16-inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16-inch, measured at jambs at floor.

3.3 HANGING DOORS

- A. Install finish hardware in compliance with its manufacturer's templates and instructions.
- B. Hang doors in compliance with their manufacturer's instructions, and adjust to the clearances specified in SDI 250.8, except as specified below, as indicated on the Drawings, or as required by UL listing and NFPA 80 for fire-rated doors.
- C. Do not install doors warped, bowed, dented or otherwise damaged.
- D. Adjust hardware so that doors operate freely for their entire travel, but not loosely, without sticking or hinge binding, with hardware adjusted and functioning properly.
- E. Fit doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-fire-rated standard steel doors:
 - a. Jambs and head: 1/8-inch plus or minus 1/16-inch.
 - b. Between edges of pairs of doors: 1/8-inch plus or minus 1/16-inch.
 - c. Between bottom of door and top of threshold: Maximum 3/8-inch.
 - d. Between bottom of door and top of finish floor (no threshold): Maximum 3/4-inch.
 - 2. Fire-rated doors: Install doors with clearances as required by UL listing and complying with NFPA 80.
 - 3. Smoke-control doors: Install doors according to NFPA 105.

3.4 TOUCHUP

- A. Clean damaged primer, sand smooth, re-clean and spot-prime with paint compatible with the primer and the scheduled finish coats.
- B. Before application of primer, touchup galvanized surfaces with zinc-rich coating where zinc coating is removed or damaged.

END OF SECTION

SECTION 08 31 16

ACCESS DOORS & PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes access panels not provided by other trades but required for access to concealed equipment and assemblies.
- B. Work installed but not supplied under this Section: Access panels furnished by other trades.
- C. Related requirements:
 - 1. Division 09 for finish painting access panels.
 - 2. Other Divisions for furnishing access panels to be installed under this Section.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Field verification: Verify actual locations of supports by field measurements and indicate measurements on Shop Drawings. Coordinate tolerances of other trades that may affect the work of this Section prior to start of Shop Drawings.
- B. Pre-installation meeting:
 - 1. Prior to start of work, arrange for Project site meeting of all parties associated with work of this Section, trades whose work affect the work of this Section, and trades whose work will be affected by the work of this Section.
 - 2. Meeting shall be attended by the Contractor, firm installing the access doors (if more than one firm, than each one shall attend), trade responsible for substrates and supports to which access doors are installed, and access door manufacturer representatives.
 - 3. Resolve conflicts and issue minutes of the meeting, in PDF format, to all present and the Architect within 48 hours of the meeting.
- C. Sequencing:
 - 1. Coordinate installation and cooperate with mechanical and electrical trades.
 - 2. Coordinate stud layout and other support locations to provide a firm support for the panel frame.

1.3 SUBMITTALS

- A. Data: The following manufacturer Product Data.
 - 1. For each type of door and frame indicated, including compliance with Code requirements for those in fire-resistive assemblies.
 - 2. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings for access doors and frames.
 - 3. Supplement with Shop Drawings as follows:
 - a. Dimensioned plan and elevation of each access panels in areas accessible to the public.
 - b. Show special installation conditions.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other Work. Superimpose plan location on piping layout Shop Drawings.
 - 2. The Architect reserves the right to ask for the relocation of up to 10 percent of the access panels and the utilities served, within a radius of 10 feet, at no cost to the Owner.
- C. Coordination Drawings: Reflected ceiling plans drawn to scale, coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following.
 - 1. Method of attaching door frames to surrounding construction.

- 2. Ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim.
 - 3. Unless otherwise accepted by the Architect, no access panels will be allowed in hard ceilings (plaster and gypsum board) in public, and semi-public areas.
 - D. Samples: Samples for each door face material, at least 3 by 5 inches, in specified finish.
 - E. Schedule: Complete schedule of access panels, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.
 - F. Closeout: Keys properly tagged.
- 1.4 QUALITY ASSURANCE
- A. All access panels for the Project shall be made by the same manufacturer.
 - B. In fire-resistive construction, provide fire-resistive assemblies bearing the label of a testing agency acceptable to the Building Department for the fire resistance indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Nystrom (basis of design).
- B. Elmdor Manufacturing Co.
- C. JL Industries.
- D. Karp Associates, Inc.
- E. Milcor.
- F. Williams Brothers Corp.

2.2 ACCESS PANELS

- A. General: Provide trimless, prime-coated units, except where stainless steel is specified, equipped with flush, key-operated cam lock.
- B. Models:
 - 1. In gypsum board surfaces, except as specified below for toilet room walls: Nystrom Type NW.
 - a. Material: Commercial grade cold-rolled steel with 16-gage (0.053 inch) frame and 14-gage (0.067 inch) door.
 - b. Trim: 22-gage (0.0299 inch) steel drywall bead.
 - 2. In plaster surfaces: Nystrom Type RP where the door is plastered; Type NP where door is painted.
 - a. Material: Commercial grade cold-rolled steel with 16-gage (0.053 inch) frame and 14-gage (0.067 inch) door.
 - b. Trim: 22-gage (0.0299 inch) steel plaster bead with expanded metal lath.
 - 3. Toilet rooms walls: Nystrom Type NT.
 - a. Material: Stainless steel, 16-gage (0.053 inch) frame and 14-gage (0.067 inch) door.
 - b. Trim: 22-gage (0.0299 inch) stainless steel drywall bead.
 - 4. Size: Unless otherwise indicated on the Drawings, provide minimum size to be 12-inch square opening for hand access; minimum 18-inch square for valve and actuator access; and 24-inch square for equipment access.
 - 5. Where door cannot swing open, provide lift off type with safety wire or chain; Similar to Karp Type DSC-212.

2.3 MATERIALS

- A. General:
 - 1. Provide sheet metal selected for its surface flatness, smoothness and absence of surface blemishes where exposed to view.

2. Do not use materials where exposed surfaces exhibit pitting, seam marks, roller marks, variations in flatness exceeding those permitted by referenced standards for stretcher-leveled metal sheet, stains, discoloration or other imperfections.
- B. Galvanized steel sheet: ASTM A 653 CQ (commercial quality), or ASTM A 653 LQ (lock-forming quality), coating designation G90, mill-phosphatized, stretcher-leveled.
- C. Steel sheet: Commercial quality cold-rolled carbon steel sheet, stretcher-leveled, complying with the following requirements at the fabricator's option.
 1. Electrolytic zinc-coated steel sheet: ASTM A 591, with Class C zinc coating; chemically treated in mill with phosphate solution and light chromate rinse.
 2. Cold-rolled steel sheet: ASTM A 1008.
- D. Stainless steel sheet: ASTM A 167, Type 302 or 304, stretcher leveled.
- E. Hardware:
 1. Hinges: Concealed spring hinges or concealed continuous piano hinge set to open 175-degree. For fire-resistive units, provide self-closing mechanism.
 2. Locking device: Flush, screwdriver-operated cam lock of number required to hold door in flush, smooth plane when closed.
 - a. In public areas, provide keyed-alike cylinder lock on all access panels. Furnish 2 keys per lock.
 - b. For recessed panel, provide access sleeves for each locking device. Provide plastic grommets installed in holes cut through finish.
 - c. For locks on panels 24 inches in any dimension, provide interior latch mechanism to allow door to be opened from the inside without a key.

2.4 FABRICATION

- A. Fabricate to profiles indicated without exposed cut edges.
- B. Produce flat, flush surfaces without cracking and grain separation at bends.
- C. Continuously weld exposed joints and seams; grind, fill, and dress welds to produce smooth flush exposed surfaces in which welds are invisible after final finishing is completed.
- D. Provide exterior access panels with weatherproof extruded door gasket.
- E. Finish:
 1. When installed in ceramic tile surfaces, provide stainless steel panels finished with a NAAMM No. 4 (brushed) finish.
 2. When installed in an exterior wall or soffit, fabricate assemblies from commercial quality carbon steel sheets complying with ASTM A 653 CQ, hot-dip galvanized to comply with ASTM A 924, G90, or hot-dip galvanize after fabrication to provide an equivalent zinc coating weight.
 3. Elsewhere provide access panels with a baked-on rust-inhibitive primer.
- F. Identification: Mark inside surface of access doors with colored dot in accordance with the following color code.
 1. Domestic Cold Water: Yellow.
 2. Domestic Hot Water and Return: Yellow.
 3. Fire Protection: Red.
 4. Waste and Vent: Green.
 5. Interior Rainwater Leaders: Green.
 6. Natural Gas: Yellow.
 7. Condensate: Green.
 8. Reclaimed Water: Purple.
 9. Gray Water: Green.
 10. Treated Gray Water: Yellow and Black.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine adjacent construction and supports.
- B. Verify that openings are properly framed, within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface.
- C. Correct detrimental conditions proceeding with installation.

3.2 INSTALLATION

- A. Install plumb, level, and square with adjacent construction.
- B. Attach assemblies securely to supports.
- C. When installed in ceramic tile surfaces, coordinate panel location with the tilework so that the panel will align and fit within the tile module with no tile cutting, or a minimum of cutting.

3.3 FIELD QUALITY CONTROL

- A. Adjust hardware for proper function so panels operate freely, but not loosely, without sticking or hinge binding.

END OF SECTION

SECTION 08 56 19

SLIDING SERVICE WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Sliding service window, Window Type 2 in Window Schedule.
 - 2. Glass and glazing for the work of this Section.
- B. Related Requirements: Section 12 36 61 Countertops.

1.2 SUBMITTALS

- A. Data: Manufacturer Product Data for window, including the following.
 - 1. Construction details and fabrication methods.
 - 2. Profiles and dimensions of individual components.
 - 3. Data on hardware, accessories, and finishes.
- B. Shop drawings: Include information not fully detailed in manufacturer standard Product Data. Indicate adjacent materials and attachment to supports.
- C. Samples: Specified finish on 6-inch long sections of window members. Where finishes involve normal color variations, include sample sets showing the full range of variations expected.

1.3 HANDLING

- A. Store off the floor in a protected location.

PART 2 - PRODUCTS

2.1 MANUFACTURER/TYPE

- A. Nissen & Co. Series F Window with insulated glass complete with stainless steel counter and surrounding housing constructed of 16-gage stainless steel, basis of design.
- B. Or equal.

2.2 MATERIALS

- A. Fasteners: Non-magnetic stainless steel, epoxy adhesive, or other materials warranted by the manufacturer to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components of window.
- B. Anchors, clips, and window accessories: Fabricate anchors, clips, and window accessories of aluminum, non-magnetic stainless steel, or hot-dip zinc-coated steel or iron complying with the requirements of ASTM B 633.
- C. Glazing: As specified.
- D. Glazing materials: Standard with the manufacturer.
- E. Sealants and back-up rods:
 - 1. Within assemblies: Manufacturer's standard non-drying, non-skinning sealant complying with AAMA 809.2.
 - 2. Between assemblies and adjacent materials: As specified in Section 07 92 00.
- F. Other materials: Standard with the manufacturer.

2.3 CONSTRUCTION

- A. Fabricate frame and sash square, without rack, and with flush, hairline joints.
- B. Provide unit reglazable from the security side, without dismantling sash.
- C. Finish:
 - 1. Stainless steel brackets: Prime with rust-inhibitive primer.
- D. Glazing: Factory glaze windows. Comply with the glazing manufacturer's recommendations and the requirements of the Window Schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine adjacent construction and supports.
- B. Verify that opening is within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface.
- C. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

- A. Install window level, plumb, square and with tight fitting joints. Attach to supporting construction with non-staining and non-corrosive shims, anchors, fasteners and spacers as shown on approved Shop Drawings.
- B. Set sill member in a bed of compound or with joint fillers or gaskets to provide weathertight construction.
 - 1. Refer to Section 07 92 00 for compounds, fillers, and gaskets to be installed concurrently with windows.
 - 2. Coordinate installation with wall flashings and other components of the work.
- C. Protect metal surfaces that will be in contact with cementitious and dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- D. Provide all accessories such as fasteners, sealants and concealed anchorage needed for a complete weatherproof installation.
- E. Adjust tray to assure smooth operation.
 - 1. Unit shall be weathertight when closed.
 - 2. Lubricate hardware and moving parts as required.
 - 3. Weatherstrip shall not bind or prevent tray from closing easily and tight with weathertight contact between metal components.

END OF SECTION

SECTION 08 56 53

TRANSACTION WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Include:

1. Exterior stainless-steel cashier windows with built-in counters and Speak Holes, Window Type 3 in the Window Schedule.
2. Exterior stainless-steel fixed windows with built-in counters, Window Type 1 in the Window Schedule.
3. Glass and glazing for the work of this Section.

B. Related Requirements: Division 08 for all other windows and for glass and glazing.

1.2 SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for window assemblies.

B. Shop Drawings:

1. Include window and counter plans, elevations, sections, and attachments to other work.
2. Full-size section details of framing members along with reinforcement, and stiffeners.
3. Location of weep holes.
4. Glazing details.

C. Samples:

1. Window manufacturer's standard size samples for each type of exposed material and finish required.
2. Framing: 12-inch- long sections of frame members.

D. Sample Warranty: For special warranty.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Windows shall conform to the reach and access requirements of CBC Section 11B-308 and 11B-401 for accessible transaction areas.
2. Accessible pass through shelf shall not exceed 34 inches above finished floor surface.

B. Installer Qualifications: Authorized representative who is trained and approved by manufacturer for installation of units required for this Project.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Pack assemblies in wood crates for shipment. Crate glazing separate from frames unless factory glazed.

B. Label packaging with drawing designation.

C. Store crated assemblies on raised blocks to prevent moisture damage.

1.5 FIELD CONDITIONS

A. Field-Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace service windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including deflections exceeding 1/4 inch.
 - b. Failure of welds.
 - c. Excessive air leakage.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: 3 years from Substantial Completion.

PART 2 - PRODUCTS

2.1 TRANSACTION WINDOWS

- A. Manufacturers:
 - 1. Nissen & Co. Cashiers Window with insulated glass complete with stainless steel counter and surrounding housing constructed of 16-gage stainless steel, basis of design with Speak Hole 410 for 1-inch glass.
 - 2. Laurence, C.R. Co., Inc.
 - 3. Or equal.

2.2 MATERIALS

- A. See Section 08 56 19..

2.3 FABRICATION

- A. General: Fabricate windows to provide a complete system for assembly of components and anchorage of window units with countertops. Provide units that are re-grazable from the secure side without dismantling the non-secure side of framing.
- B. Provide weep holes and internal water passages to conduct infiltrating water to the exterior.
- C. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.
- D. Prior to fabrication, clean stainless steel components.
- E. Fabricate window in accordance with approved Shop Drawings, to a tolerance of plus or minus 1/16-inch in any dimension, free of rack, and with flush, invisible joints.
- F. Fabricate frames of 1/8-inch wall 6063-T5 Aluminum lined with bullet-resistant fiberglass and wrapped in 16-gage stainless steel.
- G. Miter or cope corners of frame and weld continuously.
- H. The deal tray shall be fully integrated into the stainless steel top. Drawer shall have a minimum depth of 1-5/8-inch from the bottom of the glazing.
- I. Voice communication:
 - 1. Stainless voice port shall be the manufacturer standard unit, offset pattern design, with proper weather seals.
 - 2. Sound transmission shall be achieved thru natural voice communication.
 - 3. Factory-install speak hole. Conceal all raw glass edges.
- J. Glazing:
 - 1. Design window for inside glazing. Provide integral exterior glass stop.
 - 2. Provide continuous screw on interior stainless-steel glazing beads to suit glass indicated and specified, using glass bites indicated on the approved Shop Drawings to maintain the ballistic rating.

- K. Anchors: Ship loose for field installation. Provide a minimum of 3 anchors per side, not less than 0.042-inch thick or 0.167-inch diameter wire, suitable for the adjoining wall construction.
- L. Finishing exposed surfaces:
 - 1. Finish surfaces to match approved Samples.
 - 2. Finish components with a NAAMM No. 4 satin finish with the grain belting running parallel with the long dimension of the component being fabricated.

2.4 GENERAL FINISH REQUIREMENTS

- A. Finish components with a NAAMM No. 4 satin finish with the grain belting running parallel with the long dimension of the component being fabricated.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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 windows.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of windows.
- C. For glazing materials whose orientation is critical for performance, verify installation orientation.
- D. Proceed with installation only after unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other security window anchors whose installation is specified in other Sections. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

3.3 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing windows to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.
- B. Glazed Framing: Provide gasket-glazed framing. Comply with installation requirements in Division 08 Section "Security Glazing."
- C. Removable Glazing Stops and Trim: Fasten components with security fasteners.
- D. Fasteners: Install windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel fasteners in stainless-steel materials.
- E. Sealants: Comply with requirements in Division 07 Section "Joint Sealants" for installing sealants, fillers, and gaskets.
 - 1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
 - 2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.

- F. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.4 FIELD QUALITY CONTROL

- A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
- B. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

3.5 ADJUSTING

- A. Remove and replace defective work, including windows that are warped, bowed, or otherwise unacceptable.

3.6 CLEANING AND PROTECTION

- A. Clean surfaces promptly after installation of windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.
- B. Provide temporary protection to ensure that windows are without damage at time of Substantial Completion.

END OF SECTION

SECTION 08 62 13

PLASTIC UNIT SKYLIGHTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes plastic unit skylights.
- B. Related requirements: Division 07 for metal flashings at skylight perimeter.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling and sequencing:
- B. Pre-installation meeting:

1.3 DESCRIPTION

- A. Self-supporting units consisting of extruded aluminum curb supporting a double translucent acrylic dome. Units shall be provided with security bars.

1.4 PERFORMANCE REQUIREMENTS

- A. Design loads:
 - 1. Design, fabricate, and install work of this Section so that the completed assemblies will withstand dead and live loads caused by wind pressure and wind uplift. Provide additional support and reinforcement to manufacturer's standard assembly as required to meet specified performance requirements.
 - 2. FM rating: Comply with insurance rating bureau requirements for class and securement rating (wind uplift resistance) of Factory Mutual (FM) Class I-90 requirements.
 - a. Live load: 40 psf minimum.
 - b. Concentrated load: 250 lb.
 - c. 20 psf positive (external) and 20 psf negative or uplift (internal) loadings.
 - 3. Design loads shall be supported without damage, permanent deformation, or disengagement of seals or anchors.

1.5 SUBMITTALS

- A. Data: Manufacturer Product Data identifying materials, finishes, glazing light transmission and thermal characteristics.
- B. Shop drawings: Supplement Product Data with Shop Drawings indicating plan, elevation, section, details of components, interface with adjacent work, and Project-specific installation details and attachments to supports.
- C. Samples: Samples of the following.
 - 1. Three-inch square Samples of acrylic glazing.
 - 2. Twelve-inch long Samples of aluminum extrusion with specified finish.
- D. Certifications: Provide ICC-ES Evaluation Report or LARR report for skylight assembly.

1.6 QUALITY ASSURANCE

- A. Fire-test-response characteristics: Provide plastic sheets identical to those tested for the following fire-test-response characteristics, in compliance with ASTM test method specified, by a testing and

inspecting agencies acceptable to authorities having jurisdiction. Identify plastic sheets with appropriate markings of applicable testing and inspecting organization.

- B. Self-ignition temperature: 650-degree F. or greater when tested in compliance with ASTM D 1929 on plastic sheets in the thickness intended for use.
- C. Smoke density: 75 or less when tested in compliance with ASTM D 2843 on plastic sheets in the thickness intended for use.
- D. Relative-burning characteristics: Burning rate of 2.5-inch/minute or less when tested on plastic glazing indicated below with a nominal thickness of 0.060-inch or the thickness intended for use, when tested in compliance with ASTM D 635.

1.7 WARRANTY

- A. Warranty: Provide manufacturer warranty agreeing to repair or replace units that exhibit defects in materials or workmanship and guaranteeing weathertight and leak-free performance. A defect is defined as uncontrolled leakage of water and abnormal aging or deterioration.
- B. Warranty period: 5 years from date of Substantial Completion.
- C. Plastic warranty: Provide manufacturer warranty agreeing to repair or replace work that has or develops defects in the plastic. A defect is defined as abnormal aging or deterioration.
 - 1. Warranty period for acrylic lites: 5 years from Substantial Completion against cracking and yellowing.
- D. Finish warranty: Provide written warranty signed by manufacturer agreeing to repair or replace work with finish defects. A defect is defined as peeling, chipping, chalking, fading, abnormal aging or deterioration, and failure to perform as required.
 - 1. Warranty period: 5 years from Substantial Completion for color and film integrity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. One of the following:
 - 1. Bristol Acrylic Skylights by Kingspan, basis of design. ICC-ES ERS-3837.
 - 2. Dur-Red Products
 - 3. Naturalite/EPI Skylight Systems.
 - 4. Or equal.

2.2 MATERIALS

- A. Aluminum extrusions: ASTM B 221 alloys 6063-T52 or alloy and temper required to suit structural and finish requirements.
- B. Acrylic: ASTM D 4802, monolithic, thermo-formable, cast or continuous-cast, translucent (white) acrylic (methacrylate), Category C-1 or C-2, Type UVA (formulated with ultraviolet absorber), with Finish 1 (smooth or polished).
- C. Fasteners:
 - 1. Fasteners of same metal as metals being fastened or non-magnetic stainless steel.
 - 2. Match finish of exposed fasteners with finish of material being fastened.
- D. Where removal of exterior exposed fasteners affords access to building, provide non-removable fastener heads.
- E. Bituminous coating: SSPC-Paint 12, solvent-type, bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15 mils DFT thickness per coating.

F. Sealants:

1. Mastic sealant: Polyisobutylene; non-hardening, non-skinning, non-drying, non-migrating sealant as specified in Section 07 92 00.
2. Silicon sealant: As specified in Section 07 92 00.

2.3 CONSTRUCTION

- A. General: Factory-assemble units consisting of plastic glazing, extruded aluminum glazing retainer, gasketing, inner frame that may be incorporated into the curb, and integral curb with self-contained roof flashing flanges.
- B. Curb: Self-flashing, self-supporting double-wall formed or extruded (or combination) aluminum curb, minimum 0.070-inch wall thickness, with minimum 3-inch roof flanges, with welded or sealed mechanical joints at corners.
- C. Glazing: Thermo-formed acrylic with translucent glazing plastic sheet of thickness required to safely support the loads specified above, but not less than required to comply with Code.
- D. Glazing gaskets: Manufacturer standard glazing system of EPDM or neoprene, closed-cell sponge neoprene, or of partially vulcanized butyl tape or liquid-applied elastomeric sealant.
- E. Security bars: Minimum one-inch diameter steel bars running the short distance of the opening, spaced 6 inches apart and painted white. Factory-form into single unit complete with frame, and install level and secure with tamper-proof screws or bolts.

2.4 FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. High-performance organic finish (2-coat fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 1. Color and gloss: As selected by the Architect from manufacturer's standard palette.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine adjacent construction and supports.
- B. Verify that openings are within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface.
- C. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

- A. General:
 1. Comply with the skylights manufacturer's instructions and recommendations, and approved Shop Drawings.
 2. Anchor units securely to supports to withstand lateral and thermal stresses as well as loading pressures.
- B. Isolation: Where metal will be in contact with incompatible metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation.
- C. Flange seals: Seal flanges to roof to form a weathertight seal.

- D. Cap flashing: Where cap flashing is required as component of the skylights, install to provide an adequate waterproof overlap with roofing or roof flashing (as counter-flashing).
- E. Seal with thick bead of mastic sealant, unless indicated to be left open for ventilation.

3.3 CLEANING/PROTECTING

- A. Clean exposed surfaces according to manufacturer's instructions.
- B. Touchup damaged finish when the results are satisfactory to the Owner, otherwise return the damaged component to the shop for refinishing.
- C. Clean and polish skylights inside and out no more than 5 days prior to Substantial Completion.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:
 - a. Swinging doors.
2. Electronic access control system components, including:
 - a. Electronic access control devices.
3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
4. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 Section "Alternates" for alternates affecting this section.
2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
3. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
4. Division 13 Section "Radiation Protection" for requirements for lead-lining for door hardware at openings indicated to receive radiation protection.
5. Division 26 sections for connections to electrical power system and for low-voltage wiring.
6. Division 28 sections for coordination with other components of electronic access control system.

1.02 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies

4. UL 305 - Panic Hardware
- B. DHI - Door and Hardware Institute
 1. Sequence and Format for the Hardware Schedule
 2. Recommended Locations for Builders Hardware
 3. Key Systems and Nomenclature
- C. ANSI - American National Standards Institute
 1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.

B. Action Submittals:

1. Product Data: Technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated, and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
 - a. Door Index; include door number, heading number, and Architects hardware set number.
 - b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
 - c. Quantity, type, style, function, size, and finish of each hardware item.

- d. Name and manufacturer of each item.
- e. Fastenings and other pertinent information.
- f. Location of each hardware set cross-referenced to indications on Drawings.
- g. Explanation of all abbreviations, symbols, and codes contained in schedule.
- h. Mounting locations for hardware.
- i. Door and frame sizes and materials.
- j. Name and phone number for local manufacturer's representative for each product.
- k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components).
Operational description should include operational descriptions for: egress, ingress (access), and fire/smoke alarm connections.

- 1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

5. Key Schedule:

- a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
- b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
- c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
- d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
- e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
 - 1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
- f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

- 6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

C. Informational Submittals:

- 1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
- 2. Product data for electrified door hardware:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
- 3. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

- 1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.

- c. Factory order acknowledgement numbers (for warranty and service)
- d. Name, address, and phone number of local representative for each manufacturer.
- e. Parts list for each product.
- f. Final approved hardware schedule, edited to reflect conditions as-installed.
- g. Final keying schedule
- h. Copies of floor plans with keying nomenclature
- i. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
- j. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.04 QUALITY ASSURANCE

- A. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 - 4. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- B. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - 1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC).
 - 2. Can provide installation and technical data to Architect and other related subcontractors.
 - 3. Can inspect and verify components are in working order upon completion of installation.
 - 4. Capable of producing wiring diagrams.
 - 5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
- C. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
- D. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- F. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.

G. Keying Conference

1. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.

H. Pre-installation Conference

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. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

I. Coordination Conferences:

1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1. Deliver each article of hardware in manufacturer's original packaging.

C. Project Conditions:

1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
2. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

D. Protection and Damage:

1. Promptly replace products damaged during shipping.
2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

- F. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.06 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.07 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Beginning from date of Substantial Completion, for durations indicated.
 - a. Closers:
 - 1) Mechanical: [LCN 4000 series, 30 years]
 - 2) Electrified: 2 years.
 - b. Automatic Operators: [LCN, 2 years]
 - c. Exit Devices:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - d. Locksets:
 - 1) Mechanical: [Schlage, 3 years]
 - 2) Electrified: 1 year.
 - e. Continuous Hinges: Lifetime warranty.
 - f. Key Blanks: Lifetime
 - 2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.08 MAINTENANCE

- A. Maintenance Tools: Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
 - 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

- A. Fasteners
 - 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 - 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 - 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
 - 4. Install hardware with fasteners provided by hardware manufacturer.
- B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.
 - 1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
 - 2. Use materials which match materials of adjacent modified areas.
 - 3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.
- C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
 - 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Ives 5BB series.
2. Acceptable Manufacturers and Products: Hager BB series, McKinney TA/T4A series, Stanley FBB Series.

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
4. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
10. Provide mortar guard for each electrified hinge specified.

2.04 CONTINUOUS HINGES

A. Aluminum Geared

1. Manufacturers:
 - a. Scheduled Manufacturer: Ives.
 - b. Acceptable Substitute: Markar, Stanley.
2. Requirements:
 - a. Provide aluminum geared continuous hinges conforming to ANSI A156.25, Grade 2.

- b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum, with .25 inch diameter Teflon coated stainless steel hinge pin.
- c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
- d. Hinges shall be capable of supporting door weights up to 450 pounds, and shall be successfully tested for 1,500,000 cycles.
- e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by a testing agency acceptable to the authority having jurisdiction.
- f. Provide aluminum geared continuous hinges with electrified option where specified. Provide with sufficient number and gage of concealed wires to accommodate electric function of specified hardware.

Install hinges with fasteners supplied by manufacturer. Hole pattern shall be symmetrically patterned.

2.05 FLUSH BOLTS

A. Manufacturers:

- 1. Scheduled Manufacturer: Ives.
- 2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

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

2.06 MORTISE LOCKS

A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product: Schlage L9000 series. No substitutes will be accepted.

B. Requirements:

- 1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3 hour fire doors.
- 2. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
- 3. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
- 4. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
- 5. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
- 6. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
- 7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

- a. Lever Design: Schlage 06A.

2.07 ELECTRONIC ACCESS CONTROL LOCKSETS – WIRELESS MORTISE-TYPE

- a. Manufacturer: “AD-400-MS” series, as manufactured by Schlage, an Allegion Company. No substitutes will be accepted.
- b. Requirements: Wireless electronic locksets to comply with the following requirements.
 - 1) Type: Mortise, field-reversible handing.
 - 2) Backset: 2-3/4-inch (70 mm), nominal.
 - 3) Latchbolt: 3-piece, beveled, stainless steel with 3/4-inch (19 mm) throw and anti-friction latch.
 - 4) Chassis: Shall accommodate ANSI standard mortise lock prep for 1-3/4-inch (44 mm) doors standard, or 1-3/8-inch (35 mm) to 2-3/4-inch (70 mm) thick doors in 1/8-inch (3 mm) increments.
 - 5) Applicable Standards:
 - a) Listed, UL 294 - The Standard of Safety for Access Control System Units.
 - b) Compliant with A156.25 and A156.13 Series 1000, Grade 1 Operational and Security.
 - c) Lockset to meet or exceed ANSI Standard A156.25 and A156.13 Series 1000, Grade 1 strength and operational requirements.
 - d) Certified to UL10C, FCC Part15, Florida Building Code Standards TAS 201 large missile impact, TAS 202 and TAS 203.
 - e) Compliant with ASTM E330 for door assemblies.
 - f) Compliant with ICC / ANSI A117.1, NFPA 101, NFPA 80, and Industry Canada RSS-210.
 - 6) Lockset Functions: Provide locks with following functions, as scheduled, that are field configurable without taking the lock off the door:
 - a) Office 50.
 - 7) Emergency Override: Lockset shall have the ability to utilize emergency mechanical key override with the following manufacturer's key systems in the lever:
 - a) Small Format Interchangeable core up to 7 pin by Falcon.
 - 8) Levers:
 - a) Vandal Resistance: Exterior (secure side) lever designed with ability to rotate freely while door remains securely locked, preventing damage to internal lock components from vandalism by excessive force.
 - b) Levers shall operate independently of each other.
 - c) Style: Rhodes (06).
 - d) Tactile Warning (Knurling): Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous by the authority having jurisdiction.
 - 9) Power Supply:
 - a) Lockset powered by four AA batteries with options for eight AA batteries or a 12V or 24V DC power supply.
 - b) Lockset shall have ability to communicate battery status and battery voltage level by means of a handheld programming device at door and remotely by Partner integrated software.
 - 10) Features: Locksets shall incorporate the following features.
 - a) Ability to communicate unit's communication status.

- b) Visual tri-colored LED indicators that indicate activation, additional PIN code credential required, operational systems status, system error conditions and low power conditions.
- c) Visual bi-colored LED indicator on interior that is capable of indicating secured/unsecured status of device to occupants on interior. Optional Audible feedback that can be enabled or disabled.
- e) Tamper-Resistant Screws: Tamper torx screws on inside escutcheon for increased security.

11) Adaptability:

- a) Open Architecture: Locksets manufactured with open architecture characteristics capable of handling new and existing access control software and credential reading technology.
- b) Field changeable Reader Modules: Lockset to have the ability to change credential reader technologies without being removed from door.

12) Switches: Provide locksets with the following switches, standard:

- a) Door Position Switch
- b) Interior Cover Tamper Guard
- c) Mechanical Key Override
- d) Request to Exit
- e) Request to Enter
- f) Unlock/Lock Status (Clutch Position).

13) Credential Reader:

- a) Credential Reader Configuration: Provide credential reader modules in the following configurations, as indicated in door hardware sets.
 - i. Proximity, Smartcard and Multi-Technology.
- b) Credential reader capabilities, which can be configured at lockset with handheld programming device and remotely by Partner software to include, but may not be limited to (Verify):
 - i. 13.56 MHz Smart card credentials:
 - (a) Secure section (Multi-Technology and Smartcard): Schlage, XceedID ISO-X, MIFARE, ISO-X Lite, my-d, DESFire 8-EV1.
 - (b) 13.56 MHz Serial number only (Multi-Technology and Smartcard): MIFARE, DESfire, iClass, Inside Pictotag, ST Micro, TI Tagit.
 - ii. 125 kHz Proximity card credentials: Schlage, XceedID, HID, GE/CASI ProxLite and AWID.
 - iii. Multi-Technology readers that read both 13.56 MHz Smart Cards and 125 kHz Prox cards.
 - iv. Dual credential reading capabilities credential card or fob and PIN.

14) Operation:

- a) Lockset System Interface (Verify):
 - i. Wiegand or Clock & Data via PIM400-TD2 (Panel Interface Module).
 - ii. Directly via RS485.
- b) Lockset to have real-time bidirectional communication between access control system and lock.
- a. Remote Commanding Capability By Partner Integrated Access Control Network Software: Battery-powered lockset shall have "Wake on Radio" feature causing activation of remote, wireless access control locksets, enabling activated locksets to be configured, locked or unlocked from a centralized location within 10 seconds or less without user interface at the device.
- c) Local Commanding: Locksets shall have the ability to be configured, locked or unlocked locally by handheld programming device, in real-time.

- d) When Utilized with Access Control Network Software With Remote Commanding Capability: Lockset shall have ability to be remotely locked down or unlocked in real-time via configurable heartbeat without user interface at the device. Real-time response of battery powered device capable of being configured at door by handheld programming device and remotely by Partner integrated software.
- e) Upon Loss of Power to Lockset: Lockset shall have ability to manage access control offline in one of three methods below that can be configured in the field at lockset by handheld programming device and remotely by Partner integrated software:
 - i. Fail locked (secured)
 - ii. Fail unlocked (unsecured)
 - iii. Fail As-Is
- f) Upon Loss of Communication Between Lockset and Network: Lockset shall have ability to manage access control offline in one of four methods below that can be configured in the field at lockset by handheld programming device and remotely by Partner integrated software:
 - i. Fail locked (secured)
 - ii. Fail unlocked (unsecured)
 - iii. Fail As-Is
 - iv. Fail to Degraded/cache mode utilizing cache memory with following selectable options:
 - (a) Grant access up to the last 1,000 unique previously accepted User IDs.
 - (b) Grant access up to the last 1,000 unique previously accepted facility/site codes
 - (c) Remove from cache previously stored User IDs or facility/site codes that have not been presented to lock within the last 5 days.
- g) Lockset shall have ability to be configured at door by handheld programming device and remotely by Partner integrated software the length of time device is unlocked upon access grant.
- h) Lockset shall have the ability to communicate identifying information such as firmware versions, hardware versions, serial numbers, and manufacturing dates by handheld programming device and remotely by Partner integrated software.
- i) Wireless Transmission:
 - i. Modulation: 900 MHz spread spectrum, direct sequence, 10 channels.
 - ii. Encryption: AES-128 bit Key minimum.

2.08 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer: Falcon.

B. Requirements:

1. Provide interchangeable cylinders/cores to match Owner's existing Falcon key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide the following keyway: Verify.

C. Construction Keying:

1. Replaceable Construction Cores.
 - a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - 1) 3 construction control keys
 - 2) 12 construction change (day) keys.
 - b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.09 KEYING

- A. Provide cylinders/cores keyed into Owner's existing Falcon factory registered keying system.
- B. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- C. Requirements:
 1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - a. Master Keying system as directed by the Owner.
 2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 3. Provide keys with the following features:
 - a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - b. Patent Protection: Keys and blanks protected by one or more utility patent(s)
 4. Identification:
 - a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Do not provide blind code marks with actual key cuts.
 - b. Identification stamping provisions must be approved by the Architect and Owner.
 - c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
 5. Quantity: Furnish in the following quantities.
 - a. Change (Day) Keys: 3 per cylinder/core.
 - b. Permanent Control Keys: 3.
 - c. Master Keys: 6.

2.10 DOOR CLOSERS

- A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: LCN 4040XP series. No substitutes will be accepted.

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 5/8 inch (16 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.11 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.12 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: Zero International.
2. Acceptable Manufacturers: National Guard, Reese.

B. Requirements:

1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Size of thresholds:
 - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
 - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
4. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.13 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Continuous Hinges: BHMA 630 (US32D)
3. Continuous Hinges: BHMA 628 (US28)
4. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
5. Protection Plates: BHMA 630 (US32D)
6. Overhead Stops and Holders: BHMA 630 (US32D)
7. Door Closers: Powder Coat to Match
8. Wall Stops: BHMA 630 (US32D)
9. Latch Protectors: BHMA 630 (US32D)
10. Weatherstripping: Clear Anodized Aluminum
11. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Where on-site modification of doors and frames is required:
 - 1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
 - 2. Field modify and prepare existing door and frame for new hardware being installed.
 - 3. When modifications are exposed to view, use concealed fasteners, when possible.
 - 4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
 - a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 - c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as indicated in keying section.
 - 2. Furnish permanent cores to Owner for installation.
- I. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.

3. Connections to fire/smoke alarm system and smoke evacuation system.
 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 5. Testing and labeling wires with Architect's opening number.
- J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- L. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- M. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- N. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- O. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- P. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- Q. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- R. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

- A. Engage qualified manufacturer trained representative to perform inspections and to prepare inspection reports.
1. Representative will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.05 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, Installer's Architectural Hardware Consultant must examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

C. Door closing speeds shall be as follows: CBC Section 11B-404.2.8.

1. Closer shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is 5 seconds minimum.
2. Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is 1.5 seconds minimum.

D. The force for pushing or pulling open a door shall be as follows: CBC Section 11B-404.2.9.

1. Interior hinged doors, sliding or folding doors, and exterior hinged doors: 5 lbs. (22.2N) maximum.
2. Required fire doors: the minimum opening force allowable by the DSA Authority, not to exceed 15 lbs. (67N) maximum.
3. The force required to activate any operable parts, such as retracting latch bolts or disengaging other devices shall be 5 lbs. (22.2N) maximum to comply with CBC Section 11B-309.4.

3.06 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.07 DOOR HARDWARE SCHEDULE

- A. Hardware items are referenced in the following hardware. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.
- B. Hardware Sets: Starting on next page.

Hardware Group No. 1

For use on Door #(s):

PB-101 PB-102 PB-103 U-101

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD		628	IVE
1	EA	ELEC OFFICE LOCK	AD-300-MS-50-MT-SPA-LDFA7 12/24 VDC		626	SCE
1	EA	SFIC CORE	C607		626	FAL
1	EA	SFIC CONST. CORE	C607CCA		622	FAL
1	EA	SURFACE CLOSER	4040XP EDA SRI		689	LCN
1	EA	FLOOR STOP	FS444		US26D	IVE
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER

TIE TO EXISTING ACCESS CONTROL SYSTEM.

KEY TO EXISTING FALCON SFIC.

VERIFY THRESHOLD CONDITION

Hardware Group No. 1A

For use on Door #(s):

V-101 W-101

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD		628	IVE
1	EA	ELEC OFFICE LOCK	AD-300-MS-50-MT-SPA-LDFA7 12/24 VDC		626	SCE
1	EA	SFIC CORE	C607		626	FAL
1	EA	SFIC CONST. CORE	C607CCA		622	FAL
1	EA	OH STOP & HOLDER	100H		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA SRI		689	LCN
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER

TIE TO EXISTING ACCESS CONTROL SYSTEM.

KEY TO EXISTING FALCON SFIC.

VERIFY THRESHOLD CONDITION

Hardware Group No. 2

For use on Door #(s):

V-103

V-104

W-103

W-104

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	CONT. HINGE	112HD		628	IVE
1	EA	ELEC OFFICE LOCK	AD-300-MS-50-MT-SPA-LDFA7 12/24 VDC		626	SCE
1	EA	SFIC CORE	C607		626	FAL
1	EA	SFIC CONST. CORE	C607CCA		622	FAL
1	EA	SURFACE CLOSER	4040XP RW/PA SRI		689	LCN
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER

TIE TO EXISTING ACCESS CONTROL SYSTEM.

KEY TO EXISTING FALCON SFIC.

VERIFY THRESHOLD CONDITION

Hardware Group No. 3

For use on Door #(s):

X-101

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD		628	IVE
1	EA	PANIC HARDWARE	PA-AX-98-L-17		626	VON
1	EA	SFIC RIM HOUSING	80-129		626	SCH
1	EA	SFIC CORE	C607		626	FAL
1	EA	SFIC CONST. CORE	C607CCA		622	FAL
1	EA	SURFACE CLOSER	4040XP EDA SRI		689	LCN
1	EA	FLOOR STOP	FS444		US26D	IVE
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER

KEY TO EXISTING FALCON SFIC.

VERIFY THRESHOLD CONDITION

Hardware Group No. 4

For use on Door #(s):

PB-102A

PB-102B

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD		628	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BD 17A 09-544		626	SCH
1	EA	SFIC CORE	C607		626	FAL
1	EA	SFIC CONST. CORE	C607CCA		622	FAL
1	EA	FLOOR STOP	FS439		682	IVE

KEY TO EXISTING FALCON SFIC.

Hardware Group No. 4A

For use on Door #(s):

V-101A W-101A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD		628	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BD 17A 09-544		626	SCH
1	EA	SFIC CORE	C607		626	FAL
1	EA	SFIC CONST. CORE	C607CCA		622	FAL
1	EA	OH STOP & HOLDER	90H		630	GLY
KEY TO EXISTING FALCON SFIC.						

Hardware Group No. 4B

For use on Door #(s):

V-105

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD		628	IVE
1	EA	CORRIDOR LOCK	L9456BD 17A 09-544		626	SCH
1	EA	SFIC CORE	C607		626	FAL
1	EA	SFIC CONST. CORE	C607CCA		622	FAL
1	EA	SURFACE CLOSER	4040XP EDA SRI		689	LCN
1	EA	FLOOR STOP	FS444		US26D	IVE
1	EA	THRESHOLD	655A-223		A	ZER
KEY TO EXISTING FALCON SFIC.						

Hardware Group No. 5

For use on Door #(s):

V-102 W-102

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD		628	IVE
2	EA	MANUAL FLUSH BOLT	FB458		626	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BD 17A 09-544		626	SCH
1	EA	SFIC CORE	C607		626	FAL
1	EA	SURFACE CLOSER	4040XP EDA SRI		689	LCN
2	EA	FLOOR STOP	FS444		US26D	IVE
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
KEY TO EXISTING FALCON SFIC.						
VERIFY THRESHOLD CONDITION						

Hardware Group No. 6

For use on Door #(s):

V-102B

V-102A

W-102A

W-102B

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD		628	IVE
2	EA	MANUAL FLUSH BOLT	FB458		626	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BD 17A 09-544		626	SCH
1	EA	SFIC CORE	C607		626	FAL
1	EA	SFIC CONST. CORE	C607CCA		622	FAL
2	EA	FLOOR STOP	FS439		682	IVE
KEY TO EXISTING FALCON SFIC.						

END OF SECTION

DIVISION 09

FINISHES

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes non-structural metal framing (NSMF) as follows:
 - 1. Interior steel studs and furring.
 - 2. Resilient channels.
 - 3. Backing plates not provided by other trades for support of items attached to metal framing system.
- B. Work installed but furnished in other Sections:
 - 1. Access panels furnished by electrical and mechanical trades for access to their work.
 - 2. Backing plates furnished with fixtures and equipment attached to, or supported by metal framing system.
- C. Related requirements: Division 09 for ceiling and soffit suspension systems.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-construction meeting: Prior to starting erection of the NSMF, but not later than one week prior to commencing work, arrange a preliminary meeting with trades associated with the work of this Section.
 - 1. Presided over by Contractor, include subcontractor performing work of this Section, testing company representative, as appropriate, and a representative of the Fire Marshall.
 - 2. Review locations of access panels and fire extinguisher cabinets; the latter with a representative of the Fire Marshall.
 - 3. Identify those locations on the slab. Use a removable marker where the slab is scheduled to remain exposed in the Work.
 - 4. Review installation methods, procedures, time schedule and conditions under which work will proceed, including stud manufacturer's instructions and coordination required with related work.
 - 5. Review and verify availability of materials and installer's experience.
 - 6. Record meeting minutes and distribute PDF copy to all concerned, including the Architect, within 48 hours of the meeting.
- B. Coordination:
 - 1. Notify concerned trades of items required to be incorporated into work of other Sections. Certain components specified under this Section includes items which are closely integrated with doors, glazing assemblies and work specified in other Sections that require close coordination with the work of this Section.
 - 2. Be responsible for coordination required to ensure correct installation procedures and results.
 - 3. Verify actual locations of embeds and existing adjacent structural supports by field measurements before erection and indicate measurements on Shop Drawings. Coordinate tolerances of other trades that may affect the work of this Section prior to start of Shop Drawings preparation.

1.3 SUBMITTALS

- A. Data: Manufacturer Product Data consisting of a complete list of materials together with brochures and descriptive data of all items proposed for use.
- B. Load tables: Load tables and deflection table properly annotated for anticipated use for all studs.
- C. Shop Drawings: Large scale, dimensioned Shop Drawings of all assemblies showing the following.

1. Component details, framing layout, framed openings, anchorage to structure, seismic bracing, type, and location of fasteners and welds, and accessories required of related requirements.
2. Framing member size and gage designations, number, type, location, and spacing.
3. Indicate attachments, clips, strapping, bracing, splices, bridging, accessories, and details required for proper installation. Show and dimension all concealed backing plates required for wall-attached or wall-mounted items indicated; obtain dimensions from trades that will provide these items.
4. Indicate and identify all fasteners and welds (with AWS symbols).

D. Certificates:

1. Mill certificates signed by framing member/accessory manufacturer certifying compliance with material requirements.
2. Welders' certificates.

1.4 QUALITY ASSURANCE

A. Fire resistance: Where a fire resistance classification is indicated, provide materials, accessories, and application procedures listed by UL, or tested according to ASTM E 119 for the type of construction shown, and acceptable to authorities having jurisdiction.

B. Welding work qualifications:

1. Qualify welding procedures and welding operators in compliance with AWS "Qualification" requirements for AWS D1.3.
2. Use qualified welders experienced in welding light gage steel and comply with AWS D1.1 and D1.3.
3. Verify that welders to be employed in this work have satisfactorily passed AWS qualification tests.
4. If recertification of welders is required, retesting will be Contractor's responsibility.

1.5 HANDLING

A. Store materials under cover, off the ground or floor, in a dry, ventilated space.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: One of the following systems of the size indicated and gage required to comply with criteria specified.

B. Elsewhere:

1. CEMCO.
2. ClarkDietrich Building Systems.
3. MarinoWare.
4. Scafco Corp.

2.2 STUDS, RUNNERS AND FURRING

A. Studs:

1. Channel type cold-formed steel members with punched web, complying with the following, as applicable.
 - a. Roll-formed from galvanized steel meeting ASTM A 653, Classification SQ, Grade 33; galvanized meeting G60 for 18-gage and lighter gage.
 - b. For 16-gage and heavier, provide ASTM A 653, Classification SQ, Grade 50; galvanized meeting G60.
 - c. Protective coating: ASTM A 653, G40 zinc coating.
 - d. Bracing: Where the wall finish does not adequately brace both flanges of studs, add bracing or reduce allowable stresses in computing stud heights in compliance with Code.

- B. Top and bottom runner, and bridging:
1. As recommended by the manufacturer of each stud type and of same gage as stud in same wall or partition, unless otherwise indicated on the Drawings. Provide unpunched, screwable tracks, gage to match studs, 1-1/2-inch flanges.
 2. For fire-rated partitions: "MaxTrk" or "BlazeFrame" both by ClarkDietrich Building Systems, "Fire Trak" by Fire Trak Corp., "Sliptrack Systems, Inc. "Slip-Trk" for fire-rated partitions, Fire Trak Corp. "VertiTrack VTD VTX" by the Steel Network, Runners by Blaze Frame, or other Code-compliant assemblies acceptable to the Architect.
 3. Elsewhere: Use either "Slip Track 250" by ClarkDietrich Building Systems, or equal track matching (as a minimum) the stud gage in same wall but with a 2-1/2 inch leg, or a deep leg 54 mils thick (16-gage) minimum slip connection to accommodate slab deflection.
- C. Joist framing:
1. Steel Joists: Manufacturer standard C-shaped steel joists, of web depths indicated, punched or unpunched, with stiffened flanges, and as follows.
 - a. Minimum base-metal thickness: 20-gage minimum.
 - b. Flange width: 1-5/8-inch, minimum.
 2. Steel joist track: Manufacturer standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - a. Minimum base-metal thickness: 20-gage minimum.
 - b. Flange width: 1-5/8-inch, minimum.
- D. Furring channels:
1. For gypsum board and soffit board:
 - a. Zee furring channels: 30 mils thick (20-gage) model ZFN3 by Dietrich Industries, Inc. of depth to match insulation thickness, or equal.]
 - b. All others (except resilient channels): 18 mils thick (25-gage) minimum, galvanized, hat-shaped.
 2. For lath/plaster: 3/4-inch size as specified hereafter for runner channels.
- E. Prefabricated headers: At the Contractor's option, ProX Header assemblies by Dietrich Industries or Cemco may be used in lieu of job-assembled headers.
- F. Horizontal stiffener, runner channels and bridging: 54 mils thick (16-gage) channels fabricated of cold-rolled steel, ASTM A 366, with flanges not less than 7/16-inch wide. Minimum weights as follows:

Channel Size	Flange Width	Pounds/1000 linear foot
3/4-inch	7/16-inch	300
1-1/2-inch	7/16-inch	475
2-inch	19/32-inch	590

- G. Resilient channels: RC-1 by USG, R/FC-1 by Dale Industries, Resilient Channels by Scafcro, fabricated from steel sheet complying with ASTM A 924 or ASTM A 568.
- H. Resilient sound clips: Super Soundproofing Co., "SSP Sound Isolation Clips" or Acoustical Surfaces, Inc. "Noise STOP clips RSIC-1."

2.3 FASTENERS AND ACCESSORIES

- A. Screws:
1. ASTM C 1002 for metal framing 18 mils thick (25-gage) and lighter, ASTM C 954 for heavier metal framing, 3/8-inch head diameter, corrosion-resistant pan head screws; length and gage required by Code, or recommended by the metal framing manufacturer when not prescribed by Code.

2. For soffits and overhead surfaces, use with appropriate washers but not less than one-inch OD by 1/4-inch ID by 54 mils thick (16-gage) cut washer.
 3. Screws for gypsum board mounted on resilient channels shall have a maximum length of one-inch for one layer and 1-5/8-inch for 2 layers.
- B. Shot pins: 0.140-inch diameter low velocity powder-actuated drive pins equivalent to Ramset/Red Head No. 1508, or equal, with 7/8-inch minimum penetration into concrete.
 - C. Anchor bolts: ASTM A 307, non-headed type.
 - D. Expansion shields: FS FF-S-325, except do not use lead, fiber and plastic shields.
 - E. Furring channel clips: Manufacturer standard clips for attaching gypsum board furring channels to runner channels.
 - F. Welding electrodes: ASTM A 233, as recommended by AWS for the conditions of use and the metals to be welded.
 - G. Wire: ASTM A 641, galvanized, soft-annealed steel, minimum gage as follows.
 1. Ceiling and soffit suspension system: 8 BW gage.
 2. Furring channel to runner channel: 16 BW gage.
 3. Ties and splices in channels: 18 BW gage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and measurements affecting the work of this Section at site.
- B. Correct detrimental conditions before proceeding with installation.

3.2 PREPARATION

1. Ceiling anchorage:
 - a. Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorage to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.
 - b. Furnish concrete inserts and other devices indicated to other trades for installation well in advance of time needed for coordination with other construction.
2. Attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fireproofing. Where offset anchor plates are required, provide continuous units fastened to building structure not more than 24 inches o.c.

3.3 INSTALLATION VERTICAL FRAMING

- A. General:
 1. Erect metal framing systems in compliance with their manufacturer's recommendations, the reference standards, the Drawings and these Specifications.
 2. Use minimum 33 mils thick (20-gage) studs at the following locations:
 - a. Door openings.
 - b. Studs supporting cement backer boards.
 - c. Studs supporting backing plates, plumbing fixtures and wall-supported cabinets.
 - d. Elsewhere as indicated.
 3. Do not attach metal framing and suspension wires to ducts, conduits or pipes. Do not allow metal framing and suspension wires to contact pipes.
 4. Isolate framing from transfer of structural loading, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support and avoid axial loading.

5. Cut framing components squarely for a tight fit against abutting members. Erect framing plumb and level to provide solid backing for finish materials. Install all steel studs in a wall/partition so that their flanges point in the same direction.
6. Do not exceed a 1/8-inch in 10 feet deviation (non-cumulative) from true lines and levels, or 1/4-inch from true position. Perform necessary remedial work on framing to achieve specified tolerances.

B. Wall/partition framing:

1. Layout partitions, soffits and ceiling breaks, and permanently mark on slabs and soffits.
2. Align and securely anchor ceiling and floor tracks to building construction.
3. Space anchors within 6 inches of ends of each track segment and at 24 inches o.c. maximum. Do not drive fasteners closer than 2 inches to slab or curb edge.
4. Frame all openings in stud walls. Provide double studs, closer spacing, and additional reinforcement as detailed or required at door frames, borrowed light frames (interior windows), and recesses for equipment.
5. Frame both sides of control joints in gypsum board surfaces, and Portland cement plaster surfaces with separate studs and discontinuous runner; do not bridge the joint with system components or accessories.
6. Assemble corners using a minimum of 3 studs.
7. Install studs in single length, without joints, extending from floor to underside of floor or roof structure above, except where indicated on the Drawings to stop at or above suspended ceilings. Splicing studs is not permitted without the Architect's approval.
8. Where studs stop at or above suspended ceilings, unless otherwise indicated, brace every fourth stud (maximum) with opposite stud bracing at 45-degree angle securely anchored to the floor or roof above.
9. Offset studs where required so that finished wall surface will be flush.
10. Where curved walls are indicated, space studs at no more than 9 inches o.c.; space stud closer where radius requires it. Cut outside leg and entire web of runners at 2 inches intervals for the length of the arc then attach a 1-inch wide by 18 mils thick (25-gage) steel strip securely inside the cut leg of runners lapping uncut leg a minimum of 4 inches.
 - a. As an option to the above, Contractor may use curved runners by Radius Track or Flex-C Trac by Flex-Ability Concepts.
 - b. Position a stud at the beginning and end of each arc, with intermediate studs equally spaced between end studs of arc.
11. Attaching studs to runner:
 - a. Attach studs to tracks by friction fit for single stud gypsum board partitions.
 - b. Attach the following studs to runner tracks with screws or with a crimping tool in compliance with the stud manufacturer's printed instructions, except where indicated to be welded.
 - 1) Studs with gypsum board on only one side.
 - 2) Studs supporting lath/plaster assemblies.
 - 3) Studs on each side of doors.
 - 4) Studs supporting wall hung plumbing fixtures.
 - 5) Studs supporting wall hung urinal screens, toilet compartments, cabinets and equipment.
 - c. Attach corner studs, partition intersections, studs on each side of door jambs, and other openings in walls/partitions as specified in Paragraph "b" above.
 - d. Weld studs where indicated on the Drawings.
12. Unless otherwise indicated, provide horizontal stiffeners consisting of 3/4-inch channels spaced at not more than 54 inches o.c. maximum in all partitions/walls supporting wall supported cabinets and lath/plaster assemblies, and stone. Tack-weld stiffeners to each stud.
 - a. Provide an additional 3/4-inch channel 6 inches above door head and extend 2 stud spaces beyond jamb studs.

- b. Install channels in longest possible lengths; lap 12 inches and wire-tie at joints. Do not tie channels on opposite sides of staggered and double stud partitions together.
- 13. Double gypsum board studs (face to face to form a tube) adjacent to doors and openings. Extend studs at door openings to slab or deck above and anchor securely to bottom track (as specified in subparagraph 10.b. above) and to top slab or deck with clip angles.
 - a. Locate additional studs not more than 2 inches from door and window frames, abutting partitions, partition corners, and other construction.
 - b. Install a section of track over door and window frames with a clip angle at each end and attach securely to the adjacent vertical studs.
 - c. Install cut-to-length studs at the location of vertical joints and at standard spacing over the door frame header extending to the ceiling track.
- 14. Install studs 2 inches away from abutting concrete, steel columns or other structural elements. Extend the horizontal stiffeners and attach it to the structural element.
- 15. Provide additional framing, as required, for attachment of electrical boxes, fire extinguisher cabinets and similar items located in stud walls.

C. Resilient furring channels:

- 1. Install, with mounting flange down, at right angle to studs, starting within 2 inches of floor and 6 inches from ceiling.
- 2. Splice channels directly over studs and attach through both flange to studs.
- 3. Space channels as indicated on the Drawings.
- 4. Drive screws through channel attachment flange and studs at each intersection.

D. Resilient sound clips: Install the resilient clips in accordance with their manufacturer's instructions, and the following at the spacing indicated.

- 1. Install clips level and aligned on each wall.
- 2. Space bottom clips (and supported channel) no more than 3 inches from floor.
- 3. Space top clips (and supported channel) no more than 6 inches from ceiling.
- 4. Install furring channels securely in each clip.

3.4 FURRING

- A. Provide furring attached to concrete and metal framing to conceal utilities, furred soffits, and other furring as indicated.
- B. Furring to receive gypsum board shall be screw-on channels directly attached to backing material or applied over runner channels as applicable.
- C. Furring to receive plaster shall be 3/4-inch cold-rolled channels wire tied to 1-1/2-inch runner channels.
- D. Space furring as indicated for studs.

3.5 WELDING

- A. Perform welding in compliance with AWS recommendations. Welders shall be qualified to weld light-gage metal. Provide stitch plates where studs are burned-through.

3.6 BACKING PLATES

- A. Backing plates may be omitted if anchorage for wall-hung items is directly into steel studs of 43 mils thick (18-gage) or heavier, or items are furnished with equal mounting devices.
- B. Wall-mounted and wall-hung items that require backing plates, without limitation, include the following:
 - 1. Wall supported railings.
 - 2. Grab bars.
 - 3. Toilet compartments and screens.
 - 4. Toilet room accessories.

5. Wall and base cabinets.
 6. Plumbing fixtures.
 7. Wall mounted door stops.
 8. Bracket-mounted fire extinguishers.
 9. Signage.
 10. Window shades.
 11. Visual display and tack boards.
- C. Unless otherwise indicated, plates not provided with fixtures and equipment shall be long enough to span, as a minimum, across 3 studs and may be one of the following:
1. Fifty-four mils thick (16-gage) minimum steel plate by 4 inches wide.
 2. Fifty-four mils thick (16-gage) unpunched wide flange stud by 4 inches wide.
- D. Notch studs so that backing plate will be flush with exterior face of stud.
- E. Weld plates continuously along all contact surfaces at each stud crossing, or secure with 2 countersunk machine screws at each stud.

END OF SECTION

SECTION 09 22 26

CEILING & SOFFIT SUSPENSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes ceiling and soffit suspension systems for gypsum wallboard.
- B. Related requirements:
 - 1. Division 08 for access panes and their frames.
 - 2. Division 09 for the following:
 - a. Light gage metal support wall systems.
 - b. Suspension system for acoustical ceiling panels.

1.2 DESCRIPTION

- 1. Metal grillage suspended from floor structure above and designed to support a finished ceiling consisting gypsum boards.

1.3 REFERENCES

- A. Comply with the following:
 - 1. DSA IR-25-2.13.
 - 2. DSA IR 25-3.13.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Dimensioned Shop Drawings of all ceiling and soffit suspension and framing system at 1:48 scale for plans and 1:24 for details.
 - 2. Show plan layout.
 - 3. Detail attachment to overhead construction.
 - 4. Identify and dimension adjacent materials and supports.
- B. Data: Manufacturer's Product Data, specifications and installation instructions for each type of suspension system, including provisions for fixture and equipment anchorage.

1.5 HANDLING

- A. Store materials undercover, off the ground or floor, in a dry, ventilated space.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

- A. Ceiling suspensions systems shall safely support dead loads (ceiling, work of other trades supported by the ceilings such as annunciators, fire alarm and their accessories) with a maximum deflection of finished ceilings of L/240 for gypsum board.
- B. Ceiling suspensions systems shall be designed and constructed to safely resist seismic loads and movements without failure of their components, except minor damage (cracks) to the ceiling finish.

2.2 MATERIALS

- A. Metal channels: ASTM C 645, galvanized in compliance with ASTM A 924, G60 coating designation.

1. Framing, furring and stiffening:

Size	Type	Pounds per 1,000 linear feet
1-1/2-inch with 7/16-inch flanges	Hot-rolled	414

2. Furring channels: Minimum 7/8-inch, 16 mils thick (26-gage) galvanized steel with knurled faces, hat-shaped or Zee section as required.
- B. Hanger wire: Galvanized, soft, mild annealed steel, 0.148-inch diameter (#9 gauge) unless otherwise indicated.
- C. Diagonal bracing wire: Galvanized, soft, mild annealed steel, 0.109-inch (12 BW gage) unless otherwise indicated.
- D. Tie-wire: 0.0598-inch (16-gage), galvanized, single-strand annealed steel or 0.0478-inch (18-gage), galvanized, double-strand annealed steel.
- E. Fasteners and attachments:
1. Screws: ASTM C 1002, 3/8-inch head diameter, cadmium-plated pan head screws; length and gage required by CBC or recommended by manufacturer for uses and materials involved.
 2. Furring channel clips: Manufacturer standard clips for attaching gypsum board furring channels to runner channels.
 3. Welding electrodes: ASTM A 233, as recommended by AWS for the conditions of use and the metals to be welded.
 4. Hanger and bracing wire fasteners for concrete and metal deck with structural concrete fill: Unless otherwise indicated, provide ITT Phillips Drill Div., Red Head Sleeve Anchor No. TW-1614, 5/16-inch diameter, minimum 2-1/4-inch embedment.
- F. Uplift stiffeners: 0.0209-inch (25-gage) channel studs, 1-1/2-inch or compression posts indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and measurements affecting the work of this Section at site.
- B. Correct detrimental conditions before proceeding with installation.

3.2 CEILING SUSPENSION FRAMING

- A. Space main runners as indicated so that hanger wires do not support more than 12 square feet of ceiling.
- B. Hang suspended framing independent of walls, columns, pipes, ducts, and conduits, and their insulation.
- C. Do not attach wires to, or bend around, interfering material such as ductwork, pipes and conduits. Provide trapeze, or equivalent devices substantiated by detailed Shop Drawings and calculations, where obstructions interfere with direct suspension.

- D. Space runner channels not more than 6 inches from parallel walls or beams.
 - 1. Align runner channels accurately relative to indicated ceiling height and saddle tie with hanger wires.
 - 2. Lap channels 12 inches at splices and tie at each end of lap.
- E. For gypsum board ceilings, install 7/8-inch hat channels perpendicular to carrying channels, spaced 16 inches o.c. and within 6 inches of walls.
 - 1. Provide one-inch clearance between furring channels and abutting walls and partitions.
 - 2. Attach to carrying channels with furring channel clips or wire-tie with triple wrap and triple twist.
 - 3. At splices, nest furring channels with a minimum 8 inches overlap and wire-tie each end.
- F. Install 4-way, 45-degree diagonal bracing wires in a 12-foot grid maximum.
- G. Stiffener:
 - 1. For gypsum board ceiling/soffits, install uplift stiffener for each 144 square feet of ceiling, consisting of a vertical metal stud occurring at the junction of the carrier and furring channel. Wire-tie to carrier or screw to channel and secure to overhead structure.
- H. At control joints, provide discontinuous lap in main runners occurring over joints.
 - 1. Do not bridge joints with cross furring where joints run perpendicular to furring.
 - 2. Where joints run parallel to furring, provide furring to support each side of joint.
- I. Provide recesses and openings where indicated for lighting fixtures, registers, access panels and other items to be installed in ceilings. Provide additional furring channels where required by opening condition.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Gypsum board.
 - 2. Fasteners, joint reinforcing and finishing compound.
- B. Related requirements:
 - 1. Division 09 for metal framing supporting gypsum board (except for framing specified herein).
 - 2. Division 08 for access panels in gypsum board surfaces.

1.2 SUBMITTALS

- A. Data: Manufacturer Product Data for all materials to be used in gypsum board construction.
- B. Shop Drawings: Show proposed locations of control joints. Joint locations is subject to the Architect's approval and shall be relocated, when requested, at no cost to the Owner.

1.3 QUALITY ASSURANCE

- A. Requirements of regulatory agencies:
 - 1. Comply with fire resistance ratings indicated and required by Code.
 - 2. Provide materials, accessories and application procedures listed by UL or tested in compliance with ASTM E 119 for the type of construction shown.

1.4 HANDLING

- A. Procedure: In accordance with GA 801 "Handling and Storage of Gypsum Panel Products."
- B. Storage: Do not overload the floors with localized concentration of gypsum board.

1.5 JOB CONDITIONS

- A. Comply with the gypsum board manufacturer's recommendations and GA "Application and Finishing of Gypsum Board" for temperature limitations and ventilation before, during and after installation of gypsum board.
- B. Protect installed materials from drafts during hot, dry weather.
- C. Illuminate work areas during installation to provide the same or greater level of illumination required to properly perform the work and as will occur in the room or space after the building is in operation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. CertainTeed, formally BPB America, Inc.
- B. Continental Building Products
- C. G-P Gypsum Products.
- D. National Gypsum Co./Goldbond Building Products Division.
- E. PABCO Gypsum.

F. US Gypsum Co.

G. Or equal.

2.2 GYPSUM BOARD

A. General:

1. Provide boards complying with ASTM C 1396 as follows and in maximum lengths available to minimize end butt joints.
2. Unless otherwise acceptable to the Architect, no end-to-end butt joints are allowed on walls or ceilings less than 12feet long or wide.

B. Under ceramic tile: CertainTeed "GlasRoc," G-P Gypsum "Dens-Shield Fireguard Tile Backer," or equal paperless, mold-resist gypsum board complying with ASTM D 3273. Gold Bond "eXP Tile Backer" by National Gypsum complying with ASTM C1178 is also acceptable.

C. In unlined air shafts and plenums: USG Sheetrock "Mold Tough," National Gypsum "XP Mold & Moisture Resistant Gypsum Board, or equal meeting ASTM D 3273 for mold-resistance.

D. On ceilings: Contractor may use "Gypsum Ceiling Boards."

1. ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.
2. Thickness: 1/2 inch (12.7 mm).
3. Long Edges: Tapered.

E. For surfaces to be painted in toilet rooms: CertainTeed "Glasroc," National Gypsum eXP Tile Backer, or equal embedded glass mat gypsum panels.

F. Elsewhere where gypsum board is exposed and painted: Standard, Type X or C boards, as applicable to the assembly. Provide boards with paper face suitable to receive decorative finish, and long edges tapered to receive joint compound.

2.3 PAPERLESS GYPSUM WALLBOARD

A. Fiberglass-mat faced gypsum board types by National Gypsum, CertainTeed and Georgia-Pacific Gypsum LLC for walls and ceilings as a substrate to ceramic tile, or equal.

2.4 ACCESSORIES

A. Screws: The following sized in compliance with the gypsum board manufacturer's instructions and Code requirements.

1. ASTM C 954 for fastening to supporting studs and furring.
2. ASTM C 1002, Type G for gypsum board-to-gypsum board.

B. Metal trim: Galvanized steel of the types specified hereafter complying with ASTM C 1047.

1. LC-Bead: J-shaped; exposed long flange to receive joint compound; use at exposed panel edges.
2. CB corner bead: Square corner bead.
3. L-Bead: L-shaped; exposed long leg to receive joint compound; use where indicated.
4. U-Bead: J-shaped; exposed short flange not to receive joint compound; use at exposed panel edges.
5. Control joint: USG No. 093, Goldbond Building Products E-Z Strip or Trim-Tex 093V.

C. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate

D. Joint treatment for paperless assemblies: 2-inch wide fiberglass mesh tape and ToughRock 90 Setting Type joint compound, or equal.

E. Joint tape, compound and laminating adhesive: ASTM C 475, low or very low shrinkage, type recommended by the manufacturer, by Hamilton Materials, basis of design, USG or one of the gypsum board manufacturers named above.

1. Taping, and fastener and metal trim concealment: Sheetrock Brand Taping Joint Compound, Ready-Mixed by USG.
 2. Topping, finish and skim coats: Sheetrock Brand Topping Joint Compound, Ready-Mixed by USG.
 3. Joint tape complying with ASTM C475: Sheetrock Joint Tape – Heavy by USG.
- F. Sealants: As specified in Section 09 80 00.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

- A. Examine conditions affecting the work of this Section at site.
- B. Verify framing members' straightness and alignment.
- C. Correct detrimental conditions before proceeding with installation.
- D. Before enclosing stud walls and spaces that will be inaccessible after gypsum board is installed, thoroughly clean [floor tracks and]spaces of debris and dust.

3.2 GYPSUM BOARD INSTALLATION - GENERAL

- A. Comply with the applicable provisions of the reference standards and the following.
- B. Use only full-size boards above door and window openings; joints at corners of heads are not acceptable.
- C. Minimize butt joints and avoid butt joints centered on walls, over protruding studs, and above doors and windows. Avoid abutting end joints in the central area of each ceiling.
- D. Install all panels, including those in non-rated applications, with joints in moderate contact.
- E. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints.
- F. Position adjoining panels so that tapered edges abut tapered edges, and field-cut edges abut field-cut edges and ends.
 1. Do not place tapered against cut edges or ends.
 2. Where square (non-tapered) joints abut on ceilings, use Trim-Tex "Buttboard" behind the joint in accordance with Trim-Tex recommendations.
- G. Stagger vertical joints over different studs on opposite sides of partitions.
- H. Attach gypsum panels to steel studs so that the leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Attach gypsum panels to framing provided at openings and cutouts.
- J. Provide perimeter relief where board abuts structural decks, ceilings, vertical structural elements, or glazed assembly.
- K. Install horizontal boards first. Butt joints between boards loosely. Do not force boards into place. Place tapered or wrapped edges next to one another.
- L. Attach boards to all studs and furring members with power-driven screws securely engaging supporting member, and with fastener heads uniformly depressed not over 1/32-inch below surface of board (except for first layer of multiple layer assembly) without breaking face paper.
- M. After boards have been installed over screws and backing plates, tap boards with a rubber mallet to depress backside of board over heads to eliminate unacceptable bulges.

3.3 SINGLE LAYER APPLICATION

A. Horizontal surfaces:

1. Install board with long dimension at right angle to supports, with end joints located over supports.
2. Use maximum practical length boards to minimize end joints. Stagger end joints in alternate boards.

B. Vertical surfaces: [Except as specified for curved surfaces below, and] Unless otherwise acceptable to the Architect, install board vertically. Use floor-to-ceiling length boards (unless height exceeds 12-foot) with vertical joints located over supports.

1. At [stairwells and other] high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
2. Offset joints at least one stud on opposite sides of partition/walls.
3. Extend gypsum board continuously from finish floor to underside of structure above, except where indicated otherwise on the Drawings.

3.4 ALLOWABLE TOLERANCES

- A. Do not exceed 3/16-inch in 8 feet, and 1/8-inch in 4 feet from plumb, level and flat (all directions) in gypsum board surfaces.
- B. Do not exceed 1/16-inch offset at joints between boards.
- C. Shim boards as necessary to comply with these tolerances.

3.5 FINISHING

A. Finish gypsum board surfaces with exposed joints, corners and edges reinforced or trimmed in compliance with GA-216, the following and to match approved mockup where applicable.

B. General:

1. Fill joints, fastener heads, trim accessory flanges and surface defects with joint compound in compliance with the gypsum board manufacturer's recommendations to obtain a smooth, flush surface.
2. All joints, fastener heads and trim flanges in surfaces which will remain exposed to view in the building, shall be invisible after application of joint tape and compound.

C. Trim: Install in single unjointed length, unless length exceeds manufacturer's standard. Attach to gypsum board in compliance with their manufacturer's instructions.

1. Install Type CB trim at external corners.
2. Install Type LC trim where gypsum board edges are exposed in the finish work.
3. Install Type CB or LC trim where gypsum board abuts a different material, and the edges are not covered by a finish material.
4. Install control joints at no more than 30 feet o.c. in any direction (full height door frames count as control joints). Joint locations are subject to the Architect's approval. When "through wall" control joints are required in fire-rated assemblies, comply with WH International, Inc. Report WHI 651-0318.1.

D. Joints: Reinforce joints between gypsum boards, and interior corners and angles with tape set in joint compound.

1. Apply skim coat over tape in one application.
2. Where space greater than 1/16-inch occurs between abutting gypsum boards (except at control joints and for concealed layers of multiple layer assemblies), pre-fill joints with joint compound and allow to dry before applying joint tape.
3. All joints and interior angles shall have tape embedded in joint compound and 2 separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles.

E. Joint compound:

1. Lap each coat not less than 4 inches over the preceding coat (2 inches on each edge). Width of joint compound on tapered board edges shall be not less than 12 inches; width of joint compound on square board edges not less than 18-inch.
 2. Cover fastener heads and accessories with 3 separate coats of joint compound.
 3. Allow at least 24 hours drying time between applications of joint compound.
 4. Finish joint compound so that little or no sanding is required. When sanding, use sandpaper or mesh cloth with grit as fine as possible; do not scuff face paper. Remove sanding dust before painting or applying other finishes.
- F. Finishing levels:
1. Level 0: Use for first layer of multiple layer construction and gypsum board ledge guards in elevator shaft.
 2. Level 1: Use in plenum areas above ceilings, interior faces of shafts, in attics, and in areas where the assembly will generally be concealed.
 3. Level 2: Use where gypsum tile backer board is used as a substrate for tile, in storage and similar areas where surface appearance is not of primary concern.
 4. Level 3: Use in areas to receive heavy or medium texture (spray or hand-applied) finishes before final painting, or where heavy grade wall coverings are to be applied as the final decoration.
 5. Level 4: Use for all other areas to be painted and where light texture or backed lightweight wall covering will be applied.
- G. Leave gypsum board surfaces smooth, undamaged and ready to receive scheduled finishes.

END OF SECTION

SECTION 09 30 00

TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Ceramic wall tile, and trim shapes.
 - 2. Setting materials, grouts and sealants.
- B. Related requirements:
 - 1. Divisions 07 and 09 for sealants other than specified herein.
 - 2. Division 09 for lath and scratch coat on walls.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation meeting:
 - 1. Prior to start of installation arrange a pre-installation meeting between the Contractor, and the tile installer to review Project conditions, the Drawings, Specifications and the waterproofing manufacturer data. The Architect may attend.
 - 2. If more than one trade will be responsible for the successful performance of the work of this Section, these trades shall attend the meeting.
 - 3. Identify areas of concern and remedial measures.
 - 4. Record meeting minutes and distribute copy to all concerned, including the Architect, within 48 hours after the meeting.
- B. Manufacturer's inspections:
 - 1. Request the manufacturer's presence before start of this work to verify substrate acceptability, and as required thereafter to review installation procedures and completed work, and to issue warranty specified.
 - 2. Unsatisfactory conditions disclosed by the manufacturer visits to the site shall be promptly and satisfactorily repaired and the areas re-inspected by the manufacturer before work starts or resumes in affected areas.

1.3 SUBMITTALS

- A. Samples:
 - 1. Twenty-four-inch square Samples of each type and color of tile glued to hardboard backing; grout joints.
 - 2. Each type, color and shape of trim and base.
- B. Data: Manufacturer Product Data for waterproofing membrane, pre-mixed mortars and grouts, with certification that they meet ANSI standards specified.
- C. Shop Drawings:
 - 1. Show locations of each type of tile and tile pattern; widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
 - 2. If joints occur in substrate to be tiled, show their locations on the Shop Drawings.
- D. Test Results: Submit test results in accordance with the test methods specified performed by a certified testing laboratory for each material specified.

1.4 QUALITY ASSURANCE

A. Uniformity:

1. Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
2. Obtain materials of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.

B. Installer qualifications: Experienced firm who has successfully completed tile installations similar in material, design, and extent to that indicated for Project for at least 5 years.

C. Mockups: Before starting tile installation, erect one mockup for each form of construction and finish required. Build mockups complying with the following, using materials indicated for final Work.

1. Make each mockup a minimum of 6-foot square, interior and exterior corner with base. Locate on site where directed by the Architect.

D. Make modifications requested by the Architect or remove unsatisfactory mockups and construct new ones.

1. Obtain Architect's acceptance of mockups before starting final installation.
2. Retain and maintain mockups during construction in undisturbed condition as a standard for judging completed tile work.
3. When accepted by the Architect, accepted mockups in undisturbed condition at time of Substantial Completion may become part of the Work.

E. Master grade certificate: Submit, bearing the Certification Mark of the Tile Council of North America, Inc. (TCNA), signed by the tile manufacturer, stating the type and quality of each type of tile delivered to the job site.

1.5 HANDLING

A. Procedure: In accordance with ANSI A137.1 for labeling sealed tile packages.

B. Delivery: Deliver tile cartons with grade seals unbroken.

1.6 JOB CONDITIONS

A. Set and grout this work when ambient temperature is at least 50-degree F or higher. Do not install materials on surfaces (or when ambient temperature) is less than 40-degree F.

B. Illuminate work areas during installation to provide the same or greater level of illumination required to properly perform this work and as will occur in the room or space after the building is in operation.

1.7 MANUFACTURER SPECIAL WARRANTY

A. Warrant tile installation, including grout and waterproofing (system warranty), against faulty materials and workmanship for 15 years after Substantial Completion.

B. Make repairs required during the warranty period at no cost to the Owner.

1.8 MAINTENANCE

A. Furnish one full box of each type, color and size of tile properly packaged and identified, by room or area.

PART 2 - PRODUCTS

2.1 PREFORMANCE REQUIREMENTS

- A. Dynamic Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ANSI B101.3:
 - 1. Level Surfaces: Minimum 0.42 (Wet).
 - 2. Step Treads: Minimum 0.42 (Wet).
 - 3. Ramp Surfaces: Minimum 0.60 (Wet).
- B. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ANSI B101.1:
 - 1. Level Surfaces: Minimum 0.60 (Wet).
 - 2. Step Treads: Minimum 0.60 (Wet).
 - 3. Ramp Surfaces: Minimum 0.80 (Wet).

2.2 MATERIALS – GENERAL

- A. All components of the waterproofing and tile setting assemblies must be made or distributed by the same manufacturer to obtain warranty specified.

2.3 TILE

- A. Tile: Make, size, and colors indicated.
 - 1. Trim: Provide matching base, caps, stops, returns, trimmers required to complete the installation.
- B. Factory-blending: For tile exhibiting color variations within the ranges selected during sample submittals, factory-blend tiles and package accordingly so that tiles taken from one package show the same color range as those taken from other packages and match approved Samples.

2.4 SETTING MATERIALS AND GROUT

- A. Portland cement: ASTM C 150, Type 1.
- B. Sand: ASTM C 144.
- C. Water: Potable, fresh.
- D. Setting bed reinforcing mesh: 2-inch by 2-inch by 16/16, 3-inch by 3-inch by 13/13 or 1-1/2-inch by 2-inch by 16/13 wire complying with ASTM A 82 or A 185.
- E. Thin set, latex modified dry-set mortar: The following or equal with physical properties equaling or exceeding those of the products specified. Do not apply more than 1/4 inch thick and do not use for tiles larger than 15 inches complying with ANSI A118.15, A118.4, A118.11 and ISO 13007 C2EP1.
 - 1. Thin set:
 - a. Custom (basis of design): FlexBond.
 - b. Mapei: Ultra Flex III.
 - c. Laticrete: 254 Platinum.
 - d. MerKrete "705" and "735," as selected by the installer for the conditions of use.
 - e. Or equal.
 - 2. Medium bed: or Mapei "Granirapid" for tiles over 15 inches in any dimension, and as specified for other locations.
- F. Medium bed: latex modified dry-set mortar: The following or equal with physical properties equaling or exceeding those of the products specified. For setting bed from 1/4- to 3/4-inch thick and for tiles larger than 15 inches in any dimension complying with ANSI A118.15, A118.4, A118.11 and ISO 13007 C2EP1.
 - 1. Custom (basis of design): ProLite Tile & Stone Mortar.

2. Mapei: Ultraflex LFT.
3. Laticrete: 220 Marble & Granite w/3701 Mortar Ad-Mix.
4. MerKrete "720 Marble Pro"
5. Or equal.

G. Premium Grade Epoxy Grout: 100 percent solids, water cleanable, improved resistance to chemical and heat exposure and complying with ANSI A118.3 and ISO 13007 R2/RG.

1. Custom Building Products "CEG" (use for small food prep areas); Grout.
2. Or equal.

2.5 MISCELLANEOUS MATERIALS

- A. Tile levelers: Tuscan Seamclip by Pearl Abrasive Co. – no known equal.
- B. Sealant and backup for control joints in tiles: Refer to Section 07 92 00.
- C. Cleavage membrane: 10-mil thick polyethylene complying with ASTM D 2103, Type 13300.
- D. Crack isolation membrane: One of the following.
 1. "Hydro-Guard SP-1" by MerKrete.
 2. Mapei: Mapelastix.
 3. "Hydro Ban" by Laticrete.
 4. "Redgard" by Custom Building Products.
 5. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

- A. Examine conditions and measurements affecting the work of this Section at site.
- B. Remove glaze and contaminants, including remaining adhesive and setting bed, from floors and walls by scraping, wire-brushing or with a self-contained bead blasting apparatus.
- C. Verify that surfaces to be tiled are firm, dry, clean, and free from oil or waxy films and curing compounds, and within the following tolerances:
 1. Thin-set tiles:
 - a. 1/8-inch in 8 feet for walls for tiles longer than 15 inches.
 - b. 1/4 inch for smaller tiles.
 2. Mortar-set tiles: 1/4-inch in 8 feet for walls.
 3. Maximum deflection of walls to be tiled: L/360 under loads prescribed by Code. Coordinate this requirement with other design criteria specified in Section 09 22 16.
- D. Examine that installation of grounds, anchors, recessed frames, electrical and mechanical work, and similar items located in or behind tile have been completed before installing tile.
- E. Correct detrimental conditions before proceeding with installation.

3.2 GENERAL TILE INSTALLATION REQUIREMENTS

- A. General: Install proprietary materials in compliance with their manufacturer's instructions. Press or beat the tiles to obtain 90 percent coverage of mortar on back of tile, except for the following which requires 100 percent coverage:
 1. Tiles in "wet" areas.
 2. Edges and corners of all tiles regardless of location.
 3. Back butter tile if necessary.
- B. Environmental conditions: Maintain minimum temperature limits and installation practices recommended by mortar and grout materials manufacturers in areas where this work is performed.

- C. Terminations: Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignment. Saw-cut and drill tiles to obtain tight fitting, clean, sharp, undamaged cut edges.
 - 1. Rub cuts smooth with fine abrasive stone.
 - 2. Cut and drill so that electrical outlets, plumbing fixtures, pipes, fixtures and fittings standard plates, escutcheon and collars will overlap the tile.
 - 3. Do not cut or split tile at penetrations.
- D. Visual requirements:
 - 1. Install tile in patterns indicated with uniform joints and perimeter units not less than 1/2 unit wide. Adjust to minimize cutting.
 - 2. Accurately set tile with flush well-fitted joints, finished in true planes, plumb, square, sloped or level as required.
 - 3. Form corners, returns, and exposed tile edges with approved trimmers.
 - 4. Where tiles selected by the Architect are installed in the same plane, but are of a different thickness, it is the Contractor responsibility to adjust the setting bed or mortar thickness so that all tiles are flush.
 - 5. Under no circumstances will glazed tile installations be accepted if any part of unglazed tile body remains exposed after tile is installed.
 - 6. Provide matching tile trimmers of all types required to prevent such condition.
- E. Tolerances: Maximum deviation from true lines and levels shall not exceed 1/8-inch in 8-foot for walls.
- F. Sealant: Calk penetrations in tile with sealant and backing rod specified in Section 07 92 00. Provide movement joints where indicated or as recommended by TCNA Method EJ171-13.
- G. Tile blending:
 - 1. For tile exhibiting color variations within the ranges selected during sample submittals, verify that tiles have been factory-blended and packaged accordingly so that tiles taken from one package show the same color range as those taken from other packages, and match approved Samples.
 - 2. If not factory-blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILE INSTALLATION METHODS

- A. Wall tile: Install over gypsum backer board in compliance with ANSI A108.5 and TCNA installation method W243.
- B. Sound tile after setting. Replace or reset hollow sounding units.

3.4 GROUTING/CURING

- A. Grouting: Comply with ANSI A108.10. Finish joints of square edge tiles flush with tile surfaces; finish joints of cushion edge tiles to depth of cushion. Finish grout free of voids and pits.
 - 1. Fill epoxy-filled joints flush with tile edges. The epoxy will cure to a slight depression.

3.5 SEALANTS

- A. Comply with sealant manufacturer's instructions and ASTM C 1193.
- B. Install backing rod and fill joints completely with sealant tooled below surface of tile. Do not disturb until fully cured.

3.6 CLEANING/PROTECTING

- A. Cleaning:
 - 1. Clean tile and repair faulty grouting. Sponge and clean surfaces with clean water and soft brushes.
 - 2. Polish glazed tile after cleaning with clean, dry cloths.

- B. Protect completed installations until acceptance by the Owner.
- C. When recommended by tile manufacturer, apply a coat of neutral protective cleaner to completed tilework.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.
- E. Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tiles.

END OF SECTION

SECTION 09 65 10

RESILIENT WALL BASE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Rubber bases.
 - 2. Adhesive.
- B. Related requirements: Other Sections of Division 09 for resilient flooring.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling and sequencing:
- B. Pre-installation meeting:

1.3 SUBMITTALS

- A. Samples: 12-inch long Samples of each type and color of base.
- B. Data: Proof of compliance with specified requirements.

1.4 HANDLING

- A. Store materials indoors at a temperature above 60-degree F for at least 24 hours before use.

1.5 JOB CONDITIONS

- A. Illuminate work areas during installation to provide the same or greater level of illumination required to properly perform the work and as will occur in the room or space after the building is in operation.
- B. Maintain temperature in spaces to receive resilient bases between 70-degree and 90-degree F for not less than 24 hours before and 48 hours after its installation.
- C. Maintain minimum temperature of 60-degree F after bases have been installed, except as specified above.

1.6 MAINTENANCE

- A. Furnish 100 feet of each type and color of base for future maintenance.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Rubber bases:
 - 1. One-eight-inch thick, by height indicated on the Drawings, ASTM F 1861, Type TS (thermoset vulcanized rubber), Group 1 (homogeneous).
 - 2. By Burke Flooring Products, Roppe Rubber Corp., Johnsonite, Flexco Co. or Mercer Products Co., Inc., of the color(s) selected by the Architect.
 - 3. Top set base where no flooring and resilient flooring occur; straight (carpet) base at all other locations; do not use preformed corners.
 - 4. In rolls minimum 100-foot long. Walls 20-foot or less in one piece; do not use short pieces.
 - 5. Base shall be from same batch and run number for each color.
- B. Adhesive: Type and brand recommended by base manufacturer for the conditions of use.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

- A. Examine walls for excessive moisture content and unevenness which would prevent the proper execution of the work of this Section. Fill cracks and sand down bumps.
- B. Remove dirt, oil, grease, or other foreign matter from surfaces to receive bases.
- C. Correct detrimental conditions before proceeding with installation.
- D. Do not install bases until they are same temperature as space where they are to be installed. Move bases and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

3.2 ADHESIVE

- A. Mix and apply adhesive in compliance with its manufacturer's instructions.
- B. Provide safety precautions during mixing and application as recommended by the adhesive manufacturer.
- C. Apply adhesive uniformly over backing surfaces, but only on areas which can be covered by bases within the recommended working time of the adhesive.
- D. Tape adjacent surfaces to prevent migration and misapplication of adhesive.
- E. Remove adhesive which dries or films over. Do not soil walls, bases, and other adjacent surfaces with adhesive. Promptly remove spillage from adjacent surfaces without damaging those surfaces.

3.3 BASE

- A. At masonry surfaces, fill voids along top edges of base with base manufacturer's recommended adhesive filler material.
- B. Match edges at seams or double cut adjoining lengths. Install with hairline, flush butt joints.
- C. Locate end of runs not less than 36 inches from a corner, except where impossible due to length of wall.
- D. Do not use pieces less than 6-foot long, except where impossible due to length of wall.
- E. Do not use preformed corner pieces [, except for vented base].
 - 1. Form inside corners on job from straight pieces of maximum lengths possible by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce snug fit to substrate.
 - 2. Form outside corners on job from straight pieces of maximum lengths possible by shaving back of base at point where bending will occur. Remove a strip perpendicular to length of base and only deep enough to produce a snug fit without bends whitening or removal of more than half the thickness of base.
 - 3. Form without producing discoloration (whitening) at bends.
- F. Scribe base accurately to abutting materials.

3.4 FIELD QUALITY CONTROL

- A. After adhesive sets, clean bases with a neutral cleaner recommended by the base manufacturer.
- B. Verify that there are no open joints and that base is completely adhered for its full length. Re-install in fresh adhesive where applicable.
- C. Protect completed installations from damage until final acceptance.

END OF SECTION

SECTION 09 90 00

PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Painting and finishing all interior and exterior exposed surfaces throughout the Project, except as excluded in Paragraphs B and C below.
2. Surface preparation, priming and coats of paint specified herein are in addition to shop priming and surface treatment specified in other Sections.
3. Paint all exposed surfaces whether or not colors are designated, except where the natural finish of the material is obviously intended or specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas.
4. This Section also includes sealing joints between surfaces to be painted, except for joints designed to be expressed in the Work and joints between a natural finish and a painted surface.

B. Painting specified elsewhere:

1. Shop priming of ferrous metal items included under miscellaneous metal fabrications, hollow metal work, and similar work.
2. Finished (not primed) mechanical and electrical equipment including light fixtures, switchgear and distribution cabinets, except as specified in Article 3.4 below.
3. Prefinished glazed assemblies.
4. Pavement markings.
5. Toilet compartments and screens.
6. Flagpoles.
7. Signage.
8. Piping identification.

C. Painting not included: Do not paint the following surfaces.

1. Insulation and its facing.
2. Concealed concrete and CMU.
3. Sprayed fireproofing.
4. Roofing.
5. Steel decking.
6. Chain link partitions.
7. Finish hardware, except those items noted USP.
8. Flexible door and window seals and weatherstripping (paint exposed metal to match door frame).
9. Finished metal surfaces such as anodized aluminum, stainless steel, chromium-plating, copper, bronze, brass and similar finished materials will not require finish painting.
10. Painting is not required on walls or ceilings in concealed and inaccessible areas, such as furred areas, pipe spaces, duct shafts and elevator shafts.
11. Operating parts, labels and nameplates:
 - a. Do not paint moving parts of operating units, mechanical and electrical parts, such as valve and damper operator linkages, sinkages, sensing devices, motor and fan shafts.
 - b. Do not paint over any nameplates, Code required labels, such as UL and FM, or any equipment identification, performance rating, name, or nomenclature plates.

1.2 DEFINITIONS

- A. Paint: The term, as used in this Section, means all coating system components, including primers, emulsions, enamels, varnishes, stains, lacquers, sealers, fillers, and other applied materials whether used as prime, intermediate or finish coat.
- B. Definitions of painting terms: ASTM D 16, unless otherwise specified.
- C. Dry film thickness (DFT): Thickness of a coat of paint in fully cured state measured in mils (1/1000-inch).
- D. Sheen: The terms used in these Specifications refer to the following gloss ranges when tested in accordance with ASTM D 523 test method.

Name	Test Method	Gloss Range
Flat	60-degree meter	0 to 7
Low sheen	60-degree meter	10 to 15
Eggshell	60-degree meter	25 to 30
Semi-gloss	60-degree meter	55 to 60
Gloss	60-degree meter	85 to 90

- E. Coat: As used in this Section means a layer of paint, varnish, lacquer, or other material applied, then allowed to dry. To backroll or apply a wet-on-wet film still constitutes a single coat.
- F. Finish: As used in this Section means the entire coating system including the texture, color, and sheen of a surface.
- G. Refinish: As used in this Section implies a new finish will be applied to a surface that has been finished as defined above.
- H. Touchup: As used in this Section means correction of deficiencies in the specified work to achieve a properly painted surface.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Phasing: Program cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

1.4 SUBMITTALS

- A. Materials:
 - 1. Copies of a complete materials list, identified by manufacturer name and product label or stock number.
- B. Data: Manufacturer product data as follows.
 - 1. Data for paint products, including paint label analysis, application instruction, and VOC content in grams/liter.
- C. Color samples:
 - 1. Eight-and-one-half- by 11-inch samples of each color for painted finishes.
 - 2. Provide stepped samples, defining each separate coat, including block fillers and primers for each color and system. Identify paint system on back of control Samples.
 - 3. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.

4. For transparent finishes, prepare the samples on wood specie, which will be used for the Project; 12-inch for lumber; 12-inch square for veneered panels.
5. Resubmit until required sheen, color, and texture are achieved.

1.5 QUALITY ASSURANCE

- A. Painter's qualifications: Firm and individuals experienced in applying paints and coatings similar in material, design, and extent to those specified for the Project, whose work has resulted in applications with a record of successful in-service performance.
- B. SCAQMD Rule 1113: Submit paint manufacturer's certificate stating that provided coatings meet or exceed current SCAQMD Rule 1113 requirements.

1.6 JOB CONDITIONS

- A. Environmental requirements:
 1. Comply with paint manufacturer's recommendations for environmental conditions and the following.
 2. Provide adequate heating and ventilating to maintain environmental conditions recommended by paint manufacturer.
 3. Do not apply finish in areas where dust is being generated.
 4. Apply paint under the following prevailing conditions.
 - a. Air and surface temperatures are not below 40-degree F. or above 120-degree F.
 - b. Surface temperature is at least 5-degree F. above the dew point.
 - c. When there is not threat of impending rain.
- B. Protection:
 1. Protect adjacent whether being painted or not against damage from painting operation. Correct damage by cleaning, repairing, replacing, and repainting, as approved by Architect, and leave in an undamaged condition.
 2. Provide "Wet Paint" signs to protect newly coated finishes. After completing coating operations, remove temporary protective wrappings provided by others to protect their work. Post signs immediately after painting.
 3. Provide drop cloths, shields, barricades and other protection necessary to safeguard adjacent surfaces not to be painted.
 4. Provide and maintain protection as required to protect finished work from damage until its acceptance.
- C. Illuminate work area during painting to provide the same or greater level of illumination required to properly perform the work and will occur in the room or space after the building is in operation.

1.7 HANDLING

- A. Store materials indoors and mix only in spaces suitable for such purpose. Protect adjacent surfaces when mixing.
- B. Store paint containers so the manufacturer's labels are clearly visible.

1.8 WARRANTY

- A. Color of exterior surfaces painted, as part of the work of this Section shall, at the end of one year, have remained free from serious fading when compared to a control sample of the original paint.
- B. Interior and exterior paint shall have its original adherence at the end of one year and there shall be no evidence of blisters, running, peeling, scaling, chalking, streaks, or stains at the end of this period.

- C. Washing painted surfaces with alkali-free soap and water shall remove surface dirt from painted surfaces without producing deteriorating effects.

1.9 MAINTENANCE MATERIAL

- A. With closeout submittals deliver one identified unopened gallon of each type and color of paint material used on the Project to the Owner for future paint touchup.
- B. In addition to manufacturer label, identify with room number, floor or area, type of paint, color and sheen, as applicable, for future identification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Specified and approved manufacturers:
 - 1. Catalog names and numbers refer to products manufactured or distributed by the Vista Paint Corp. and Dunn Edwards Corp., except as otherwise specified.
 - 2. Equivalent acceptable products by Benjamin Moore, Sherwin Williams and PPG may be substituted when approved by the Architect.

2.2 PAINT

- A. General:
 - 1. Provide coating systems meeting or exceeding current SCAQMD Rule 1113 requirements.
 - 2. Biocide content shall not exceed 0.025 percent by weight or volume.
 - 3. Paint shall not contain fungicides or bactericides classified as mercury acetates, phenol phenates, or phenol formaldehyde.
 - 4. Water-based paints shall not be formulated or manufactured with chemicals listed by Green Seal to be hazardous including, but not limited to, formaldehyde, halogenated solvents, aromatic hydrocarbons, mercury, and mercury compounds.
 - 5. Paints shall not be tinted with pigments of lead, cadmium, chromium, and their oxides.
- B. Quality and manufacture: Insofar as practicable, each paint shall be factory-mixed to match approved samples and colors and be of a consistency permitting immediate application. Use best quality grade regularly manufactured by one of the manufacturers listed in the schedule at the end of the Section.
- C. Paint uniformity and compatibility:
 - 1. Box at the job site or factory-batch paint to ensure color uniformity and consistency. This includes the required maintenance materials.
 - 2. Provide finish coats compatible with the prime coats used.
 - a. Review other Sections of these Specifications, in which prime coats are specified, and manufacturer data for shop-primed surfaces to be painted.
 - b. Be responsible for the compatibility of the total coating system.
 - 3. Provide barrier coats over incompatible primer or remove and reprime.
 - 4. Products of more than one approved manufacturer may be used, except that all products applied on a surface shall be by the same manufacturer.

2.3 MISCELLANEOUS MATERIALS

- A. Joint sealant: Paintable sealant as specified in Section 07 92 00.

B. Galvanized etching product: One of the following.

1. Jasco Prep N Prime.
2. Oakite 747 LTS.
3. Henkel Galvaprep 5.

2.4 COLOR SCHEDULE

- A. Refer to the Room Finish Schedule and exterior elevations for paint colors.
- B. The Architect will prepare a color schedule with samples for guidance in painting.
- C. The Architect may select, allocate, and vary colors and sheens on different surfaces throughout the Work.
- D. Number of colors to be used will be determined by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be painted for conditions that would adversely affect the permanence and quality of this work.
- B. Correct unsuitable conditions before proceeding with painting.

3.2 SURFACE PREPARATION

- A. General: Prepare surfaces to receive the specified finishes in compliance with the paint manufacturer's instructions and the following. Extend painting on all surfaces visible from any angle.
- B. Galvanized steel: Comply with American Galvanizers Association recommendations, ASTM D 2092, ASTM D 6386 - 10 Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting, and the following.
 - 1. Clean with commercial phosphoric acid solution or one of the products named above for pretreatment or by brush off blast cleaning with a fine abrasive to achieve a uniform anchor profile of 1.5 to 2 mils.
 - 2. Recoat within the time limit recommended by the primer manufacturer.
- C. Shop-primed metal: Remove oil, grease, dirt and foreign matter. Spot prime abraded surfaces with compatible primer.
- D. Shop-painted metal: Sand to provide a mechanical bond with field applied finishes, or use a commercial preparation specifically formulated to improve paint bond.
- E. Unprimed ferrous metal: Remove rust, mill scale, oil and other foreign matter.
- F. Aluminum: Remove foreign matters and clean with mineral spirit.
- G. Factory-primed equipment: Repair damaged primer; remove rust and clean to bright metal where appropriate. Sand or etch primer to permit bonding of finish coats. Clean surfaces thoroughly before applying additional coats.
- H. Concrete and CMU:

1. Clean surfaces of dirt, laitance, encrustations and foreign matter. For concrete, comply with SSPC-SP13, "Surface Preparation of Concrete."
 2. In plaster and concrete, patch cracks, holes, pits and other imperfections, not patched under other Sections, flush and smooth with adjacent surfaces.
 3. Do not apply sealer or paint when the moisture content of the surfaces to be painted exceeds 8 percent.
 4. Touchup suction spots after priming with an additional prime coat until all surfaces show a uniform coating.
- I. Gypsum board:
1. Remove dust, loose particles or other matter that would prevent proper paint adhesion.
 2. Check to see that joints and screw heads are properly covered with joint compound and sanded smooth and flush with adjacent surfaces.
- J. Wood:
1. Sandpaper smooth and dust clean. Remove handling marks and raised grain.
 2. Fill nail holes, cracks and depressions with wood filler, colored to match finish for wood scheduled to receive a transparent finish. Use a tack cloth on wood to receive a transparent finish to remove sanding dust.
- K. Other materials not covered above: Prepare to receive paint in compliance with the paint manufacturer instructions.
- L. Existing painted surfaces:
1. General:
 - a. Wash surfaces with biodegradable detergent to remove dirt, dust and contaminants. Rinse clean. Use bleach on mildew; remove mildew completely.
 - b. Patch dents, gouges and other imperfections in painted surfaces and sand smooth and flush with adjacent undamaged surfaces so that patching will be invisible after painting.
 - c. Remove dust, rust and other surface contaminants, loose and unsound paint coatings, etc. as required to provide clean and sound surfaces to receive new paint.
 - d. Remove gloss from enamel paints with steel wool or by treating them with a commercial de-glosser used in compliance with its manufacturer's instructions.
 - e. Where paint is missing, damaged, or dented and where bare substrate is exposed, remove all surfaces contamination and featheredge all edges to zero. Sand surfaces smooth and prime.
 - f. Additionally, paint that is loose or is not otherwise tightly adhered to the substrate must be removed back to sound paint and down to the substrate, and all edges feathered to zero. When 40 percent or more of the paint on a given substrate is loose, damaged, or otherwise unsound, all the paint down to the substrate must be removed.
 2. Wood:
 - a. Verify that substrate is smooth and free of dirt, oil, and other foreign substances, while knots shall be seasoned, clean, dry, and sealed.
 - b. Holes and imperfections must be filled with putty or plastic wood filler and sanded smooth, with the edges, ends, faces, undersides, and backsides primed.
 - c. There shall be neither signs of steel wool (used for smoothing) nor blue stain.
 3. Galvanized surfaces:
 - a. Clean of soil, cement spatter, weld flux and spatter, oil grease, grime, and other surface dirt.
 - b. Additionally, repair damaged zinc coating on galvanized surfaces with high zinc content cold-galvanizing repair.
 - c. Remove grease, oil, dust, grime, and loose dirt are removed;

- d. Abrade surfaces sufficiently and roughen to provide a sound-anchoring base for new paint.
- 4. Rust: Remove down to bright metal and prime surfaces with rust-inhibitive primer.
- 5. Test: Test a small area of the previously painted finish with the new coating by applying to specified thickness and then continuing the test for the manufacturer's recommended published length of time before re-coating. If the previously painted surface blisters, wrinkles, dissolves, and/or delaminates, it will not work with the new finish. Where the previously painted surface is incompatible with the finish coat, one should apply a proper barrier coat to the prime coat. It is important to allow the manufacturer's suggested drying time between the succeeding coat, and to check the film of the previous coat be certain it is cured.
- M. Hardware:
 - 1. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures and similar items in place and not to be painted or provide surface- applied protection prior to surface preparation and painting.
 - 2. Coat cutouts for hinges, edges of lockset holes and same as for first coat.
 - 3. Following completion of painting each space or area, reinstall the removed item by workmen skilled in the trades involved.
- N. Weatherstripping and sound seals. Paint exposed metal surfaces to match the door frame, whether or not unfinished, furnished with factory prime coat, or factory treated for paint adhesion.
- O. Access doors and panels: Generally, paint the same color as surrounding walls and ceiling.
- P. Registers: Paint exterior of register same color as adjacent wall. Paint interior of connected duct flat black for a distance of 18 inches.

3.3 PAINT PREPARATION

- A. Open paint containers only as required for use. Mix paint in designated areas.
- B. Thoroughly stir and agitate paint to uniformly smooth consistency suitable for proper application.
- C. Do not reduce, change or use any materials except in compliance with manufacturer printed instructions.
- D. In all cases, prepare and handle paint to prevent deterioration and inclusion of foreign matter.

3.4 APPLICATION

- A. General:
 - 1. Seal interior joints between differing materials, trim, baseboard, molding, and casements and adjacent materials with paintable sealant specified in Section 07 92 00.
 - 2. Apply paint only under conditions that will insure finishes free from blemishes and defects. Leave corners with no undue amount of paint buildup.
 - 3. Use a slightly different shade for each coat of paint so that it may be readily identified.
 - 4. Primer and intermediate coats shall be unscarred and completely integral when succeeding coats are applied. Sand and dust between each coat to remove defects visible from a distance of 5 feet.
 - 5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
 - 6. Remove paint spillage and spatters on adjacent surfaces so as not to damage the surface being cleaned.
 - a. Perform patching and repairs required because of painting operations.

- b. Refinish entire panel or assembly where portion of finish has been damaged or is not acceptable to the Architect.
- 7. Paint interior surfaces of ducts, where visible thru registers and grilles, with a flat nonspecular black paint.
- 8. Unless otherwise directed by the Architect, spray-paint exposed surfaces of ceiling diffusers, air return grilles, speakers and other electrical and mechanical items, except smoke detectors and sprinkler heads, in painted ceilings to match the ceilings, whether these items are primed or factory-finished.
- 9. Number of coats:
 - a. The number of coats and paint film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has completely dried.
 - b. The number of coats specified is the minimum required for complete coverage and uniformity of color.
 - c. Apply additional coats when undercoats, stains, or other conditions show through the final finish until the finish is of uniform color and appearance.
- 10. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.
- 11. Paint interior surfaces, which are a continuation of exterior surfaces, subject to exterior exposure (such as an out-swinging door), with the applicable exterior coating system.
- 12. For opaque finishes, completely cover surfaces to be painted to provide an opaque, smooth surface film uniform in finish, color, appearance, and coverage. Painted surfaces with cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness and other imperfections are not acceptable. Cut paint in sharp lines and color breaks.
- 13. Completed work shall match approved samples, as determined by the Architect. Remove, refinish, or repaint work not complying with specified requirements.
- B. Labeling rated (fire and smoke walls and partitions): Identify both sides of rated walls and partitions above finished and decorative ceilings (plenum) with minimum 2-inch high, bright red letters spaced at 10 feet o.c. maximum, as follows. Identification can be painted using a stencil or by using pre-printed self-adhesive labels.
 - 1. Fire rated partitions: "FIRE PARTITION - DO NOT PENETRATE."
 - 2. Smoke barrier partitions: "SMOKE PARTITION - DO NOT PENETRATE."
- C. Painting plumbing, HVAC, electrical, communication, and electronic safety and security work: Paint the following and their hangers and accessories where exposed to view:
 - 1. Uninsulated metal piping.
 - 2. Uninsulated plastic piping.
 - 3. Pipe hangers and supports.
 - 4. Ductwork.
 - 5. Metal conduit.
 - 6. Plastic conduit.
 - 7. Tanks that do not have factory-applied final finishes.
- D. Application method: Contractor's option provided applied coatings match approved samples. The Architect reserves the right to require that paint be sprayed for smoothness and uniformity.
- E. Priming:
 - 1. Prime bare metal scheduled to be painted, and not embedded in concrete and masonry, immediately upon delivery to the site.
 - 2. Time lapse between priming and application of second coat shall be as short as possible.
- F. Shop-primed metal:

1. Apply 2 finish coats of paint to match adjoining surfaces, as directed by the Architect, to shop primed mechanical and electrical equipment. This work includes but is not limited to interior of air grilles, ceiling diffusers, electrical and telephone panels, and access panels.
 2. Paint conduits, outlets and pull boxes, and mechanical equipment exposed to view, such as covered and uncovered piping and ductwork, pumps, compressors, air conditioning equipment and tanks as specified in this Section.
 3. Paint the back side of access panels, removable or hinged covers to match the exposed surfaces.
- G. Miscellaneous painting: Surfaces to be painted and not specifically described herein, shall be painted with a product specifically manufactured or prepared for the material and surface to be painted with a prime and 2 finish coats.

3.5 TOUCHUP/CLEANING

- A. At completion of construction activities of other trades, touchup and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 PAINT FINISH SCHEDULE

- A. Finish all surfaces in compliance with the following schedule. Catalog names and numbers refer to products by the Vista, Dunn Edwards, Monochem and Carboline except as otherwise specified.

END OF SECTION

SUBSTRATE**VISTA PAINT****DUNN EDWARDS**

SECTION 09 90 00A

PAINT SCHEDULE

EXTERIOR SURFACES

Wood: 100 percent Acrylic Flat

1 Coat	4200 Terminator II	UGPR00 Ultra Grip Primer
2 Coats	2000 Duratone	EVSH10 Evershield

Wood: 100 percent Semi-Gloss Acrylic

1 Coat	4200 Terminator II	UGPR00 Ultra Grip Primer
2 Coats	8400 Carefree SG	EVSH50-0 Evershield SG

Wood: 100 percent Gloss Acrylic

1 Coat	4200 Terminator II	UGPR00 Ultra Grip Primer
2 Coats	8500 Carefree Gloss	EVSH60-0 Evershield GL

Wood: Semi-Transparent Stain

2 Coats	Olympic Maximum Semi-Transp. Stain	Okon WPT-3 Semi-Transp. Stain

Concrete and Brick: 100 percent Acrylic Flat

1 Coat	4600 Uniprime II	ESPR00 Eff-Stop
2 Coats	2000 Duratone	EVSH10 Evershield

Portland Cement Plaster: 100 percent Acrylic Flat

1 Coat	4600 Uniprime II	ESPR00 Eff-Stop
2 Coats	2000 Duratone	EVSH10 Evershield

CMU: 100 percent Acrylic Flat

1 Coat	018 Acrylic Block Filler	SBPR00 Blockfil
2 Coats	2000 Duratone	EVSH10 Evershield

CMU: 100 percent Acrylic Elastomeric

1 Coat	018 Acrylic Block Filler	SBPR00 Blockfil
1 Coat	1900 Weather Master At 8 to 10 MILS per coat DFT	DE 7100 Elast-0-Kote Finish at 8 to 10 MILS per coat DFT

CMU, Concrete, Brick: Graffiti-Resistant Coating (Permanent Matte Flat)**Painted Surfaces:**

SUBSTRATE	VISTA PAINT	DUNN EDWARDS
2 Coats	Monochem 6100 Clear or 6150 Pigmented Base at 4-6 MILS TDFT	Monochem 6100 Clear or 6150 Pigmented TDFT Base at 4-6 MILS TDFT
2 Coats	Monochem 5600 Permashield Premium at 4-6 MILS TDFT	Monochem 5600 Permashield Premium at 4-6 MILS TDFT

Clear Water Repellent:

Monochem Aquaseal ME12	Okon S-20

Unpainted Surfaces: Permanent (Matte Flat)

2 coats	Monochem 6100 Clear Base at 4-6 Mils TDFT	Monochem 6100 Clear Base at 4-6 Mils TDFT
2 coats	Monochem 5600 Clear Permashield Premium at 4-6 Mils TDFT	Monochem 5600 Clear Permashield Premium at 4-6 Mils TDFT

Iron and Steel: 100 percent Gloss Acrylic

1 Coat	9600 Protec Primer	BRPR00 Block Rust
2 Coats	8500 Carefree Gloss	EVSH60-0 Evershield GL

Iron & Steel: 100 percent Semi-Gloss Acrylic

1 Coat	9600 Protec Primer	BRPR00 Block Rust
2 Coats	8400 Carefree SG	EVSH50-0 Evershield SG

Aluminum & Galvanized Steel: 100 percent Gloss Acrylic

Pretreat	Jasco Prep N Prime	SCME-01 Supreme Etch
1 Coat	4800 Metal Pro Primer	UGPR00 Ultra Grip Primer
2 Coats	8500 Carefree Gloss	EVSH60-0 Evershield GL

Aluminum & Galvanized Steel: 100 percent Semi-Gloss Acrylic

Pretreat	Krud Kutter	SCME-01 Supreme Etch
1 Coat	4800 Metal Pro Primer	UGPR00 Ultra Grip Primer
2 Coats	8400 Carefree SG	EVSH50-0 Evershield SG

Fiber Cement Board: 100 percent Acrylic Flat

1 Coat	4600 Uniprime II	ESPR00 Eff-Stop
2 Coats	2000 Duratone	EVSH10 Evershield

Zinc Alloy: 100 percent Semi-Gloss Acrylic

Pretreat	Krud kutter	SCME-01 Supreme Etch
1 coat	4800 Metal Pro Primer	UGPR00 Ultra Grip Primer
2 Coats	8400 Carefree SG	EVSH50-0 Evershield SG

Ferrous Metal: Heavy Duty Aliphatic Urethane

1 Coat	Carboline Carboguard 890 VOC at 5 MILS DFT	Carboline Carboguard 890 VOC at 5 MILS DFT
1 Coat	Carboline Carbothane 133MC at 5 MILS DFT	Carboline Carbothane 133MC at 5 MILS DFT

SUBSTRATE**VISTA PAINT****DUNN EDWARDS****Gypsum Soffit Board: 100 percent Acrylic Flat**

1 Coat	4600 Uniprime II	UGPR00 Ultra Grip
2 Coats	2000 Duratone	EVSH10 Evershield

INTERIOR SURFACES**Wood: Low Sheen 100 percent Acrylic**

1 Coat	4200 Terminator II	UGPR00 Ultra Grip Primer
2 Coats	8200 Carefree Velva Sheen	SPMA20 Suprema Velvet Sheen

Wood: Semi-Gloss 100 percent Acrylic

1 Coat	4200 Terminator II	UGPR00 Ultra Grip Primer
2 Coats	8400 Carefree Semi Gloss	SPMA50 Suprema Semi Gloss

Wood: ST Stain & Clear Lacquer Finish (275 g/liter VOC)

1 Coat	VWS0250 Series ST Stain	V-QYB Stain Seal
1 Coat	NRS 1620 Sanding Sealer	Contractor's Edge Sanding Sealer
1 Coat	NRF 1626 Satin Lacquer	Contractor's Edge Satin Lacquer

Wood: Stained, Water White Finish (for light colored stains) (275 g/liter VOC)

1 Coat	VW0250 Series ST Stain	V-QYR Stain Seal: Mission White Stain
1 Coat	NAF 1420 Satin Sealer	Contractor's Edge WW Sanding Sealer
2 Coat	NAF 1426 Satin Lacquer	Contractor's Edge Satin Lacquer

Wood: Varnish Flat Clear

2 Coats	McCloskey's 6701 Flat	McCloskey's 6701 Flat
	OR Varnish Satin Clear	
2 Coats	McCloskey's 6702 Satin	McCloskey's 6702 Satin
	OR Varnish Gloss Clear	
2 Coats	McCloskey's 6703 Gloss	McCloskey's 6703 Gloss

Wood and Metal: Acrylic Dryfall – Flat

2 Coats	DF 12 Dryfall Flat	AQUA10 Aquafall Dry Fall

Rough Sawn Wood: Stain, Semi-Transparent

2 Coats	Olympic Semi-Transparent Stain	Okon WPT-3 Semi-Transparent Stain

Concrete, Plaster, CMU: Flat Acrylic

Concrete: 1 Coat	4600 Uniprime II	ESPR00 Eff-Stop
Plaster 1 coat	4600 Uniprime II	ESPR00 Eff Stop
CMU 1 coat	018 Acrylic Block Filler	SBPR00 Blockfill
All 2 Coats	8100 Carefree Flat	SPMA10 Suprema Flat

CMU, Concrete, Plaster: Eggshell Acrylic

1 Coat Concr.	4600 Uniprime II	ESPR00 Eff-Stop
1 Coat Plaster	4600 Uniprime II	ESPR00 Eff-Stop
1 Coat CMU	018 Acrylic Block Filler	SBPR00 BlockFill
2 Coats All	8200 Carefree Velva Sheen	SPMA30 Suprema EG

CMU, Concrete, Plaster: Semi-Gloss Acrylic

1 Coat Concr.	4600 Uniprime II	ESPR00 Eff-Stop

SUBSTRATE	VISTA PAINT	DUNN EDWARDS
1 Coat Plaster	4600 Uniprime II	ESPR00 Eff-Stop
1 Coat CMU	018 Acrylic Block Filler	SBPR00 Blockfill
2 Coats	8400 Carefree SG	SPMA50 Suprema SG
CMU, Concrete, Plaster: Gloss 100 percent Acrylic		
1 Coat Concr.	065 Acry-Prime	ESPR00 Eff-Stop
1 Coat Plaster	4600 Uniprime II	ESPR00 Eff-Stop
1 Coat CMU	018 Acrylic Block Filler	SBPR00 Blockfill
2 Coats All	8500 Carefree Gloss	EVSH60 Evershield GL
Masonry: Gloss Acrylic Epoxy		
1 Coat Concr.	4600 Uniprime II	ESPR00 Eff-Stop
1 Coat Plaster	4600 Uniprime II	ESPR00 Super-Loc
1 Coat CMU	018 Acrylic Block Filler	SPR00 Blockfill
1 Coat All	S60 WB Gloss Epoxy @ 2-3 MILS DFT	S60 WB Gloss Epoxy @ 2-3 MILS DFT
Gypsum Board: Flat		
2 Coats	8100 Carefree Flat	SPMA10 Suprema Flat
Gypsum Board: Eggshell		
1 Coat	1100 Hi-Build PVA Primer	VNPR00 Vinylastic Primer
2 Coats	8200 Carefree Velva Sheen	SPMA30 Suprema EG
Gypsum Board: Low Sheen 100 percent Acrylic		
1 Coat	1100 Hi-Build PVA Primer	VNPR00 Vinylastic Primer
2 Coats	8300 Carefree Eggshell	SPMA40 Suprema Low Sheen
Gypsum Board: Semi-Gloss Acrylic		
1 Coat	1100 Hi-Build PVA Primer	VNPR00 Vinylastic Primer
2 Coats	8400 Carefree Semi-Gloss	SPMA50 Suprema Semi Gloss
Gypsum Board: 100 percent Gloss Acrylic		
1 Coat	1100 Hi-Build PVA Primer	VNPR00 Vinylastic Primer
2 Coats	8500 Carefree Gloss	EVSH60 Evershield Gloss
Gypsum Board: Gloss Acrylic Epoxy		
1 Coat	1100 Hi-Build PVA Sealer	VNPR00 Vinylastic Primer
2 Coats	Carboline Sanitile 255 @ 2-3 MILS DFT	Carboline Sanitile 255 @ 2-3 MILS DFT
Ferrous Metal: Semi-Gloss 100 percent Acrylic		
1 Coat	9600 Protec Primer	BRPR00 Block-Rust
2 Coats	8400 Carefree SG	SPMA50 Suprema SG
Ferrous Metal: Gloss 100 percent Acrylic		
1 Coat	9600 Protec Primer	BRPR00 Block-Rust
2 Coats	8500 Carefree Gloss	EVSH00 Evershield GL
Ferrous Metal (Heavy Duty): Aliphatic Urethane. Refer to Exterior Surfaces		
2 Coats	Carboline Carboguard 890VOC at 5 MILS DFT	Carboline Carboguard 890VOC at 5 MILS DFT
OR	For shop-primed omit first coat	For shop-primed omit first coat
Aluminum: Semi-Gloss 100 percent Acrylic		

SUBSTRATE	VISTA PAINT	DUNN EDWARDS
1 Coat	9600 Protec Primer	BRPR00 Block-Rust
2 Coats	8400 Carefree SG	SPMA50 Suprema SG

Aluminum: Gloss 100 percent Acrylic

1 Coat	4800 Metal Pro Primer	UGPR00 Ultra Grip
2 Coats	8500 Carefree Gloss	EVSH00 Evershield GL

Stainless Steel, Copper, Brass: Semi-Gloss 100 percent Acrylic

1 Coat	4800 Metal Pro Primer	UGPR00 Ultra Grip
2 Coats	8400 Carefree SG	SPMA50 Suprema SG

Stainless Steel, Copper, Brass: Gloss 100 percent Acrylic

1 Coat	4800 Metal Pro Primer	UGPR00 Ultra Grip
2 Coats	8500 Carefree Gloss	EVSH60 Evershield GL

Intumescent Paint on Plywood Backing Panel: Latex.

1 Coat min.	"Intumescent Latex" (thin film) by Contego International.	
	"Flame Stop IM" by Flame Stop, Inc., or equal.	

MISCELLANEOUS EXTERIOR AND INTERIOR APPLICATIONS

Stair Tread Edges: Tnemec Series 222 Deco-Tread, color to be selected by the Architect.

END OF SECTION

SECTION 09 96 23

GRAFFITI-RESISTANT COATING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and application of a clear 100% silane system of graffiti-resistant coating.
- B. Related requirements: Other Section of Division 09 for painting.

1.2 SUBMITTALS

- A. Data: Manufacturer Product Data including installation instructions.
- B. Samples: 8-1/2-inch by 11-inch, of coating on the substrate scheduled to be protected.
- C. Certification: Duplicate copies of manufacturer's affidavit with each shipment of materials delivered to the jobsite certifying that material furnished complies with specified requirements.

1.3 QUALITY ASSURANCE

- A. Compliance with air quality regulations: VOC of coatings used for this work shall not exceed limits prescribed by SCAQMD.
- B. Sample panel:
 - 1. Apply sample finish, approximately 10-foot square, to wall areas, as directed by the Architect.
 - 2. Obtain Architect's approval of sample panel before proceeding further.
 - 3. Approved sample panel will be used as a standard for the Project, and if properly identified may remain a part of the Work.
- C. Applicator's qualification: Licensed or approved in writing by the coating manufacturer.

1.4 JOB CONDITIONS

- A. Environmental requirements:
 - 1. Comply with coating manufacturer's recommendations for environmental conditions regarding coating application.
 - 2. Do not apply finish in areas where dust is being generated.
- B. Provide drop cloths, shields, barricades and other protection necessary to safeguard adjacent surfaces not to be painted. Post signs immediately after painting.
- C. Provide and maintain protection as required to protect finished work from damage until its acceptance.

1.5 HANDLING

- A. Take necessary precautions to prevent fire. Remove soiled rags and other waste items from premises at end of each day's work, or store in metal containers with tightly fitting metal covers.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
- B. Maintain ambient temperature above 40 degrees F during and 24 hours after installation.
- C. Do not proceed with application if temperature of surface exceeds 100-degree F.
- D. Do not proceed with the application of materials in rainy conditions or if heavy rain is anticipated within 4 hours after application.

1.7 MAINTENANCE

- A. With closeout submittals, deliver one identified unopened 5 gallon container of each color (if more than one color was used) of coating used on the Project, and a 5 gallon container of solvent to be used for graffiti removal, to the Owner. Identify with area and material for future identification.
- B. Provide the District with a copy of instructions for graffiti removal and maintenance recommendations.

PART 2 - PRODUCTS

2.1 COATING

- A. Product:
 - 1. Basis of design: Protectosil 100SK as manufactured by Evonik Industries.
 - 2. Or equal.
- B. Description: Aqueous silane-based systems intended to render porous mineral substrates hydro- and oleophobic, making them easy to clean

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be coated for conditions that would adversely affect the permanence and quality of this work.
- B. Correct detrimental conditions before proceeding with application.

3.2 SURFACE PREPARATION

- A. Prepare surfaces to receive the specified finishes in compliance with the coating manufacturer's printed instructions.
- B. Surfaces to receive sealer shall be cleaned of dirt, oil, grease, laitance, and other contaminants. Oil, grease and other automotive contaminants shall be removed with degreasers. All other surfaces shall be cleaned by high pressure water (3000 psi). High pressure water is the minimum cleaning that will be accepted, other methods, such as blast-tracking, mobile power scrubbing and sandblasting may be submitted for approval.
- C. Remove dirt, dust and materials that will interfere with the proper and effective application of the penetrating sealer.
- D. Protect surrounding materials/areas from overspray.

3.3 PAINT PREPARATION

- A. Open containers only as required for use. Mix coatings in designated areas.
- B. Thoroughly stir and agitate coating to uniformly smooth consistency suitable for proper application.
- C. Do not reduce, change or use any materials except in compliance with manufacturer's printed instructions.
- D. In all cases, prepare and handle coating to prevent deterioration and inclusion of foreign matter.

3.4 APPLICATION

- A. Apply coating only under conditions that will insure finishes free from blemishes and defects. Leave corners with no undue amount of paint accumulation.
- B. Remove spillage and spatters on adjacent surfaces so as not to damage the surface being cleaned.
 - 1. Perform patching and repairs required because of painting operations.
 - 2. Refinish entire panel or assembly where portion of finish has been damaged or is not acceptable to the Architect.
- C. Number of coats:
 - 1. The number of coats and film thickness required is the same regardless of application method. Do not apply succeeding coats until previous coat has completely dried.
 - 2. The number of coats specified is the minimum required for complete coverage and uniformity of color.
 - 3. Apply additional coats when undercoats, stains, or other conditions show through the final finish until the finish is of uniform color and appearance.
- D. Completed work shall match approved Samples, as determined by the Architect. Remove, refinish, or repaint work not complying with specified requirements.

END OF SECTION

DIVISION 10

SPECIALTIES

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Exterior signs:
- B. Interior Signs:
 - 1. Room and door signs.
 - 2. Building identification signs.
 - 3. Code-compliance signs at exits, stairs and toilet rooms.
 - 4. Exit signs, unlighted.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- B. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
- C. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment. Include the letters "B" and "H" in cast steel letters with paint.
- D. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- E. Verification Samples: Submit samples showing colors specified.
- F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Uniformity: For each sign form and graphic image process indicated furnish products of a single manufacturer.
- C. Coordination: Before starting Shop Drawings, notify the Architect and arrange a meeting with the Owner's designated personnel to review in detail the work of this Section. Review and coordinate layouts for each sign, and obtain Architect's approval prior to manufacture.
- D. All tactile room identification and exit signs shall include Grade 2 Braille translation with the tactile portion of the sign following the requirements of ADA.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.5 FIELD CONDITIONS

- A. Verify type of supporting construction; provide suitable attachments.

- B. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- C. Maintain this minimum temperature during and after installation of signs.
- D. Adhesive as the sole means of installation is only allowed where sign is to be on glazing.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Signage shall conform to the CBC and specifically to the following CBC chapters:
 - 1. Chapter 11B-201.1 for design and construction, 11B-603 and 11B-604.8 for passageways.
 - 2. Chapter 11B-216.6 for scoping for signs where accessible routes diverge from the regular circulation path
 - 3. Chapter 11B-703 for non-accessible existing entrances and general standards.
 - 4. Chapter 11B-703.3 for braille requirements.
 - 5. Chapter 11B-703.5.1, 6.2 and 7.3 for finish and contrast.
 - 6. Chapter 11B-703.2.4 and 2.6 for proportions.
 - 7. Chapter 11B-307.3 for pole-mounted objects, edges and corners.
- B. Braille Symbols:
 - 1. Character Type: Characters on signs shall be raised 1/32 inch minimum and shall be sans serif uppercase characters accompanied by contracted Grade 2 Braille (see Note 5 below).
 - 2. Character Size: Raised characters shall be a minimum of 5/8 inch and a maximum of 2 inch high.
 - 3. Finish and Contrast: Contrast between characters, symbols and their background must be 70% minimum and have a non-glare finish. CBC 1117B.5.2.
 - 4. Proportions: Characters on signs shall have a width-to-height ratio of between 3:5 and 1:1 and a stroke width-to-height ratio of between 1:5 and 1:10. CBC 1117B.5.3.
 - 5. Letters measured must be uppercase. After choosing a typestyle to test, begin by printing the letters I, X, and O at 1 inch height. Place the template's 1:1 square over the X or O, whichever is narrower. If the character is not wider than 1 inch, nor narrower than the 3:5 rectangle, the proportions are correct. Use the 1:5 rectangle to determine if the stroke of the I is too broad, and the 1:10 rectangle to see if it is too narrow. If all the tests are passed, the typestyle is compliant with proportion code.
 - 6. Braille: Contracted Grade 2 Braille shall be used whenever Braille is required in other portions of these standards. Dots shall be spaced 1/10 inch on center in each cell, with 2/10 inch space between cells, measured from the second column of dots in the first cell to the first column of dots in the second cell. Dots shall be raised a minimum of 1/40 inch above background. CBC Section 1117B.5.6.
 - 7. Provide rounded or domed Contracted Grade 2 Braille dots, each distinct and separate. Dots with straight sides and flat tops are not acceptable.
- C. Type Imagery:
 - 1. Type style: Sans Serif upper case.
 - a. Letter Size: See signage drawings.
 - b. Number Size: See signage drawings.
 - c. Raised Letters: Letters shall be raised a minimum of 1/32 inch above background.
 - d. Other Sizes: As specifically indicated.
 - 2. Arrangement: Use standard spacing between letters, words, numbers and lines; center text.
 - 3. Symbol Style: Recognized standard International Symbols of Accessibility, such as those developed by the American Institute of Graphics, for the U. S. Department of Transportation.
 - a. Accessible Restrooms shall include a 6 inch high wheelchair logo. Logo shall be raised a minimum of 1/32 inch above the background.

- b. On visual signs, characters and symbols shall be sized according – to view distance. Signs mounted 80 inch or more AFF shall have minimum 3 inch high characters.
 - c. Pictographs and ISA's (International Symbol of Accessibility) on interior signs at eye level, shall be minimum 3 inch high or twice as high as the height of text on the sign; whichever is greater. On signs where bottom is 72 inch or more AFF, minimum height shall be 6 inch or twice as high as the largest text on the signs; whichever is greater.
- 4. Colors:
 - a. Background Colors: As selected by the Architect from manufacturer's standard color range (12 colors maximum); one color maximum, typically.
 - b. Type Imagery: White or black, as selected by Architect to contrast with background colors; one color maximum, each, for interiors and exteriors.
 - c. Code Required Colors for Symbols and Signs: Where colors are mandated by Codes or Regulations conform to their requirements including 11B-703; colors from the CBC.
 - d. Other colors: Certain colors are specifically noted.

2.2 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Advance Corporation; Braille-Tac Division.
 - 2. ASI.
 - 3. Architectural Graphics, Inc.
 - 4. Architectural Signs and Directories.
 - 5. Vomar Products, Inc.
 - 6. Or equal.

2.3 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: All signs are required to comply with ADAAG and CBC Chapter 11B and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. All Signage Types: Unless otherwise indicated:
 - 1. Character Font: Helvetica, or other sans serif font acceptable to the Architect.
 - 2. Character Case: Upper case only.
 - 3. Background Color: Clear.
 - 4. Character Color: Contrasting color.
- C. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, see above.
 - 3. Braille shall be rounded or contracted domed top.
 - 4. Character Height: 1 inch.
 - 5. Sign Height: 2 inches, unless otherwise indicated.
 - 6. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings.
 - 7. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers shown on the drawings.
 - 8. Service Rooms: Identify with the room names and numbers shown on the drawings.

2.4 PLASTIC SIGN MATERIAL

- A. Material:
 - 1. Type: Phenolic Resin Core with a three-ply melamine resin surface.
 - 2. Thickness: 1/8 inch.

- B. Adhesive: Pressure sensitive, hi-tack transfer tape with peel-back paper backing. Structural grade silicone adhesive for mounting on glazing.
- C. Mounting Screws: Non-corrosive, tamperproof screws. Match finishes to the door hardware for the door where the signs are mounted.
- D. Signs shall be non-static, fire retardant, and self-extinguishing.
- E. No. SP125 Manufacturing Specifications per basis of design manufacturer:
 - 1. Material thickness: 1/8 inch.
 - 2. Standard sheet size: 48 inch x 96 inch.
 - 3. Weight: 1/8 inch = 1 lb/ square foot.
 - 4. Maximum continuous operating temperature: 225°F.
 - 5. Flexural strength flat: 21,497 psi.
 - 6. Tensile strength: 22,000 psi.
 - 7. Shear strength: 22,729 psi.
 - 8. NEMA rated "self-extinguishing"

2.5 SIGN TYPES

- A. Graphic Process and Fabrication: All signs shall be manufactured using "Sand-Etched Process" or equivalent system, as per acceptable manufacturers stated methods, whereby characters are integral part of signage body.
 - 1. Tactile characters shall be raised the required 1/32 inch from sign face. Glue-on letters, images and/or symbols are not acceptable.
 - 2. Work to have sharp clean profiles.
 - 3. Text shall be accompanied by Contracted Grade 2 Braille. Braille shall be separated 1/2 inch from corresponding raised characters or symbols.
 - 4. Perimeter borders shall be 1/4 inch minimum.
 - 5. Edges: Finish edges smooth and clean, without chips or burrs.
 - 6. Corners: Provide radius corners; 1/8 inch diameter.
 - 7. Cut-outs For Hardware: Factory made, accurately, to templates.
 - 8. Mounting Holes: Factory drilled.
 - 9. Adhesive Backing: Completely cover rear surface of each sign.
- B. Room Identification Signs:
 - 1. Refer to Drawings for names, numbers, identification symbols, sizes, configurations, and locations.
 - 2. Colors for Type Imagery:
 - a. Room Name Signs:
 - 1) Type: Black or white, to be selected by Architect.
 - 2) Background: One color to be selected by the Architect from manufacturer's standard color range (12 colors, minimum) for interior signs, unless otherwise noted. Refer to signage schedule.
 - b. Room Number Signs:
 - 1) Type: Black or white, to be selected by Architect.
 - 2) Background: One color to be selected by the Architect from manufacturer's standard color range (12 colors, minimum) for interior signs, unless otherwise noted. Refer to signage schedule.
 - 3) Architect shall select a second color for signs located on exterior.
- C. Accessibility Symbol Signs:
 - 1. Refer to Drawings for identification symbols, sizes, configuration, and locations.
 - 2. Figure Symbols for Building Entrance Signs:
 - a. Size: 6 inch x 6 inch, typically.
 - b. Refer to Drawings.

3. Geometric Symbols for Toilet Rooms:
 - a. For Men/Boys: An equilateral triangle, 10 inch on a side; 1/8 inch thick.
 - b. For Women/Girls: A 12 inch diameter circle; 1/8 inch thick.
 - c. For Both Sexes: An equilateral triangle, 10 inch on a side, inlayed in 12 inch diameter circle; 1/8 thickness.
4. Directional Signs.
5. International Symbol for Access for the hearing impaired.
6. Colors for Symbols:
 - a. International Accessibility Symbols:
 - 1) Symbols: White.
 - 2) Background: Blue, Color No. 15090 per Federal Standard 595B.
 - b. Male and Female Symbols:
 - 1) Symbols: Blue.
 - 2) Background: White.

D. Room Capacity Signs:

1. Wording for sign at Assembly Room at Multi-Purpose Building: See Plans and Signage drawings. Number to be on Drawings or provided by Architect.
2. Refer to Drawings for identification.

E. Exit Signs; Floor Level, Self-Luminous:

1. General:
 - a. Conform to State Fire Marshal, Title 19.
 - b. UL listed 924 Floor-level exit signs.
 - c. UL listed 1994 floor-level exit markers and exit path marking.
 - d. ICBO No. ERS-5101.
2. Refer to Drawings for identification, symbols, sizes, configuration, and location.
3. Mounting Locations: Single-face for flat-to-wall mounting.
4. Acceptable Manufacturer and Product: Active Safety; Murray, Utah; 800-657-6324; Model #16.000 SWMA stencil-faced Exit Marker, or equal.

F. Metal Signs:

1. Sign Components:
 - a. Extruded anodized brushed aluminum sign casement with a thickness of 2mm dimensional curved profile. Color to be natural mill finish.
 - b. Protective Cover: Clear non-glare plastic cover of PETG, or Lexan with a 1mm thickness luminous insert.
 - c. Anti-Graffiti, 3M Scotchgard Multi-Layer Protective Film 1004 (0.5mm), ASTM D3652.
 - d. Aluminum end-caps, pre-drilled with a 3mm thickness.
2. Refer to Drawings for sign locations and configuration.
3. Photo-luminescent pigment PVC vinyl compound sheet with adhesive back.
 - a. Printing Method: Silkscreen printing.
 - b. Luminescent Properties: Yellowish green glowing color with brightness of afterglow of 12 hours (according to DIN 6210, Part 1).
 - c. Flame Retardant: 27.
 - d. Thickness: 0.79mm (luminous film of 0.63mm plus self-adhesive backing of 0.04mm).

2.6 ACCESSORIES

A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.

1. Exterior:
2. Interior: Bright finish.

- B. Tape Adhesive: Double sided tape, permanent adhesive.
 - 1. Completely cover the plate with adhesive.
- C. Where flat signs are mounted on glass walls:
 - 1. Provide an additional blank plate with same background color.
 - 2. Mount this plate on the inside of glass in alignment with sign plate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.2 PREPARATION

- A. Layout: Accurately lay out work to maintain proper lines, levels and spacing.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and CBC Chapter 11B.
- B. Install neatly, with horizontal edges level.
- C. Mounting location shall be determined so that a person may approach within 3 inches of signage without encountering protruding objects or standing within the swing of the door. CBC Section 1117B.5.7.
- D. Mounting:
 - 1. See drawings for locations.
 - 2. Press tape firmly to mounting surface, and secure each plaque or sign with minimum four tamper-proof screws for square or rectangular signs; minimum three tamper-proof screws for triangle, or round signs.
 - 3. Signs shall have pre-drilled holes when delivered, and mounted with non-corroding anchors and tamper-proof screws.
 - 4. When mounting on glazing, press silicone adhesive firmly to glazing. Clean excess adhesive from glazing.
- E. Protect from damage until Substantial Completion; repair or replace damage items.

END OF SECTION

SECTION 10 21 13

TOILET COMPARTMENTS AND SCREENS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Floor-Ceiling-supported stainless-steel toilet compartments.
 - 2. Wall-mounted stainless steel urinal screens.
- B. Related requirements:
 - 1. Division 05 for suspension system for toilet compartments.
 - 2. Division 10 for toilet room accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate installation of toilet partitions and screens with their supports, including overhead (above ceiling) supports. Supply Shop or setting drawings, templates and directions for installing backing plates, brackets, anchors, suspension system, and other accessories.
 - 2. Coordinate fabrication of toilet partitions for installation of surface-mounted and recessed toilet room accessories supported by the partitions. Obtain Shop or setting drawings, templates and directions required for reinforcement to be built-in the partitions.
 - 3. Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

1.3 SUBMITTALS

- A. Data: Manufacturer Product Data for compartments and screens, supplemented by Shop Drawings showing plan layout, attachment to adjacent construction and other details not shown on the manufacturer's data.
- B. Shop Drawings:
 - 1. Show layout of compartments and screens in each space to receive them.
 - 2. Show elevations.
 - 3. Show fabrication and erection of compartment assemblies, to extent not fully described by manufacturer's data sheets.
 - 4. Show anchorage, accessory items and finishes.
 - 5. Provide location drawings for bolt hole locations in supporting members for attachment of compartments.
- C. Samples: 6-inch by 6-inch by 22-gage stainless steel Samples with the selected finish.
- D. Closeout: With closeout submittal, provide instructions for proper care of toilet partitions, such as required lubrications, adjustments, and cleaning.

1.4 HANDLING

- A. Protection: Cover stainless steel components, after fabrication, with Electrostatically-applied plastic film.
- B. Storage: Undercover, off the ground or floor, in a dry, ventilated space out of harm's way.

PART 2 - PRODUCTS

2.1 MANUFACTURE/TYPE

- A. Flush Metal Corp.
- B. ASI Accurate Partitions.
- C. Metpar.
- D. Or equal.

2.2 MATERIALS

- A. Face plates:
 - 1. Stretcher-leveled, cold-rolled AISI Type 302/304 stainless steel.
 - 2. Metal thicknesses:
 - a. Doors: 22-gages.
 - b. Partitions and screens: 20-gage.
 - c. Stiles or pilasters: 16-gage.
 - d. Door and partition edge locking strips: 20-gage.
 - e. Stile or pilaster edge locking strips: 18-gage.
 - f. Stile or pilaster ceiling trim: 20-gage.
- B. Reinforcement:
 - 1. For tapping: 14-gage.
 - 2. For anchoring: 12-gage.
- C. Sound-deadening core: Manufacturer's standard consisting of Kraft paper honeycomb, fiberboard or corrugated paperboard.
- D. Minimum section thicknesses:
 - 1. Doors and partitions: One inch.
 - 2. Pilasters and stiles: 1-1/4-inch.
 - 3. Urinal screens: One inch.
- E. Hardware:
 - 1. General: Stainless steel, chrome-plated brass, chrome-plated Zamac and polished aluminum brackets, hardware and fasteners.
- F. Hinges: 54-inch 16-gage stainless steel continuous cam hinge. Hinge shall be gravity type for self-closing action and shall be fully adjustable up to 360 degrees.
- 1. Latches: Mounted within door with combination keeper and bumper mounted on opposite pilaster. Latch shall allow operation of turn bolt from both sides of door and shall comply with ADA. Provide U-shaped handles with sliding latch.
- 2. Coat hook/bumper: Combination coat hook/bumper mounted on the water closet side of each compartment door.
- 3. Fasteners: Theft-resistant (one-way) stainless steel fasteners for attachment of exposed hardware, component connections and compartments to walls; finished to match the hardware and fittings.

2.3 FABRICATION

- A. Fabricate components straight, clean cut and free from defective workmanship and materials.
- B. Assemble doors, panels and pilasters from 2 face sheets with integrally interlocked edges, or form edges by assembling and cementing under pressure to core; bind formed edges with lock strips.
- C. Miter corners of edge moldings, weld and grind smooth and flush with adjacent surfaces.
- D. Provide concealed reinforcement for tapping, or rivet nuts where machine screws are required for fastening.
- E. Provide cutouts and reinforcement in toilet compartments as required for installation of accessories specified in Section 10 28 00. Make cut-outs plumb, level and square; verify size of accessories before making cut-outs so that the accessory flanges will conceal all raw edges.

- F. Finishing:
 - 1. Exposed surfaces: NAAMM No. 4 finish with grain direction parallel with the length of the component.
 - 2. Exposed hardware and fittings: US 26 polished chrome (complying with ASTM B 456, Type SC2), or AISI No. 8 (mirror) finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine adjacent construction and supports.
- B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

- A. Set compartments and screens plumb, level, and space uniformly in compliance with their manufacturer's printed instructions and the following.
- B. Provide solid spacers to prevent crushing ceiling finish material where compartment stiles meet ceiling.
 - 1. Secure pilasters to supporting structure. Level, plumb and tighten installation with devices furnished.
 - 2. Hang doors and adjust so that bottom of doors are level with bottom of pilasters when doors are closed.
- C. Secure panels to walls with not less than 2 stirrup brackets attached near top and bottom of panel.
 - 1. Locate wall brackets so that holes for wall anchorages occur in tile joints.
 - 2. Secure panels to pilasters with not less than 2 stirrup brackets located to align with stirrup brackets at wall.
 - 3. Anchor panels to studs or backing plates; fastening components to walls with toggle bolts will not be allowed.
- D. Install hardware as recommended by manufacturer. Conceal evidence of drilling in finished work.

3.3 ADJUSTING/CLEANING

- A. Adjust brackets and hardware to provide uniform clearances not exceeding the following dimensions:
 - 1. Pilasters and walls: One inch.
 - 2. Panels and walls: One inch.
 - 3. Pilasters and panels: 1/2-inch.
 - 4. Pilasters and doors: 3/16-inch.

3.4 FIELD QUALITY CONTROL

- A. Adjust hardware for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched, except set hinges on out-swinging doors (and entrance swing doors) to return to fully closed position.
- B. After completion of installation, clean and polish exposed surfaces and touchup minor scratches. Remove and replace components that cannot be satisfactorily touched-up in the field, in the Architect's opinion.

END OF SECTION

SECTION 10 28 00

TOILET ROOM ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Warm-air dryers.
 - 3. Underlavatory guards.
 - 4. Custodial accessories.
- B. Related Requirements: Section 01 17 00 for OFCI products.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Manufacturer's warranty.
 - 5. Wiring diagrams for electrically operated devices.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated on drawings.

1.3 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.4 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.5 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings by the following:
 - 1. Bobrick Washroom Equipment, Inc.
 - 2. Or equal.
- C. Liquid-Soap Dispenser : Owner Furnished Contractor Installed.
 - 1. Basis-of-Design Product: B-2111 by Bobrick
 - 2. Mounting: Surface Mounted
 - 3. Description: Accessory mounted at 36" max. from finish floor to operable part. Accessory protrudes 3-1/2" from wall.
- D. Grab Bar:
 - 1. Basis-of-Design Product: B-5806 by Bobrick.
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 - 4. Outside Diameter: 1-1/2 inches.
 - 5. Configuration and Length: As indicated on Drawings.
- E. Mirror Unit :
 - 1. Basis-of-Design Product: Bobrick Model B-290
 - 2. Size: 23-1/2 inches W x 35-1/2 inches H.
 - 3. Frame: Stainless-steel angle, 0.05 inch thick.
 - a. Corners: Manufacturer's standard.
- F. Toilet paper dispenser to be continuous flow type:
 - 1. Basis-of-Design Product: Bobrick Model B-4288 - surface mounted. Size: 6-1/16 in Wx11 in. x 5-15/16in deep.
 - 2. Gamco - TTD-9 Recessed multi-roll toilet tissue dispenser.
- G. Sanitary Napkin Dispenser
 - 1. Basis-of-Design Product: Bobrick Model B-370634
 - 2. Description: Accessory mounted 40" from finish floor to operable parts.

G. Sanitary Napkin Disposal

1. Basis-of-Design Product: Bobrick Model B-354.
2. Mounting: Mounted to toilet partition.
2. Description: Accessory mounted 19" min. from finish floor to operable parts.

2.3 WARM-AIR DRYERS

A. Manufacturers:

1. Xlerator Hand Dryer XL-W by Excel Dryer Company, basis of design.
2. Or equal.

B. Warm-Air Dryer:

1. Mounting: Semi recessed with ADA compliance recess kit #40502.
2. Operation: Electronic sensor activated with timed power cut-off switch.
 - a. Operation Time: 60 seconds.
3. Cover Material and Finish: Steel, with white enamel finish.
4. Electrical Requirements: 115 V, 20 A, 1500 W, U.N.O.

2.4 UNDERLAVATORY GUARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Plumberex Specialty Products, Inc.
2. Truebro by IPS Corporation.

B. Underlavatory Guard :

1. Basis-of-Design Product: As indicated on drawings.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.5 CUSTODIAL ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. Or equal.

B. Mop and Broom Holder:

1. Basis-of-Design Product: As indicated on drawings.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches .
4. Hooks: Three.
5. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.
 - b. Rod: Approximately 1/4-inch- diameter stainless steel.

2.6 ADULT CHANGING STATION

- A. Changing Stations shall be adjustable to meet the current CBC.
- B. Adjustable Height Adult Changing Station:
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Model Number R8592318021 by Pressalit Care Inc., basis of design.
 - 2. Smirthwaite USA LLC.
 - 3. Or equal.
- D. Description: Height adjustable horizontal unit electrically operated with wired hand control and with safety rail and receiver tray.
 - 1. Engineered to support minimum of 400-lb static load when opened.
 - 2. 70-inches in length, 28-inches high adjustable, electric motor and safety rail.
 - 3. Adjustable range: 28-inches minimum.
- E. Mounting: Surface mounted, foldable by pneumatic shock-absorbing mechanism.
- F. Electrical Characteristics: Manufacturer's standard actuator and control system, with integrated 24-V dc transformer, powered by a single 120-V electrical receptacle.
- G. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin), with PVC mattress.

2.7 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Adult Changing Stations: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

SECTION 10 44 00

FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Fire extinguishers.
 - 2. Fire extinguisher cabinets.
 - 3. Mounting brackets.
 - 4. Fire extinguisher locators.
- B. Related requirements: Division 21 for fixed fire protection systems.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation meeting:
 - 1. Coordinate size of fire extinguisher cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
 - 2. Coordinate sizes and locations of fire extinguisher cabinets with wall depths. Final location of fire extinguisher cabinets is subject to the Fire Department's approval.
 - a. Verify cabinet locations with both the Fire Department and the Architect and Owner's Authorized Representative during the framing stage of the Project.
 - b. Positioning of cabinets at locations other than indicated shall be done at no additional cost to the Owner.
 - c. Where extinguisher Locations are not indicated, assume cabinet and extinguishers will be located within 75 feet of any point in the building, or at a rate of one for each 3,000 square feet of building area, or portion thereof, whichever yields the greater number of extinguishers.

1.3 SUBMITTALS

- A. Data: Manufacturer Product Data and installation instructions for the work of this Section.
 - 1. For fire extinguishers, submit Drawings indicating locations and type of extinguishers after approval by Fire Marshall.
 - 2. For extinguisher cabinets, include roughing-in dimensions and details showing mounting methods, door hardware, cabinet type and materials, trim style and door construction, and materials.
 - 3. Include color charts showing full range of manufacturer standard colors and designs available.
- B. Closeout: 2 keys for each cabinet, all keyed alike, and properly tagged.

1.4 QUALITY ASSURANCE

- A. Uniformity: Provide all fire extinguishers, cabinets and accessories made by one manufacturer.
- B. UL listing: Provide UL listed fire extinguishers bearing the UL "Listing Mark" for type, rating, and classification specified. Provide cabinets with the same fire-rating as walls in which they are installed.
- C. NFPA compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

1.5 SPECIAL WARRANTY

- A. Fire extinguisher warranty:
 - 1. Warranty stating that manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship for 5 years from Substantial Completion.
 - 2. Failures include:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of design: Products by Larsen's Manufacturing Co.
- B. Other acceptable manufacturers:
 - 1. JL Industries, Inc./Division of Activar Construction Products Group.
 - 2. Potter Roemer LLC.
 - 3. Or equal.

2.2 FIRE EXTINGUISHERS

- A. Multi-purpose dry chemical: 3A:40B:C UL rated, 6 lb. capacity, aluminum valve.
 - 1. Markings:
 - 2. Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
 - 3. Label with standard warnings concerning breathing, eyes, skin and ingestion. Provide emergency and first aid procedures.

2.3 FIRE EXTINGUISHER CABINETS

- A. Basis-of-design-product: "Architectural Series" Steel "Tub" box, "Larsen Loc", with solid, lockable door.
 - 1. Provide the following cabinet types at locations indicated:
 - a. Semi-recessed non- fire-rated cabinets (2409-R7): Square-Edge Trim: 1-1/2-inch backbend depth.
 - b. Semi-recessed fire-rated cabinets (FS 2409-R7): Square-Edge Trim: 1-1/2-inch backbend depth.
 - c. Surface-mounted, non-fire-rated cabinets (2409-SM): Cabinet box fully exposed and mounted directly on wall with no trim.
 - d. See Drawings for each type of cabinet location. Coordinate locations with Fire Marshall prior to hanging gypsum board.
- B. Construction: Manufacturer standard enameled steel box. Miter and weld perimeter door and frames and grind smooth.
- C. Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend). Miter and weld all joints.
- D. Door hardware: Manufacturer standard door operating hardware and keyed lock. Provide concealed or continuous type hinge permitting door to open 180 degrees.
- E. Factory-finishing:
 - 1. After cleaning and pretreatment, apply manufacturer's baked enamel coating of the color selected by the Architect from manufacturer's palette.
 - 2. Identify fire extinguisher in cabinet with lettering spelling "FIRE EXTINGUISHER" painted on door by silk-screen process.

3. Provide vertical lettering on door as selected by Architect from manufacturer's standard letter sizes, styles and layouts.

2.4 ACCESSORIES

- A. Fire extinguisher locators: White plastic. Red edge in white vinyl with a fire extinguisher symbol and "Fire Extinguisher" lettering by Flynn, or equal.
- B. Mounting brackets (wall hooks):
 1. Basis-of-design-products: Larsen's Model B4, standard brackets of sizes required for extinguisher specified, in manufacturer standard plated finish.
 2. Provide brackets for extinguishers, other than those in cabinets.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine adjacent construction and supports.
- B. Verify that openings are within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface.
- C. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

- A. Verify with Fire Marshal and Architect each fire extinguisher cabinet location during the framing stage of the Project; location of fire extinguisher cabinets is subject to the Fire Marshal's approval.
 1. Position cabinets at locations other than indicated at no cost to the Owner.
 2. Where not indicated; locate cabinets and extinguishers with the Architect's approval.
- B. Verify with Fire Marshal and Architect each fire extinguisher cabinet location during the framing stage of the Project; location of fire extinguisher cabinets is subject to the Fire Marshal's approval.
- C. Position cabinets at locations other than indicated at no cost to the Owner.
- D. Where not indicated locate, cabinets and extinguishers with the Architect's approval
- E. Install cabinets so that the fire and/or acoustical rating of the walls are not compromised.
- F. Attach mounting brackets and fire extinguisher cabinets securely to studs or backing plates, square, plumb and level, in compliance with their manufacturer's instructions; do not attach them to gypsum board with Molly or toggle bolts.
- G. Install fire extinguisher locators where indicated. Secure to supports with double-sided foam tape.

3.3 FIELD QUALITY CONTROL

- A. Verify that installed extinguishers are fully charged and tagged in accordance with requirements of authorities having jurisdiction.
- B. Touchup damaged finish, when the results are acceptable to the Architect, otherwise replace damaged components.

END OF SECTION

SECTION 10 75 00

FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes ground-set aluminum flagpole.
- B. Work not in Contract (NIC): Flags.
- C. Related work: Division 03 for concrete footing for flagpoles and installation of anchor bolts.

1.2 SUBMITTALS

- A. Samples: Color samples of base metal with specified finish.
- B. Data: Manufacturer data for the flagpole.
- C. Shop drawings: Supplement manufacturer's data with shop drawings showing the following.
 - 1. Large scale, dimensioned shop drawings showing materials, joints, finishes, methods of anchorage, method of grounding flagpole, and other pertinent data.
 - 2. The shop drawings shall be signed and stamped by a professional engineer licensed to practice in the state in which the flagpole is fabricated.
- D. Closeout: A minimum of 4 keys, properly labeled, and instructions for raising and lowering the flags.

1.3 QUALITY ASSURANCE

- A. General: Engineer, fabricate and install the flagpole to withstand, without permanent deformation or failure, the wind loading indicated on the Structural Drawings, but not less than 20 psf.
- B. Manufacturing standards: Provide flagpole as complete unit produced by a single manufacturer, including fittings accessories, bases, and anchorage devices.

1.4 HANDLING

- A. Protection: Protect flagpole with heavy Kraft paper and wood stripping held in place with steel bands before shipment.
- B. Delivery: Deliver flagpole and accessories completely identified for installation procedure.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Flagpole assemblies shall withstand the effects of earthquake motions determined according to CBC and seismic criteria on Structural Drawings.
- B. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.
- C. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location is indicated on Structural Drawings.

- D. Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

2.2 MANUFACTURER

- A. American Flagpole.
- B. Or equal.

2.3 FLAGPOLE MATERIALS/CONSTRUCTION

- A. Pole style: Cone-tapered.
- B. Height above ground: 30 feet.
- C. Diameter: Manufacturer standard, but not less than 6 inches at the butt and 3 inches at the top.
- D. Flagpole material: 6063T6 aluminum alloy, seamless tubing with a minimum wall thickness of 0.188-inch.

2.4 FITTINGS

- A. Finial: Anodized aluminum ball, same diameter as the pole butt, spun from 14-gage aluminum with watertight seams and mounted to a 5/8-inch diameter rod fitted to truck.
- B. Truck: Revolving, double 2-7/8-inch diameter stainless steel or non-ferrous sheaves, same material as pole, mounted on stainless steel ball bearings.
- C. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
- D. Sling: Nylon beaded retainer assembly.
- E. Snaps: Stainless steel, minimum 4 (2 for each flag).
- F. Cables: 1/8-inch diameter, stainless steel aircraft cable.
- G. Access door: Removable.
- H. Flash collar: Manufacturer's standard flat spun aluminum collar, 3 inches high by 18 inches diameter.
- I. Cleat: Two 9-inch long cast aluminum.
- J. Cleat box covers: Cast aluminum mounted on concealed stainless steel or non-ferrous hinge and provided with a cylinder lock.
- K. Base plate: Manufacturer's standard cast metal shoe base of same material as flagpole.
- L. Anchor bolts: Manufacturer's standard complying with ASTM A 307.
- M. Fasteners: Type 302/304 stainless steel screws, bolts and rivets.
- N. Sealant: As specified in Section 07 92 00.

2.5 FABRICATION

- A. Weld all joints unless other fastening methods are acceptable to the Architect. Make exposed joints close fitting and locate where least conspicuous.
- B. Fabricate flagpole in longest possible sections without joints. If joints must be made, make only in the locations approved on the shop drawings.
- C. Finish exposed surfaces of flagpole and accessories, except cables and faying surfaces, with a clear anodized finish to match approved samples. Shop coat mast sections to be encased in foundation sleeve with a heavy coating of asphalt paint both inside and out.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and measurements affecting the work of this Section at site.
- B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

- A. Erect flagpoles in accordance with the approved shop drawings and the flagpole manufacturer's instructions, plumb, centered in foundation sleeve with temporary wood wedges with cleat located in prevailing wind direction.
- B. Keep variation from true vertical within one inch of true vertical, measured at top of pole, in 3 directions.
- C. Provide positive lightning ground for flagpole installation.
- D. Install truck assembly and halyards and adjust to permit smooth non-binding hoisting.

3.3 REPAIR/REPLACEMENT/DEMONSTRATION

- A. Touchup marred and abraded surfaces to match adjacent undamaged surfaces, when the results are satisfactory to the Architect, otherwise promptly replace damaged components.
- B. Demonstrate operation of the halyards to the designated District's employees.

END OF SECTION

DIVISION 11

EQUIPMENT

SECTION 11 68 43

FOOTBALL SCOREBOARD

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single-sided LED football scoreboard

1.2 REFERENCES

- A. Standard for Electric Signs, UL 48
- B. Standard for CSA C22.2 #207
- C. Federal Communications Commission Regulation Part 15
- D. National Electric Code

1.3 SUBMITTALS

- A. Product data: Submit manufacturer's product illustrations, data and literature that fully describe the scoreboards and accessories proposed for installation.
- B. Shop drawings: Submit mechanical and electrical drawings.
- C. Maintenance data: Submit manufacturer's installation, operation, and maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Product delivered on site
- B. Scoreboard and equipment to be housed in a clean, dry environment

1.5 PROJECT CONDITIONS

- A. Environmental limitations: Do not install scoreboard equipment until mounting structure is secure and concrete has ample time to cure.
- B. Field measurements: Verify position and elevation of structure and its layout for scoreboard equipment. Verify dimensions by field measurements.
- C. Verify mounting structure is capable of supporting the scoreboard's weight and windload in addition to the auxiliary equipment.
- D. Installation may proceed within acceptable weather conditions.

1.6 QUALITY ASSURANCE

- A. For outdoor use
- B. Source Limitations: Obtain each type of scoring or related equipment through one source from a single manufacturer.
- C. ETL listed to UL 48.
- D. NEC compliant.
- E. FCC compliant.
- F. ETLC listed to CSA 22.2 #207.

1.7 WARRANTY

- A. Provide 5 years of no cost parts exchange including standard shipping on electronics parts and radios due to manufacturing defects.
- B. Provide toll-free service coordination.
- C. Provide technical phone support during Daktronics business hours.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Daktronics, Inc., 201 Daktronics Drive, P.O. Box 5128, Brookings, SD 57006-5128.
- B. Or equal.

2.2 SCOREBOARD

- A. Daktronics FB-2021 single-sided football scoreboard displays period time to 99:59, HOME and GUEST scores to 99, and DOWN/TO GO/BALL ON/QTR (quarter) information. T.O.L. (time outs left) to nine. Arrows indicate possession. During the last minute of the period, the clock displays time to 1/10 of a second.
- B. General information:
 - 1. Dimensions: 8'-0" high, 25'-0" wide, 0'-8" deep.
 - 2. Base weight: 820 lb. with vinyl captions – options may increase weight.
 - 3. Base power requirement: 705 W (white digits) with vinyl captions – options may increase wattage.
 - 4. Color: provide over 150 colors to choose from.
- C. Construction:
 - 1. Alcoa aluminum alloy 5052 for excellent corrosion resistance.
 - 2. Scoreboard back, face, and perimeter: 0.063" thick.
 - 3. Scoreboard top and bottom: 0.125" thick.
- D. Digits & Indicators:
 - 1. LED color:
 - a. Game information digits White.
 - b. Team information digits White.
 - 2. Clock digits: 30" high.
 - 3. HOME, GUEST, DOWN, TO GO, BALL ON, and QTR digits: 24" high.
 - 4. T.O.L. (time outs left) to nine.
 - 5. Seven bar segments per digit.
 - 1. PanaView® LED digit technology.
 - 6. All digits and indicators are sealed front and back with weather-tight silicone gel.
- E. Captions:
 - 1. Vinyl applied directly to scoreboard face.
 - 2. HOME and GUEST captions: 15" high.
 - 3. DOWN, TO GO, BALL ON, and QTR captions: 12" high.
 - 4. Color: standard white or others available upon request.

F. Accessory Equipment Required:

1. Back of the scoreboard to be painted the same color as the front.
2. Soccer captions on changeable panels.
3. Standalone Time of Day (scoreboard acts as a clock when control console is unplugged/off).
4. Horn.
5. Border stripe around perimeter of scoreboard.

2.3 SCORING CONSOLE

- A. Console is an All Sport® 5000 controller.
- B. Scores multiple sports using changeable keyboard inserts.
- C. Controls multiple scoreboards and displays, including other All Sport 5000 controlled displays currently owned by customer.
- D. Recalls clock, score, and period information if power is lost.
- E. Console capable of automatically calculating and displaying DOWN & TO GO for each play.
- F. Runs Time of Day and Segment Timer modes.
- G. Console includes:
 1. Rugged aluminum enclosure to house electronics.
 2. Sealed membrane water-resistant keyboard.
 3. 32-character LCD to verify entries and recall information currently displayed.
 4. Power cord that plugs into a standard grounded outlet; 6 watts max.
 5. Control cable to connect to the control receptacle junction box (wired system only).
 6. Hand-held switch for main clock start/stop and horn.
 7. Soft-sided carrying case.
- H. Accessory Equipment Required: 2.4 GHz spread spectrum radio system with frequency hopping technology and 64 non-interfering channels; system includes a transmitter installed inside the console and a receiver installed inside the scoreboard(s).
 1. Hard carrying case.
 2. Battery pack.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that mounting structure is ready to receive scoreboard. Verify that placement of conduit and junction boxes are as specified and indicated in plans and shop drawings. Verify concrete has cured adequately according to specifications.

3.2 INSTALLATION

- A. All power and control cables to scoreboards and displays will be routed in conduit. Power to the scoreboards/displays as well as raceways shown on electrical plans by the Electrical Contractor. Scoreboard control wiring including conduit will be the responsibility of the contractor assigned the scoreboard equipment.
- B. Install scoreboards and exterior displays to beams in location detailed and in accordance with manufacturer's instructions. Verify unit is plumb and level.

3.3 INSTALLATION—CONTROL CENTER

- A. Provide boxes, cover plates and jacks in locations per plans.

- B. Test connect control unit to all jacks and check for proper operation of control unit, scoreboard, and all features. Leave control unit in carrying case and other loose accessories with owner's designated representative.
- C. Verify earth ground does not exceed 15 ohms.

END OF SECTION

DIVISION 12

FURNISHINGS

SECTION 12 36 16

STAINLESS-STEEL COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Stainless-steel countertops.
 - 2. Stainless -steel counters at service windows.
- B. Setting materials and accessories.
- C. Related requirements:
 - 1. Section 05 50 00 for metal supports.

1.2 REFERENCES

- A. Woodwork Institute's "North American Architectural Woodwork Standards Section 11, "Premium Grade."

1.3 SUBMITTALS

- A. Data: Manufacturer Product Data for specified products.
- B. Shop drawings:
 - 1. Indicate materials, fabrication details, field jointing, adjacent construction and methods of support, integration of plumbing components and anchorages.
 - 2. Show joint locations; locations are subject to the Architect's relocation at no additional to the Owner.
 - 3. Show position of openings, with rough-in sizes. Provide templates for cast-in or placed frames or anchors, tolerances for item placement and temporary bracing of components.
- C. Samples: 6-inch square Samples representative of color, texture and finish to be expected for final product, with a finished edge.
- D. Manufacturer certificate: Certification that polymer meet or exceed specified requirements for stain resistance.

1.4 QUALITY ASSURANCE

- A. Fabricator qualifications: Firm specializing in manufacturing the products specified in this Section with minimum 3 years documented successful experience.
- B. Flammability and toxicity: Conform to applicable code for flame/smoke rating in accordance with ASTM E 84.
- C. Sample Panel:
 - 1. Construct countertop sample panel 3-feet wide, full depth, with splash and skirt.
 - 2. Include a seam.
 - 3. Approved sample panel shall be maintained undamaged until project close-out. Dispose of upon Substantial Completion.

1.5 HANDLING

- A. Store properly supported and off the floor as required by manufacturer.

1.6 WARRANTY

- A. Provide manufacturer's 10-year warranty against defects including cracking, softening and discoloration of the countertops.

1.7 MAINTENANCE

- A. Furnish list of approved cleaning materials and procedure required and provide list of substances that are harmful to product. Include instructions for stain removal, surface and gloss restoration and scratch removal.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

2.2 STAINLESS STEEL COUNTERTOPS

- A. Substrate: 23/32-inch CDX plywood, see Section 06 10 53.
- B. Countertops: Fabricate from 0.062-inch-thick, stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and end overhang of 1 inch over the base cabinets.
 - 1. Joints: Fabricate countertops [without field-made joints][in sections for joining in field, with joints at locations indicated].
 - 2. Weld shop-made joints.
 - 3. Sound deaden the undersurface with heavy-build mastic coating.
 - 4. Extend the top down to provide a 1-inch-thick edge with a 1/2-inch return flange.
 - 5. Form the backsplash coved to and integral with top surface, with a 1/2-inch-thick top edge and 1/2-inch return flange.
 - 6. Provide raised (marine) edge around perimeter of tops containing sinks; pitch tops containing sinks two ways to provide drainage without channeling or grooving.
 - 7. Where stainless-steel sinks occur in stainless-steel tops, factory weld into one integral unit.

2.3 WALL-MOUNTED SHELVES

- A. Fabricate from stainless-steel sheet, not less than 0.050-inch nominal thickness. Weld shop-made joints. Fold down the front edge a minimum of 3/4 inch ; fold up the back edge a minimum of 3 inches . Provide integral stiffening brackets, formed by folding up ends a minimum of 3/4 inch and by welding to upturned front and back edges.

2.4 STAINLESS-STEEL FINISH

- A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 satin brushed finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

2.5 SEALANTS

- A. Mildew-Resistant Joint Sealant: Mildew resistant, single component, non-sag, neutral curing, silicone. See Section 07 62 00.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and measurements affecting the work of this Section at site.
- B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

- A. Install components in compliance with the approved Shop Drawings, the reference standard, and the polymer manufacturer's instructions, plumb, level, with tight, flush joints.
- B. Install plumb and level, with tight, hairline, flush joints. Shim as required using concealed shims.
- C. Anchor securely to supports into underside of countertop.
- D. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
- E. Scribe and fit accurately where they abut adjacent surfaces for a close fit.
 - 1. Fill space between countertops and walls with sealant; comply with the requirements of Section 07 92 00.
 - 2. Tool sealant uniformly to form a cove and shed water.
- F. Install countertops with no more than 1/8-inch in 96-inch sag, bow, or other variation from a straight line.
- G. Wall-Mounted Shelves: Fasten to masonry, partition framing, blocking, or reinforcements in partitions. Fasten each shelf through upturned back edge at not less than 24 inches o.c.

3.3 CLEANING/PROTECTING

- A. Clean and polish fabrications in compliance with the polymer manufacturer's instructions.
- B. Protect finished work from damage by covering with heavy Kraft paper until final cleaning.

END OF SECTION

DIVISION 13

SPECIAL CONSTRUCTION

SECTION 13 34 16

PERMANENT GRANDSTANDS AND PRESS BOX

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

- A. Provide labor, material, equipment and supervision necessary to complete installation of permanent steel grandstand, including the following:
 - 1. Steel Substructure
 - 2. Decking System
 - 3. Concrete Foundation
 - 4. Press Box Support Structure
 - 5. Press Box

1.2 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturers must have ten years of experience in the manufacture of bleachers and grandstands; manufacturer must exhibit proof of business existence for past five years with documentation; welders must be AWS certified.
- B. Installer Qualifications: Experienced in the proper installation of grandstands.
- C. Source Quality Control: Mill Test Certification.

1.3 SUBMITTALS

- A. Manufacturer's Product Data: Submit manufacturer's descriptive product data for project.
- B. Shop Drawings: Manufacturer to submit shop drawings sealed by a California registered engineer and shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the applicable code and relevant laws.
- C. Product Sample: Submit one 18-inch seat sample.
- D. Color Sample: If applicable, submit sample.

1.4 SITE CONDITIONS

- A. Field Site:
 - 1. Owner to make site accessible.
 - 2. Owner to verify site locations, benchmarks.
- B. Underground Utility Line: Owner to clearly mark all underground utilities and obstructions and Owner to relocate all that conflict with grandstand.
- C. Soil Test: Furnished by Owner.

1.5 BUILDING CODES

- A. Must meet or exceed all State and Local applicable codes and in compliance with the California Building Code, Title 24 and ICC 300.

1.6 WARRANTY

- A. Permanent Grandstand shall be under warranty for a period of one (1) year beginning at date of substantial completion for projects installed by manufacturer. The warranty will provide for repair or replacement of failed components due to defect in materials and workmanship of installation for the specified period. This warranty excludes any other defects resulting from

abnormal use in service, vandalism, weathering, oxidation, accidental or intentional damage or any occurrences beyond manufacturer's control.

1.7 MAINTENANCE

- A. Owner is to conduct annual inspection and required maintenance of grandstand to assure safe conditions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis of Design: Southern Bleacher Co. (800) 433-0912 Horizontal Beam Design.
 - 1. Alternate manufacturers seeking to be approved to bid must submit product literature and references (with contact names/numbers) to the Owner/architect, 14 days prior to bid date, for five similar size DSA approved projects completed within the past two years.
 - 2. Alternate manufacturers seeking to bid the project must submit their own schematic design drawings (plan and elevation) to the architect, 7 days prior to bid to ensure compliance with project design.
 - 3. Alternate manufacturers are responsible for the cost for review, submission, and approval of their submittal drawings and engineering calculations by both the Architect and DSA.
 - 4. No time extensions to the schedule will be granted awaiting DSA approval of submittals, and liquidated damages apply.

2.2 PERMANENT STEEL GRANDSTAND

- A. Product Description
 - 1. Horizontal Beam Design
 - a. Home:
 - 1) Gross seating capacity of 6,200, net seating capacity of 5,035 plus 47 wheelchair spaces, 31 rows, and 300' long
 - 2) Box Support Structure: 48" x 8', plus elevator landing deck
 - 3) Prefabricated Press Box: 36' x 8'.
 - b. Visitors:
 - 1) Gross seating capacity of 3,600 net seating capacity of 3,031 plus 32 wheel chair spaces, 18 rows, and 300' long.
 - 2. Vertical columns are placed 18 feet on center laterally. As required on center front to back on both home and visitor stands.
 - 3. Horizontal beams are wide flange beams.
 - 4. Traverse bays are free of cross-bracing the total length of the grandstand.
 - 5. Stringers are wide flange with steel angle rise and depth fabrication and are placed 6 feet on center.
 - 6. Front Walkway:
 - a. Width: 11' 2" on home side and 7' 6" on visitor side.
 - b. Elevated: 6' 0" on home and visitor side above grade at the benchmark.
 - 7. Entry stairs to be firmly anchored to uniformly poured concrete bases.
 - a. Stair rise: 7 inches with aluminum closure and contrasting aluminum stair nose.
 - b. Stair tread depths: 11 inches.
 - c. Guardrails: As required by code.
 - d. Stairs to have handrail extension. The handgrip portion of handrails shall not be less than 1 1/2 inches or more than 2 inches in cross sectional dimension or the shape shall provide an equivalent gripping surface. The handgrip portion of handrails shall have a smooth surface with no sharp corners. The top of handrails

and handrail extensions shall be placed not less than 34 inches or more than 38 inches above the nosing of treads and landings. Where handrails are not continuous between flights, the handrails shall extend horizontally at least 12 inches beyond the top riser and continue to slope for the depth of one tread beyond the bottom riser. Ends shall be returned or shall terminate in newel posts or safety terminals.

8. Aisles:

- a. Aisles with seating on both sides to have discontinuous mid-aisle handrails. The handrails shall be discontinuous with breaks at intervals not to exceed five rows. These breaks shall have a clear width of at least 22 inches and not greater than 36 inches horizontally.
- b. Anodized aluminum handrails with rounded ends to be provided with an intermediate handrail below the main handrail.
- c. Aluminum tread nosing of contrasting color on aisle steps.
- d. Half-steps shall be provided for riser heights above 8 inches.
- e. Half-steps shall provide equal rise and run throughout aisle. Each shall have aisle nosing with non-skid black powder coated finish or other paint system meeting AAMA 603.8-92 specifications with a hardness rating of 2H and riser closure with clear anodized finish.
- f. Aisles with a riser height of non-uniformity shall be indicated with distinctive markings as required by code.

9. Decking:

- a. Rise per row 8" and 14" with tread depth of 26".
- b. Each seat 17 inches above its respective tread.
- c. Mill Aluminum Decking Arrangement
 - 1) Interlocking
- d. Seating Selection
 - 1) Anodized Aluminum Bench Seat
 - a) 2 x 10 (standard), Die #7758 with height of 1 1/2".

10. Guard railing: To be at all sides of bleacher, entry stairs and ramps, portals, and landings. Railing to be anodized aluminum with end plugs at ends of straight runs and/or elbows at corner. All guardrails shall be secured to angle rail risers by galvanized fasteners. Railing shall be at heights as required by code for its location on the grandstand. Guard railing shall include intermediate railing, or galvanized chain link fencing fastened in place with galvanized fasteners and aluminum ties.

11. Ramps:

- a. Slope: 1 in 12.5.
- b. Guardrails: As required by code plus toe board.
- c. Handrail: Ramps to have handrail extension. The handgrip portion of handrails shall not be less than 1 1/2 inches or more than 2 inches in cross sectional dimension or the shape shall provide an equivalent gripping surface. The handgrip portion of handrails shall have a smooth surface with no sharp corners. The top of handrails and handrail extensions shall be placed not less than 34 inches or more than 38 inches above the ramp surface. Where handrails are not continuous between runs, the handrail shall extend horizontally above the landing 12 inches minimum beyond the top and bottom ramps. Ends shall be returned or shall terminate in newel posts or safety terminals.

12. Handicap provision:

- a. Quantity of wheelchair spaces: 47 on home stand and 32 on visitor stand.
- b. Riser area adjacent to wheelchair spaces to have closed intermediate construction.

13. Clear anodized aluminum riser board façade at front of stand, behind elevated walkway, and at exposed facias of ramps and stair units.

B. Materials/Finishes

1. Substructures: Structural shapes meet one of the following ASTM specifications: A36, A36/A572 grade 50, A572 grade 50, A529-50, or A500 grade B.
 - a. Shop connections are seal welds.
 - b. After fabrication, all steel is hot-dipped galvanized to ASTM-A-123 specifications.
 - c. Painted steel finish is unacceptable.
2. Extruded Aluminum:
 - a. Seat Planks, Backrests, Stanchions, Riser Planks, and Railing are extruded aluminum alloy, 6063-T6.
 - 1) Clear anodized 204R1, AA-M10C22A31, Class II finish
 - b. Tread planks are extruded aluminum alloy 6063-T6 mill finish.
 - c. Railing: Extruded aluminum alloy, 6063-T6 clear anodized 204R1, AA-M10C22A31, Class II.
3. Accessories:
 - a. Channel End Caps: Aluminum alloy 6063 T6, clear anodized 204R1, AA M10C22A31, Class II.
 - b. Hardware:
 - 1) Bolts, Nuts: Hot dipped galvanized or mechanically galvanized.
 - 2) Hold down Clip Assembly: Aluminum alloy 6005A T6, mill finish.
 - 3) Structural Hardware: Equal to or greater than hot dipped galvanized ASTM A307. No connections utilizing high strength bolts are classed as slip critical.
 - c. Aisle Nose and Stair Nose: Aluminum alloy, 6063-T6, non-skid black powder coated finish or other paint system meeting AAMA 603.8-92 specifications with a hardness rating of 2H.

C. Fabrication:

1. Design Load:
 - a. Tread and Seat Area: 100 psf uniform live load.
 - b. Seat (Vertical): 120 lbs/lf.
 - c. Seat (Horizontal Sway): 24 lbs/lf parallel and 10 lbs/lf perpendicular to seat.
 - d. Handrail and Guardrail: 50 lbs/lf in any direction.
 - e. Handrail and Guardrail: 200 lbs concentrated in any direction.
 - f. Snow Loads: As per State adopted code.
 - g. Wind Loads: As per State adopted code.
 - h. Seismic Loads: As per State adopted code.
2. All manufactured connections to be shop welded.
 - a. Manufactured by certified welders conforming to AWS Standards.

2.3 PRESS BOX WITH METAL STRUCTURE

A. Product Description: Type II Construction:

1. Press Box Support Structure: Integrated in to to rear of grandstand. Support Structure to be 48 feet wide x 8 feet deep.
2. Press Box Dimensions: 36 feet wide x 8 feet long.
3. Filming Area/Observation Deck located on Press Box roof.
4. Press Box to be of open construction, allowing inspection of electrical wiring, switches, and other components without destructive disassembly.

B. Materials/Finishes

1. Press Box Support Structure:

- a. Structural shapes meet one of the following ASTM specifications: A36, A36/A572 grade 50, A572 grade 50, A529-50, or A500 grade B.
- b. Shop connections are seal welds.
- c. After fabrication, all steel is hot-dipped galvanized to ASTM-A-123 specifications.

2. Press Box: All materials shall be new and shall comply with ASTM specifications.

a. Floor

- 1) Main support to be a galvanized steel floor frame sized to support structure and metal belly pan for support of insulation.
- 2) Floor to be INTERLOCK Aluminum Decking System, extruded aluminum alloy 6063-T6, mill finish. Attach Decking System to steel floor frame with mechanical fasteners at end of plank and at intermediate supports. (Tongue & Groove or Standard extrusion is not acceptable.)
- 3) Insulation: Poly-encapsulated Formaldehyde-free fiberglass building insulation R-13, 3 1/2 inches thick. Batt or roll as manufactured by Johns Manville, or equal.

b. Wall Structure

- 1) 4 inch x 4 inch x 11 gauge square tubing with maximum span of 14 feet on front wall and maximum span of 6 feet on back wall and 4 inch x 2 1/2 inch x 14 gauge steel "cees" with maximum spacing of 5 feet for all walls with siding. Spans greater than these require engineered calculations for design.
 - a) Steel framing shapes to meet one of the following ASTM's, A500 Grade A or B 45 ksi, A36 50ksi, A1011 CS Type B.
- 2) Insulation: Poly-encapsulated Formaldehyde-free fiberglass building insulation R-13, 3 1/2 inches thick. Batt or roll as manufactured by Johns Manville or equal.
- 3) Interior Finish
 - a) 1/2 or 5/8 inch vinyl coated gypsum panels (as required), Gold Bond vinyl-surfaced Durasan.
 - b) Cove Base: Vinyl 4 inches x .080.
- 4) Exterior Finish
 - a) 26-gauge prefinished R-Panel paneling as manufactured by MBCI, Signature 200 color series, or equal.
 - b) Wall panels are attached with #12 TEK screws - 6" O.C. at the top, midpoint and bottom of the panels.
 - c) Lap screws are placed at each end of the panels, at the intermediate supports, and at the mid point between supports (TEK #14).
 - d) All fasteners to be painted same color as exterior paneling.

c. Roof Structure

- 1) 4 inch x 4 inch x 11 gauge square tubing with maximum spacing of 6 feet on center and 4 inches x 2 1/2 inches x 14 gauge steel "cees" with maximum spacing of 2 feet on center.
- 2) Roof: 1/8 inch four way steel plate roof, continuous welded seams coated with acrylic metal primer as manufactured by Coronado and 36 mils of acrylink roof coating as manufactured by Isothermal Protective Coatings, or equal. Plate is welded on both sides of rafters with 1-1/2 inch long 1/8 inch fillet welds on 12 inch centers.

- 3) Insulation: Poly-encapsulated Formaldehyde-free fiberglass building insulation, R-19 (minimum) 6 inches thick. Batt or roll as manufactured by Johns Manville or equal.
 - 4) Cornice: 26 gauge steel prefinished to match metal siding.
 - 5) Ceiling: 24 inch x 24 inch x 5/8 inch acoustical lay in ceiling tile with removable tiles, per 2006 IBC or local code, applicable category per seismic zone, (in California per 2007 CBC, applicable category per seismic zone, ref. DSA IR 25-5).
- d. Exterior Door(s)
- 1) Full flush steel construction with hollow or polystyrene core. 18-gauge skin sheets. Dimensions: 3 feet 0 inches x 7 feet 0 inches. Color: Coordinated with press box siding color.
 - 2) Steel door frame (16 gauge) complete with 1/2 inch threshold and weather-stripping.
 - 3) Exterior Hardware: Per project door hardware schedule and SECTION 08 71 00 - Door Hardware.
 - 4) Interior Hardware: Per project door hardware schedule and SECTION 08 71 00- Door Hardware
- e. Interior Doors
- 1) Interior Hollow Core Birch Unit. Dimensions: 3 feet 0 inches x 7 feet 0 inches.
 - 2) Hardware: Handles shall be lever type that allows operation without tight grasping or twisting of the wrist.
- f. Interior Walls
- 1) Framing to be steel galvanized studs (25 gauge) 1 1/4 inch x 3 5/8 inch or 4 inch at maximum 2 feet on center.
 - 2) Finishes are to be consistent with all other interior finishes.
- g. Windows
- 1) Frame: Extruded aluminum single hung, vertical sliding unit, thermal break.
 - 2) Sash: Tilt toward inside for easy cleaning.
 - 3) Glazing: Clear tempered panes.
 - 4) Dimensions of each unit: Dependent on compartment size. At interior wall locations or structural support locations the dimension between windows shall be no greater than 6 inches.
 - 5) Finish: Electrostatically applied acrylic enamel.
- h. Work Bench
- 1) 1 inch thick x 21 inch wide clear anodized aluminum work bench supported by 4 inch x 2 1/2 inch x 14 gauge steel. Countertops heights shall be constructed to allow wheelchair usage at all locations.
- i. Caulking: Sonneborn NP1 - Polyurethane sealant, all temperature, UV resistant, or equal. Silicone products are not acceptable.
- j. Electrical
- 1) Submittal drawing shall indicate devices and circuitry.
 - 2) Fixtures: Low Profile lay-in LED fixtures. Fixtures shall be located above countertop and be maximized to full length of compartment space.
 - 3) Wiring to be in EMT, flexible metal conduit or surface raceway. N.E.C. breaker panel to be 100 amp flush or surface mounted on wall with 1 1/4 inch conduit stubbed out bottom of press box or 2 inch rigid conduit to be stubbed out at back wall of press box ready for service line to be connected. (Service line to Press Box is responsibility of Owner).

- 4) Electrical outlet(s) installed per NEC shall be standard duty. All outlets shall be surface or flush mounted.
 - 5) Sound, Telephone, Clock, and Field Communication: Empty single or double outlet boxes (as required) per N.E.C. with 3/4 inch conduit stubbed out bottom of Press Box for use of Owner. Outlet boxes to be flush mounted into wall. Any wiring completed on-site will be responsibility of such contractor for inspections. A quantity of two will be provided. Owner shall indicate additional boxes needed.
 - 6) Filming Area/Observation Deck: Weathertight outlet box for cameras. Quantity: One. Owner shall indicate additional outlets needed.
- k. Filming Area/Observation Deck
- 1) Access
 - a) Interior: Roof hatch with OSHA-rated aluminum ladder mounted to an interior back wall.
 - 2) Roof guard railing to be 42" above walking surface around perimeter of deck attached to 5/8 inch galvanized studs to be welded to roof support structure. The guard railing to include anodized aluminum vertical picket system.

I. Coiling Shutters at Windows

1) General:

a) Summary:

- 1) All Aluminum Roofing Counter Doors shall be Series CD8 Crank-up as manufactured by The Cookson Company, Phoenix, Arizona. Furnished materials shall include all curtains, bottom bars, guides, brackets, hoods, operating mechanisms and any special features.
- 2) Work not to be included by The Cookson Company includes design of, material for and preparation of door openings but not limited to structural or miscellaneous iron work, metal or wood trim, access panels, and finish painting.

b) Quality Assurance:

- 1) All rolling counter doors shall be designed to a standard maximum of 10 cycles per day and an overall maximum of 20,000 operating cycles for the life of the door.

2) Products:

a) Materials:

- 1) The door curtain shall be constructed of interconnected .050 extruded aluminum No. 8 (1-5/16" high by 3/8" deep) slats as designated by The Cookson Company. The curtain shall receive a 204-R1 clear anodized finish.
- 2) The bottom bar shall be constructed of tubular extruded aluminum measuring 1-5/16" deep by 2-1/4" high with double vinyl astragal on the bottom edge. The bottom bar shall receive a 204-R1 clear anodized finish.
- 3) The guides shall be constructed of extruded aluminum and measures 1-3/4" square. Each side of the channel portion capturing the curtain shall contain wool pile weatherstripping. The guides shall receive a 204-R1 clear anodized finish.
- 4) The brackets shall be constructed of 3/16" thick die cast aluminum.

5) The barrel shall be steel tubing of not less than 4" in diameter. Oil tempered torsion springs shall be capable of correctly counter balancing the width of the curtain. The barrel shall be designed to limit the maximum deflection to .03" per foot of opening width. The barrel shall receive one (1) coat of bronze rust- inhibiting prime paint.

6) The hood shall be fabricated from .040 aluminum and shall be formed to fit the square brackets. The hood shall receive a 204-R1 clear anodized finish.

b) Operation: Push-up operated doors shall open and close with a maximum of 30 pounds of effort utilizing finger lifts in the bottom bar. This type of operation should not be used for doors over 12 feet wide.

c) Locking Mechanism: The push-up doors shall be secured by means of a concealed sliding bolt deadlock in the bottom bar operated by a cylinder lock.

3. Execution:

a. Installation: All Cookson Rolling Aluminum Counter Doors shall be installed by an authorized Cookson Distributor.

b. Crank Up Operation

C. The Press Box shall be under warranty for a period of one year beginning at date of substantial completion for projects installed by manufacturer. The press box is warranted to be free from defect in materials and workmanship in the course of manufacture. This warranty excludes any other defects resulting from abnormal use in service, accidental or intentional damage or any occurrences beyond manufacturer's control.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All work performed by technicians experienced in bleacher seating installation.
- B. Project as per approved shop drawings.

3.2 FIELD QUALITY CONTROL

- A. Foundation: Footings for the grandstand shall provide sufficient bearing area at bottom to support all loads of the grandstand. Depth and design of footings shall be determined by Owner supplied soil test. Hot-dipped galvanized anchor bolts shall be secured in the concrete footings. Concrete shall attain working strength of 3,000 psi.

3.3 CLEAN UP

- A. Clean up all debris caused by work of this section.
- B. The Owner, Architect and Contractor acknowledge and accept that mill finish aluminum as specified will have water stains present from transportation and storage during installation. Removal of these stains is not part of this contract.
- C. Stand to be broom cleaned at completion.

END OF SECTION

DIVISION 21

FIRE SUPPRESSION

SECTION 21 13 13

FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Fire sprinkler systems for protection of buildings V and W.
- B. Related requirements: The requirements of this Section, NFPA 13 shall take precedence over requirements found in the following:
 - 1. Division 01 - General Requirements.
 - 2. Section 07 92 00: Joint Sealants
 - 3. Section 10 44 13: Fire Extinguishers and Cabinets
 - 4. Section 22 05 00: Basic Plumbing Materials and Methods.
 - 5. Section 22 05 53: Plumbing Identification.
 - 6. Section 26 05 00: Common Work Results for Electrical.
 - 7. Section 28 31 00: Fire Detection and Alarm.
 - 8. Section 31 23 16: Trenching.
 - 9. Section 33 11 00: Water Distribution.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Field verification: Verify actual locations of supports.

1.3 SUBMITTALS

- A. Product data, showing the following:
 - 1. Submit complete and detailed equipment and material list of items to be furnished and installed under this section.
 - 2. Submit manufacturer's specifications and other data required to demonstrate compliance the plans and specified requirements.
- B. Drawings:
 - 1. Submit shop drawings of wet pipe fire protection sprinkler system in compliance to CBC / CFC Chapter 9, NFPA 13 2013, Standard for the Installation of Sprinkler Systems, Sprinkler systems shall comply with the provisions of CBC, CFC, and NFPA 13.
 - 2. Shop drawings shall fully comply with the most stringent provisions of this specification and plans, and with the applicable codes and standards.
- C. Regulatory Requirements:
 - 1. Installation of fire sprinkler system shall not vary from the plans unless alterations have been approved by the State Fire Marshal at DSA.

2. Complete DSA standard testing forms and get sign-off by the Project Inspector.

D. Closeout Submittals: Submit in accordance to Section 01 79 00 and as specified herein:

1. Record Drawings:

- a. Record drawings of installed Work shall be maintained current on the Project site for a minimum of 5 years available for Fire Marshal and the Project Inspector to review per Title 19; CFC 901.6.2.
- b. At completion of installation submit Record Drawings signed by installing Contractor in AutoCad format, including:
 - 1) Record Specifications.
 - 2) Record Product Data: Include specific model, type and size for equipment and material installed.
 - 3) Record Test Results.
 - 4) Maintenance Manuals.

1.4 QUALITY ASSURANCE

- A. Comply with applicable California, national, or local codes and standards.
- B. Except where exceeded by the requirements of these specifications, the following are made part of this section: prints and details, and provisions of the NFPA 13 Standard for Installation of Sprinkler Systems and NFPA 14 Standard for the Installation of Standpipes and Hose Systems.
- C. Qualifications of Manufacturer: Products used in work of this section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a 5 year history of successful production that is acceptable to the Architect.
- D. Qualifications of Installer: Installer shall have a current C-16 license in the State of California in the installation of fire sprinkler systems.

1.5 EXTRA MATERIALS FOR MAINTENANCE

- A. Provide spare sprinkler heads in quantity equal to 2 percent of total number of each type of sprinkler head installed. There shall be no less than two heads of each type and temperature rating provided, and in no case less than six spare sprinkler heads per building. There shall be no fewer than 6 spare sprinkler heads for up to 300 sprinkler heads installed; no less than 12 spare sprinkler heads for up to 1,000 sprinkler heads installed; and no less than 24 spare sprinkler heads for the sites with more than 1,000 sprinkler heads installed. Spare sprinkler heads shall be kept inside of spare sprinkler head box(s). A spare sprinkler wrench for each type of sprinkler head shall also be provided inside of each spare sprinkler head box, at each building. Locations of spare sprinkler boxes shall be located at:
 1. Fire Sprinkler Riser, when enclosed and secure.
 2. Plant Manager's Office, when Fire Sprinkler Riser is exposed.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION SYSTEM DESCRIPTION

- A. General: Provide systems complete including, but not limited to Limited Protection Areas as noted on Fire Sprinkler Drawngs:

1. Materials and equipment shall be UL/FM listed and approved as required by NFPA for their application. Required signage shall be provided and installed as required by NFPA 13. Provide overhead sprinkler system with sprinklers installed as required according to type, location and temperature rating.

B. Sprinkler Heads:

1. Provide concealed pendant spray type sprinkler heads with matching escutcheons in areas with finished ceilings. Exterior escutcheons shall be poly-coated type to prevent rusting and oxidation.
2. Provide upright sprinklers in areas with exposed piping and as referenced in drawings.
3. Provide poly-coated glass bulb corrosion resistance type sprinklers heads in areas exposed to a corrosive environment such as parking garages and coastal air.
4. Sprinklers shall be quick response, glass bulb type, with hex-shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation.
5. Sprinklers in concealed spaces, exterior locations, and other areas that will experience over 100 degrees F ambient temperature shall be furnished with 200 to 225 degree rated sprinklers. Sprinkler heads in other locations, unless otherwise noted, shall be 155 to 165 degrees F rated.
6. Automatic fire sprinkler head type shall be as follows:
 - a. In areas with ceiling heights of nine-feet or lower, sprinkler heads installed shall be recessed or fully concealed.
 - b. Ceilings eight-feet or lower shall be provided with fully concealed sprinkler heads (where possible).
 - c. Areas with ceiling height of nine-feet or lower, that are not constantly supervised such as corridors, arcades, students restrooms, and other restrooms shall be provided with fully concealed sprinkler heads (where possible).
7. Sprinkler heads in light hazard occupancies are required to be Quick Response sprinklers as required in NFPA 13. Sprinkler heads shall be of the same manufacturer throughout the building/site as indicated. Sprinklers shall typically be ½ inches NPT, standard orifice, minimum 5.6 nominal K factor, UL listed for 175 psi, and listed for light and ordinary hazard occupancies.
8. Other specialized sprinkler heads such as walk-in refrigerator or freezer heads, side wall, ¾ inches sprinklers above 5.6 K factor, and those sprinklers with a K factor below 5.6, shall only be used where required by project condition. Large drop sprinkler heads and extended coverage sprinkler heads shall not be installed.
9. Sprinkler head location shall be designed and installed in an aesthetically pleasing manner and should generally be located in center of 24-inch by 24-inch ceiling tiles and in center of 24-inch by 48-inch ceiling tiles in the 24-inch direction and no closer than 12-inch from the edge in the 48-inch direction.
10. UL/FM listed Sprinkler head guards shall be provided on Sprinkler heads installed at seven feet six inches above floor or lower in exposed locations, or that are deemed subject to damage. Guards shall also be provided on upright and sidewall heads where sprinklers are installed at seven feet six-inch heights or lower.

C. Fire Sprinkler Systems:

1. Underground piping: Comply with the requirements of Section 33 11 00, Water Distribution.

2. Fire Department Connection (FDC) with check valve shall be provided after the backflow preventor, and before the building fire sprinkler riser(s), located where the FDC will be accessible to the fire department from the street or sidewalk without obstructions. FDCs shall have a height between two and four-foot above the ground. There shall be a clear working space maintained. A metal sign with raised letter at least 1" in size shall be to FDC and shall read: FIRE DEPT. CONN. AUTOMATIC SPRINKLERS.
3. PIVs shall be electrically supervised regardless the number of fire sprinkler served (CBC 903.4), and set at a height of three feet to the top and have the handle locked in place with a break-a-way lock.
4. Flow indicator shall activate the fire alarm system between 45 and 90 seconds, and activate a local alarm on the outside of the building continuously with water flow. Connection of this switch is a part of the Work of Division 26. Shut-off including valves on the fire main backflow preventor shall be electrically supervised according to CBC 903.4., NFPA 13 and Section 28 31 00 – "Fire Detection and Alarm".
5. Furnish and install required signs, spare heads, special wrenches, and spare sprinkler head boxes as required to satisfy NFPA 13, NFPA 14 and this specification.
6. Sprinkler system piping shall be provided with complete drainage as required by NFPA. Test valve discharge shall be piped away from egress routes and planters to asphalt areas. Furnish protection of piping against accidental or malicious damage.
7. Upon completion of the Work of this section, and before Substantial Completion, subject system, including underground supply connection, to tests required. A minimum hydrostatic test shall be two hundred pounds (200 psi) or fifty pounds (50 psi) in excess of the maximum system working pressure, whichever is greater, for two hours with no leaks or loss of pressure per NFPA 13 and NFPA 24. The Project Inspector shall be furnished with a NFPA 13 and NFPA 24 test certification.
8. Hanging, bracing and support shall utilize only UL/FM listed approved products, and comply with NFPA 13, Chapter 9 requirements for rod and bolt sizes. Hanger rods in exterior locations and in parking structures shall have Electrodeposited Zinc Coating per ASTM B633 to prevent rusting.
9. Building Fire Sprinkler riser assemblies shall be provided as follows. Every building shall be provided with an accessible and electrically supervised riser shut off valve at a height not to exceed five-feet above the floor. Every building riser assembly shall be equipped with a check valve followed by a main drain valve and then the flow indicating switch and pressure gauge immediately after the shut-off valve. In cases where a riser assembly is provided for each floor in the building, a check valve, main drain and flow switch shall be provided for each floor; the main building shut-off shall not be required. An electrically supervised Post Indicator Valve located outside the building may serve as the building riser shut-off valve.

2.2 MATERIALS

A. Automatic Fire Sprinkler Head, UL/FM listed:

AFSH-1	Brass pendant type for areas with suspended ceilings:			
Victaulic	Tyco	Viking	Reliable	Or equal
V27	TY 3231	VK302	F1FR56	

AFSH-2	Brass upright type for areas with no ceilings:			
Victaulic	Tyco	Viking	Reliable	Or equal
V27	TY3131	VK300	F1FR56	

AFSH-3	Fully concealed type sprinklers; white cover			
Victaulic	Tyco	Viking	Reliable	Or equal
V38	TY3531	VK462	G556	

B. Backflow Prevention Assembly:

Ames model Deringer 20GX or equal.

C. Check Valves:

CV-1 Iron check valves: 2-1/2 inches and larger, class 175, composition disc, swing type, bolted cap, UL listed, FM approved flanged ends:

Stockham	Kennedy	Tyco	Clow	Or Equal
G-940	126	Model G	F5380	

CV-2 Grooved Check valve 2 1/2 inch and larger

United	Gruvlock	Reliable	Victaulic	Tyco	Or equal
67	7800	Mode "G"	Series717	590F	

D. Outside Stem and Yoke Valves:

2 1/2-inch and larger, epoxy coated, resilient wedge, 175 pounds gate valve for riser valves, P.I.V., and shut off

Clow	Nibco	Kennedy	Mueller	Or equal
F-6136	617-0	KV-4068	A-2360	

E. Fire Sprinkler Pipes:

Fire sprinkler pipe: 1 inch through 2-inch, Schedule 40, black or galvanized steel meeting ASTM Standards A53, A135, or A795. 2 1/2 inch through 8-inch, Schedule 10, black or galvanized steel meeting ASTM Standards A53, A135, or A795. Corrosion Resistance Ratio (CRR) shall be 1.00 or greater.

- Piping 2 inches and smaller shall have threaded joints and fittings Groove coupler connections on pipe sizes 1 inch through 2 inches are acceptable in accessible areas with required seismic bracing provided. Plain end connections such as "Plainlock" and "FIT" are prohibited.
- For pipe sizes 2 1/2-inch and larger, grooved type, welded and flanged connections may be used.
- Submit Verification from manufacturer stating that piping material furnished meets above criteria; (i.e.: threadable pipe has a UL assigned CRR of 1.00 minimum, that it meets ASTM A53, A135 or A795, and it is UL listed, FM or NFPA approved.)

2.3 ACCESSORIES AND APPURTENANCES

- A. Escutcheons: Polished chrome plated split-ring type for exposed piping at every penetration inside finished rooms
- B. Guards: Provide sprinklers with guards at ceiling at or under seven feet six-inch high and where subject to damage or vandalism.
- C. Miscellaneous: Provide accessories and appurtenances for a complete system

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which Work of this section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel or groove plain end ferrous pipe ends.
- B. Remove scale and foreign matter, from inside and outside of pipes, before assembly.
- C. Provide piping connections to equipment with flanged or grooved connections.

3.3 INSTALLATION

- A. Install FDCs, check valves, shut-off valves, gauges, Inspector's test and drain assemblies and flow indicator. FDC must be installed so that it is unobstructed and accessible for the Fire Department's first response unit.
- B. Install underground supply line connected to detector check or water main indicated. Braced or clamped bends shall be in accordance with requirements of CBC / CFC Chapter 9 and NFPA 24. Provide vertical clamp rods at flange and spigot piece of risers, long enough to pass through riser's base flange where required. Furnish concrete thrust blocks where required. Tracer wire shall be installed as per Section 22 0553: Plumbing Identification on PVC underground piping
- C. Examine areas and conditions under which Work of this section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.
- D. Pipe through floors, wall, and ceilings, at head locations, shall be furnished with required sleeves, and escutcheons and fire caulking where indicated and/or required by code. Escutcheons shall be polished chrome plated unless other finish is selected by the Architect.
- E. Sprinkler system shall be provided with complete drainage facilities in accordance with CBC standards. Drain discharge may discharge into a sewer, storm drain, sump pit or street gutter. Fire sprinkler drains shall not discharge onto a playground or across a sidewalk.
- F. Upon completion of the Work of this section, and before Substantial Completion, subject the entire system, including underground supply connections, to tests as required by NFPA 13, and CBC standards and furnish the Owner with a certificate of compliance as required.
- G. Close nipples are prohibited. Threaded unions are prohibited. Where a threaded union or coupling is needed, a groove type fitting (Victaulic or equal) shall be used instead.
- H. Fire sprinkler systems piping hangers, seismic bracing, anchors and supports shall conform to NFPA 13, CBC and other applicable codes and the requirements of this specification.
- I. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer.

- J. Tee branch outlets on fire sprinkler mains shall be by the use of a threaded ductile iron tee fitting, a groove type tee fitting, (Victaulic or equal), or by the use of a thread-a-let welded on by a certified welder as required by NFPA. Mechanical tee bolted branch outlet fittings are prohibited except for branch outlet sizes 2-inch and smaller.
 - K. Sprinkler lines within the building shall be concealed within the structure. Risers shall be installed in utility, supply rooms or similar service areas whenever possible, and shall not obstruct access, or maintenance of other equipment within the space. Mains and risers shall be located within the area protected by the sprinkler system unless otherwise approved by fire authorities having jurisdiction.
 - L. Sprinklers that have been dropped, damaged, have cracked bulbs, or show a visible loss of fluid shall not be installed.
 - M. Sprinkler bulb protectors shall be removed by hand after sprinkler installation. Tools or other devices to remove the protector that could damage the bulb in any way shall not be used.
 - N. Routing of piping in non-concealed exposed areas shall be subject to the Architect's review in the final shop drawings.
 - O. Underground piping shall have a minimum of 36 inches of cover to grade. Underground pipe shall be installed on a flat not less than 6-inch thick undisturbed sand bed. After required pressure-leak test, pipe shall be covered with sand not less than 6 inches thick, before backfilling. Comply with NFPA Standards. Piping is not allowed to be underground below the building floor slab.
 - P. Provide approved backflow prevention assemblies. Installations of backflow prevention assemblies shall be tested and certified by a certified Los Angeles County backflow prevention device tester prior to Substantial Completion. Tests shall be performed in the presence of the Project Inspector. Test reports shall be turned over to the Project Inspector for mailing to proper agency.
 - Q. Each building with a sprinkler riser shall be furnished with an accessible shut off riser valve installed no higher than five feet from the finish floor. Each floor shall have a separate shut off valve with flow switch, and shall be securely enclosed or secured with a chain and break-a-way lock.
- 3.4 PROTECTION
- A. Protect the Work of this section until Substantial Completion.
- 3.5 CLEANUP
- A. Remove rubbish, debris, and waste materials and legally dispose at off-project site.

END OF SECTION

DIVISION 22

PLUMBING

SECTION 22 05 00

BASIC MATERIALS & METHODS

PART 1 - GENERAL

Division 1 requirements apply to this Section.

1.01 SUMMARY

- A. The work includes, but is not limited to the following:
 - 1. Construction, installation, materials and equipment described herein are generally common to the various sections of this Division as listed in Section 23 00 00, GENERAL PROVISIONS.
- B. Related Sections:
 - 1. All other sections in Division 22.
 - 2. Electrical: Division 26.

1.02 QUALITY ASSURANCE

- A. Standards: Comply with applicable national or local codes and standards.
- B. Qualifications of Manufacturer: Products used in the work of this section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a 5 year history of successful production acceptable to the Architect.
- C. Qualifications of Installers: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section. All contractors shall have California State License as follows: HVAC and process piping installer including chilled water, heating hot water, boiler and accessories (C-4); Plumbing Contractor (C-36); Fire Protection Contractor (C-16); and Welders (C-60). Proof of licenses shall be submitted to the Owner's representative and a copy shall be provided at the jobsite construction office.

1.03 SUBMITTAL DATA

- A. Requirements: In addition to the requirements of Section 23 00 00, GENERAL PROVISIONS, the submittal material shall include six (6) copies of descriptive data for all products and materials including, but not limited to, the following:
 - 1. Complete material list of all items proposed to be furnished and installed under this section.
 - 2. Manufacturers' specifications and other data required to demonstrate compliance with the specified requirements.
 - 3. Shop Drawings Showing:
 - a. Complete system layout and description of components and all piping work.
 - b. Schedule and description of pipes, fittings, and valves.
 - c. Special valves of all types.

- d. Specialty fittings.
- 4. Manufacturer's Recommended Installation Procedures: The manufacturer's recommended installation procedures, when accepted by the Architect/Engineer, will become the basis for inspecting and accepting or rejecting actual installation procedures used on the work.

1.04 COORDINATION

- A. Coordinate all activities in accordance with the provisions of Section 23 00 00.

PART 2 - PRODUCTS

2.01 PIPING SCHEDULES

A. General.

- 1. Refer to individual mechanical section for piping schedule required for each particular piping system.

B. Requirements.

- 1. Requirements of this section are in addition to any similar or more comprehensive requirements in other sections of this Division.
- 2. Requirements of this section apply to all sections in this Division, except as may be specifically modified in those sections.
- 3. Standards & Specifications: Conform to the current edition of the following:

Cast iron soil pipe & fittings	CS188.
Steel Pipe:	ASTM A120
Drainage fittings:	ANSI B16.12.
Hard drawn copper tubing:	ASTM B88
Hard-drawn Medical gas tube:	ASTM B819
150# malleable-iron screwed fittings and couplings:	ANSI B16.3
300# malleable-iron screwed fittings and couplings:	ANSI B16.19
Cast iron screwed fittings:	ANSI B16.4
Cast-iron flanged fittings:	ANSI B16.1
Rubber ring cast-iron fittings:	ANSI A21.10
Wrought copper fittings and couplings:	ANSI B16.22
Bell & Spiogot cast-iron pipe:	ANSI B21.8
Cast-iron Class "D" fittings:	AWWA C100

- C. Piping schedule "A" - NOT USED
- D. Piping schedule "B" - NOT USED
- E. Piping schedule "C" - NOT USED
- F. Piping schedule "D".
 - 1. Service: Potable water (hot and cold) and Industrial water (hot and cold).
 - 2. Pipe.
 - a. Above ground. Seamless Type "L", hard drawn, copper tubing, ASTM B-88.
 - b. I.P.S. red brass nipples for rigid connections.
 - c. Underground (Size 3" and smaller): Seamless Type "K", hard drawn copper tubing, ASTM B-88.
 - 3. Fittings.
 - a. Wrought copper solder sweat type, ANSI B-16.22.
 - b. Cast bronze solder sweat type, ANSI B-16.18, shall be used only where wrought copper fittings are not available.
 - c. Manufactured braze-to-sweat type reinforced "tap-in" fittings.
 - 4. Unions.
 - a. Tubing: 2" and smaller, 150 lb. cast bronze or copper, ground joint, non-ferrous seat with sweat ends.

Recommended Manufacturers: (or approved equal)

Walseal, Nibco, Mueller, Flag-Flo.
 - b. Pipe: 2" and smaller, 150 lb. cast brass ground joint, brass to brass seat, threaded ends.
 - 5. Flanges: 150 lb. cast brass, flat faced, solder sweat type, ASA B-16.4, on piping 2-1/2" and larger.
 - 6. Gaskets: 1/16" thick rubber, Manville 107, Garlock 22, or Crane 555, full faced.
 - 7. Service valves.
 - a. Gate valves 2" and smaller: Class 125 SWP/200 WOG, Non-rising stem, threaded bonnet, stem material shall be ASTM B-62, bronze body malleable iron handwheel. Valves shall meet or exceed MSS-SP 80.

 - 1). Recommended Manufacturers: (or approved equal).
 - a). Nibco T-113 Thread S-113 Solder, b). Milwaukee 1105 Threaded 1145 Solder c). Stockham B-103 Thread B-104 Solder

- b. Gate valves 2-1/2" and larger: Class 125, IBBM, body and bonnets shall be ASTM A-126, Class B. cast iron, non-rising stem, flanged end.
 - 1). Recommended Manufacturers: (or approved equal)
 - a). Nibco F-619-N
 - b). Milwaukee F-2882
 - c). Stockham G-612
 - c. Ball valves 2" and smaller: Class 150 SWP/600 WOG, three piece construction, reinforced teflon seats, separate adjustable packing gland. Blow out proof stem, chrome plated bronze ball, full port, extended cup solder end valves. Valves shall meet or exceed Federal Specification, WOO-V-35, Type II, Class A, Style A, Style 3 or MSS-SP 110.
 - 1). Recommended Manufacturers: (or approved equal).
 - a). Apollo 82-100 Full Port-Threaded 82-200 Full Port-Solder
 - b). Hammond 8604 Full Port-Threaded 8614 Full Port-Solder
 - c). Milwaukee BA-300 Full Port-Threaded Milwaukee BA-350 Full Port-Solder
 - d). Nibco T-595-Y-70 Full Port-Threaded S-595-Y-70 Full Port-Solder
 - d. Globe valves 2" and smaller: Class 125 SWP/200 WOG, body and bonnet to be cast bronze, teflon impregnated packing, bronze packing gland.
 - 1) Recommended Manufacturers: (or approved equal)
 - a). Nibco T-211 -Y Threaded S-211-Y Soldered
 - b). Milwaukee 502 Threaded 1502 Soldered
 - c). Stockham B-13-T Threaded B-14-T Soldered
 - e. Globe valves 2-1/2" and larger: Class 125 SWP/200 WOG, body and bonnet to be A-126, Class B. cast iron, teflon impregnated packing, brass packing gland, flanged end.
 - 1) Recommended Manufacturers: (or approved equal)
 - a). Nibco F-718-B
 - b). Milwaukee F-2890
 - c). Stockham G-512
8. Check valves.
- a. Swing checks.

- 1). 2" and smaller: Class 125 SWP/200 WOG, swing-pattern, threaded bonnet, replaceable teflon disc. Valves shall meet or exceed MSS-SP 80.
 - a). Recommended Manufacturers: (or approved equal)
 - 1). Nibco T-413-Y Threaded S-413-Y Solder
 - 2). Milwaukee 509-T Threaded, 1509-T Solder.
 - 3). Stockham B-320-T Threaded B-309-T Solder.
- 2). 2-1/2" and larger: Class 125, SWP/200 WOG, swing-pattern, bolted bonnet, bronze disc, ASTM A-126, Class B. cast iron.
 - a). Recommended Manufacturers: (or approved equal) 1). Nibco F-918 2). Milwaukee F-2974 Stockham G-931

9. Strainers.

- a. 2" and smaller: 250 lb. Y-pattern bronze, screwed, with 20 mesh 304 stainless steel strainer screen and machined, gasketed, strainer screen retainer cap.
 - 1) Recommended Manufacturers: (or approved equal)
 - a. Bailey 100B
 - b. Mueller H-9330
 - c. Watts 777S
- b. 2-1/2" and larger: Class 125, Y-pattern, epoxy coated, cast iron with 1/16" diameter perforated 304 stainless steel strainer screen and blow-off outlet.
 - 1) Recommended Manufacturer: (or approved equal)
 - a. Watts 77F-D-FDA

10. Mechanical shock absorbers: Bronze or stainless steel metal bellows type. Sized per Plumbing and Drainage Standard P.D.I. WH201.

11. Refer to paragraph 2.02 "Valves General".

G. Piping schedule "E" - NOT USED

H. Piping schedule "F" - NOT USED

I. Piping schedule "G".

1. Service: Sanitary soil, waste and vent piping.
 - a. Exterior below ground (over five feet outside the building), to connect to sewer:
 - (1) Piping:

- (a) Bell and spigot vitrified clay pipe, which may have factory applied polyvinyl chloride plastic joining material. Approved neoprene flexible compression joints clearly identified for size, class and manufacturer may also be used.
 - (b) Standard weight no-hub cast iron soil pipe conforming to CISPI Specification 301 latest revision.
 - (2) Fittings:
 - (a) Bell and spigot vitrified clay.
 - (b) Standard weight no-hub cast iron soil pipe fittings conforming to CISPI Specification 301 latest revision with cast iron coupling with neoprene gasket and stainless steel bolts and nuts. MG Couplings.
- b. Interior below grade (to 5 feet outside the building).
 - (1) Piping: Standard weight no-hub cast iron soil pipe conforming to CISPI Specification 301 latest revision.
 - (2) Fittings and traps: Standard weight no-hub cast iron soil pipe fittings conforming to CISPI Specification 301 latest revision with cast iron coupling with neoprene gasket and stainless steel bolts and nuts. MG Couplings.
- c. Above grade.
 - (1) Piping: 2" and larger:
 - (a) Standard weight no-hub cast iron soil pipe conforming to CISPI Specification 301 latest revision.
 - (2) Fittings:
 - (a) Standard weight no-hub cast iron soil pipe fittings conforming to CISPI Specification 301 latest revision. No-hub couplings with neoprene gasket conforming to ASTM C-564 and a series 300 stainless steel clamp. Husky Series 4000.
 - (3) Piping: 1-1/2" and smaller: Schedule 40 galvanized steel pipe.
 - (a) Fittings: 1-1/2 and smaller: Galvanized cast iron drainage pattern screwed fittings ANSI 16.12.

J. Piping schedule "H". NOT USED

2.02 DIELECTRIC ISOLATORS

A. General.

Isolators shall be so constructed that the two pipes being connected are completely insulated from each other with no metal-to-metal contact, and suitable for service on which used. Insulating couplings are not acceptable.

- B. Unions.
1. For piping 2" and smaller, unions shall be brass solder sweat with ground-joint and micarta sleeving.
 2. Steam and condensate lines: High temperature type, suitable for continuous operation on temperatures up to 250 degrees F. for condensate and 400 degrees F. for steam.

- C. Flanges.
1. For piping 2-1/2" and larger, flanges shall be flanged sets with neoprene gasket for flat face flanges with bolt hole punches to receive bolt sleeves of 1/32" micarta with 1/8" thick micarta washers.
 2. All others: Insulating flanges or unions, suitable for 125 psig WSP.

- D. Manufacturer.
1. Dielectric isolator shall be as manufactured by F.H. Maloney, EPCO, Cathodic Protection Service, Corro Ban Products, W.C. Vallett, or approved equal.

2.06 FLEXIBLE PIPING CONNECTIONS

- A. Flexible connections for copper piping; corrugated seamless bronze flexible hose with bronze wire braid.
- B. Flexible connections for steel piping: Corrugated stainless steel with stainless steel wire braid.
- C. Designation and length as recommended by manufacturer for system's test and operating pressures and temperatures.
- D. Recommended Manufacturers: (or approved equal)
- Metraflex, U.S. Flex, Anaconda.

2.03 PIPE SUPPORTS

- A. General.
1. Supports shall be defined as hangers, brackets, framing, guides and anchors.
 2. Supports shall be factory fabricated units with published load limits.
 3. Supports fabricated of steel shapes and installed in weather exposed locations, in equipment rooms or regularly occupied areas shall be hot dip galvanized after fabrication.
 4. Supports for fire protection installation shall be in accordance with NFPA Standard No. 13.
- B. Horizontal piping.
1. Hangers shall be of the following types:
 - a. For piping 4" and smaller adjustable malleable iron split ring type, Grinnel Fig. No. 104, or Fig. 174, B-line Fig. B3171, Super Strut, or approved equal.

- b. For piping larger than 4" and all insulated pipe fitted with inserts and shields, adjustable steel clevis type Grinnel Fig. No. 260, B-Line Fig. B3100, Super Strut or approved equal.
 - c. Rod lengths shall be adjustable.
 - d. Trapeze hangers may be used for parallel piping arrangements. Submit detail drawings and calculations for approval. For four or less pipes 2-inches and smaller, framing manufactured by Unistrut selected to accept five times the weight or thrust of the pipe per manufacturer's ratings, are acceptable. Framing finish shall be a light colored polyester paint. Submit calculations.
 - e. Hang rods for both single and trapeze hangers from suitable clips, beam clamps or self-drilling expansion type or from 3/8" diameter rods and percussive driven studs. Verify with Structural Engineer.
- 2. Brackets shall be Grinnel 194 or 195, B-Line Fig. B3063 or B3066, Super Strut or approved equal.
- 3. Roll stands shall be Grinnel Fig. 271, B-Line Fig. B3117SL or approved equal.
- C. Vertical piping.
 - 1. Clamps shall be Grinnel Fig. No. 261, B-Line Fig. B3373, Super Strut or approved equal.
- D. Rods.
 - 1. Solid mild steel minimum size as follows:

<u>PIPE SIZE</u>	<u>ROD SIZE</u>
2" and smaller pipe	3/8" diam. rod
2-1/2" to 3-1/2" pipe	1/2" diam. rod
4" to 5" pipe	5/8" diam. rod
- E. Insulated piping.
 - 1. Provide shields between supports and the pipe insulation.
 - 2. Shields shall be 16 gauge galvanized steel for all piping and shall be preformed to proper radius, and shall extend up to the centerline of the pipe. Lengths shall be 4" for pipe sizes 2-1/2" and smaller, and 7" for larger pipes. Pipes 4" and larger at rollers, guides and supports shall have 14 gage shields. All shields at rollers, guides, and supports shall be securely strapped in place.
 - 3. Insert sections of insulation shall be Type P-4 at each support as specified in Section 15180: Insulation.
- F. Vibration isolation.
 - 1. Vibration isolation shall be as specified in Section 23 05 48: Vibration Isolation and Seismic Restraints.
 - 2. Where isolation elements are required on hangers provide 2 piece rods.

- 3. Pipe Isolators:
 - a. Manufactured hair felt pad enclosed in corrosion resistant metal shield with end flanges to assure the pads proper retention between the support and the pipe, Trisolator S-100 or approved equal.
 - b. Provide plastic isolating suspension clamp on all water piping to prevent contact between the pipe and the structural framing. "Flexi-Fin" isolating suspension clamp or approved equal (L.A.R.R. 3850).
- G. Concrete fasteners.
 - 1. Percussion driven studs shall be Ramset No. 2049, Drivet Remington, or approved equal.
 - 2. Self drilling anchors shall be Rawl Philips Red Head, Wej-it or approved equal.
- H. Floor Supports: Grinnell Figure 264, B-Line Fig. B3093 or approved equal.
- J. Wall Supports: Grinnell Figure 168, 195, B-Line Fig. B3153 or approved equal.
- K. Riser clamps for copper piping: Super Strut CT-720-F copper plated, plastic coated, B-Line Fig. B3373CT or B3373CTC or approved equal.
- L. Riser clamps for other piping: Super Strut C-720, B-Line Fig. B3373 or approved equal.
- M. Beam clamps: Super Strut U-520, B-Line Fig B318 or Fig. B3050 or approved equal.

2.04 SLEEVES, CORE DRILLING AND ESCUTCHEONS

- A. General.
 - 1. Sleeves shall be permanently installed type where waterproofing is required cast-in-place or dry-packed in core drilled hole.
 - 2. Escutcheons shall be prime coated steel type except for escutcheons specified in Section 22 40 00 - Plumbing Fixtures.
- B. Sleeves shall be as follows:
 - 1. Exterior walls below grade and floor slabs on grade: Concrete pipe dry-packed in place with annular space caulked watertight.
 - 2. Floor slabs inside partitions, furred spaces and interior concrete walls: Core drill as necessary.
 - 3. Roof slab: Cast iron sleeve with integral flashing clamp, Smith No. 1722 or equal by Josam, Zurn or Wade.
 - 4. Floor slab with waterproof membrane: Cast iron sleeve with integral flashing clamp, Smith No. 1722 or equal by Josam, Zurn or Wade.
 - 5. Cast concrete beams: Core drill as necessary.
- C. Escutcheons shall be as follows:
 - 1. 6" and smaller: Prime coated steel with set screw, Beacor No. 13 or equal by F & S Manufacturing Co.

2. Larger than 6": Prime coated brass with set screw, Beacor No. 3 or equal by F & S Manufacturing, Fig. 605 or equal.
3. Raised sleeves in floor slabs: Deep drawn prime coated steel or brass, F & S Manufacturing Fig 605, or equal by Beacor.

D. Caulking shall be as follows:

1. Watertight: Projects Research Co. "Rubber Caulk" No. 150 heavy type DAP, Dow Corning, General Electric, or approved equal.
2. Fireproofing: Caulked glass fibrous rope.
3. Sound attenuating: Caulk with a compressible polyurethane foam strip saturated with polybutylene, Poly-Tite Compriband, or approved equal.

2.05 FLASHING

A. General.

1. Flashing shall be 4 lb. seamless lead flashing assembly with 10 in. skirt, steel reinforcing boot and caulk type counterflashing sleeve.
2. Manufacturer: Flashing assembly shall be Stoneman S-1300-6, or approved equal.

2.06 ACCESS PANELS

A. General.

1. These specifications cover prefabricated wall and ceiling access panels normally required to provide access to equipment requiring servicing and adjustment.
2. The types of wall and ceiling access panels required are similar to Milcor Styles A, L, K, and M, Potter-Roemer No. 265 and 275, Zurn Series Z-1376, Carey Styles HP, HP HPE, and AT, or Karp #214, for the appropriate locations and with hinge, metal gauge, latch, and other modifications necessary to conform to requirements specified hereinafter. Panels shall be U.L. labeled to match wall or ceiling rating requirements.

B. Location.

1. Furnish for installation by the pertinent trade, access panels wherever fans, air handlers, air filters, valves, balance valves, damper operating mechanisms, fire damper access doors and similar items normally requiring adjustment or servicing are installed in concealed spaces.
2. Where furred ceilings are of the removable panel type of construction, the removable panels will be used for access to small equipment such as valves, dampers and controls.

C. Sizes.

1. Access panels shall be of a size to permit removal of equipment for servicing, but not less than 12" x 12" minimum opening.

2. Where proper servicing of the equipment requires the entrance of a serviceman, the access opening shall be sized accordingly with minimum opening not less than 18" x 24".
3. Where access panels are to be located in acoustic tile ceilings, size of access panel shall be increased, when required, to next nearest full tile size so that access panel can be installed integral with tile pattern without cutting into tiles.

D. Construction.

1. Access panels shall be neatly constructed and substantially made of steel complete with frame and with necessary grounds for attaching to metal lath, tile walls or other construction, as required. Hinges shall be of concealed type. Minimum door and frame gauges shall be USS No. 16 and USS No. 18, respectively. Panels and frames shall be furnished with a factory-applied prime coat, except panels in toilet and restroom walls shall be chrome plated and polished or satin finish Type 304 stainless steel.
2. Panels to be installed in acoustical tile ceilings shall be as specified in paragraph one (1) above except that the door panels shall be recessed and faced with acoustical tile to match the ceiling tile so the frame will be concealed. The depth of the door recess shall be such that door facing tile are flush with ceiling tile.

E. Exceptions.

Normally, access doors to large attic spaces and large pipe spaces behind toilet batteries will be furnished under another section, and when so furnished will be shown on the architectural plans. Examine all plans carefully and furnish any access panels or doors to equipment in these spaces where they are not to be furnished under the other section.

2.07 CHANNEL FRAMING

A. General.

1. Channel combinations and accessories shall be of compatible design in arrangements and combinations as shown on the drawings. Channels and accessories shall have a hot dipped galvanized finish.
2. Manufacturer: Channel framing shall be as manufactured Superior Strut and Hanger Company, Unistrut, B-Line Systems Inc. or approved equal.

2.08 PIPE WRAPPING

A. Buried piping.

1. Underground copper or steel piping buried directly in the soil shall be coated and machine wrap as follows:
 - a. Apply one (1) coat of primer similar to Pabco No. 3972-R.
 - b. Apply wrapping coat of enamel similar to Pabco No. 240 to 1/8" thickness.
 - c. Wrap a layer of 50 lb. Kraft paper as per manufacturers recommendation.
2. Field joints wrapping:
 - a. Tear off 4" Kraft paper from each end, clean pipe, apply 1/2" thick enamel similar to Pabco No. 240 and wrap with felt similar to Pabco No. 190, using a minimum of 2" overlap.

- b. Spiral wrap saturated cloth strip similar to Pabco No. 276 over hot enamel using 1/2" overlap. Flood coat the entire joint with enamel.
- c. Wrapped pipe and fittings shall be inspected over proven sound with Tinker Razor "Holiday Spark tester".

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPING

A. General.

1. Furnish and install all piping, equipment trim, etc., including all work necessary to make complete and properly operating systems, whether or not all details are mentioned in these specifications or indicated on the drawings.
2. Rough-in work: Pipe sizes shown on the drawings are nominal inside diameter except copper tubing for refrigerant service which is outside diameter. Wherever five inch size pipe is shown, six inch may be substituted. Unless noted otherwise, make all pipe trim full line size.
3. Proceed as rapidly as the building construction will permit, so as to be completed, tested and approved before being enclosed.
4. Carefully inspect each piece of pipe and each fitting to see that there is no defective workmanship on the pipe or obstructions or dirt in the pipes and fittings. Material having burrs, slag intrusions, cracks, eccentricity, excessive roughness, damage due to rough handling, etc., will be rejected and shall be removed from the job site.
5. Whenever work is not in progress and at the end of each workday, cap or plug all openings in completed piping to prevent the entrance of materials that would obstruct the pipes. Leave in place until removal is necessary for completion of installation.
6. No piping shall be permanently closed up, furred in, or covered over before it has been tested and inspected as specified herein and is accepted by the Architect.
7. Install piping parallel to walls and to present a neat appearance both as to workmanship and grouping.
8. Piping shall clear all obstructions, preserve headroom and keep openings and passageways clear whether shown on the plans or not.
9. Should structural difficulties prevent the running of pipes or the setting of equipment at the point indicated by drawings, the necessary minor deviations therefrom, as determined by the Architect will be allowed, but must be made without additional cost.
10. Locate piping to clear steel reinforcing bars in beams. Offset reinforcing bars in walls to clear piping and sleeves. Get approval from Structural Engineers.
11. Joists, girders, beams, columns or reinforcing steel shall not be cut or weakened.
12. Conceal all piping within the building wherever possible, unless otherwise noted on drawings. Exposed piping, wherever necessary, shall if possible be run in unfinished rooms.
13. Do not use couplings except where required pipe runs between fittings that are longer than a standard length of the type of pipe being used and except where their use is specifically approved by the Architect.

14. Copper, bronze, and brass solder type fittings, including unions and flanges, shall have sockets of proper diameters to suit outside diameters of copper and brass pipe and copper tubing with which they are being used. The expanding or swaging of tubing to fit IPS fitting sockets will not be permitted.
15. Cut pipe accurately to measurements established at the site. Work into place without springing or forcing. Properly clear all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted.
16. Pipe damage: Show no tool marks or threads on exposed plated, polished or enameled connections to fixtures. Tape finished surfaces to prevent damage during plastering. Brass and copper piping shall have no tool marks wherever installed.
17. Make all changes in direction with fittings and changes in main size with reducing fittings. Unless otherwise noted, for pipe size change on all horizontal pump circulated water supply and return piping, use eccentric couplings flat on top.
18. Grooved end pipe shall be installed only outside (weather exposed).
19. Dielectric insulation.
 - a. Provide dielectric insulation at all points where copper water piping including brass nipples in same, is connected to ferrous metal such as steel piping, tanks, water heaters, etc.
20. Pitch pipe lines to be free of sags, traps or unnecessary bends as required for proper drainage. Provide a gate valve of same size as line but 3/8" minimum and 3/4" maximum size at each low point.
21. For expansion and contraction of heated or cooled piping, provide sufficient swing joints, ball joints, expansion loops, and devices necessary for a flexible piping system, whether shown or not shown on drawings. Anchors shall be constructed of structural shapes. Submit details to the Architect.
22. Support piping independently at pumps, coils, tanks, and other equipment so that its weight will not be supported by the equipment.
23. Thrust blocks and anchors.
 - a. On all buried cast iron bell and spigot or concrete water lines, furnish and install anchors, clamps and rods, or thrust blocks at all elbows, at all connections or branches from the mains 2" and larger, and at capped connections.
 - b. Form anchor or thrust blocks by pouring concrete between pipe and the undisturbed trench wall. Thrust blocks to be of adequate size and placed to take all thrusts created by the maximum internal water pressure.
 - c. Size and place thrust blocks for concrete pipe in accordance with Division 3.
24. Unions and Flanges.
 - a. Provide unions or flanges suitably located to facilitate maintenance and removal of all equipment or automatic pipe mounted apparatus.
 - b. Faces of flanges to be connected shall, in all cases, be alike.
 - c. Provide two unions at threaded three way mixing valves.

25. Shop or field fabricated fittings, bushings, street ells, and long screw nipples are not acceptable and shall not be used. Reducer couplings, tees or ells shall not be used.
26. Equipment by others: For rough-ins and final connections to equipment furnished by others, ascertain exact sizes, type, services and locations before starting work.
27. Springing, bending or forcing of pipe into place shall not be allowed. Use fittings for all off-sets or changes in alignment of piping.
28. Flexible Pipe Connections.
 - a. Provide flexible piping connection on each pipe connection to equipment mounted on or suspended from isolators with one half inch or more static deflection or where such connections are shown on plans.
29. Install piping outside of building at not less than 18" below finish grade in landscaped, unpaved areas or finished subgrade surface in paved areas. Natural gas piping outside of buildings shall have 24" of cover or as recommended by Southern California Gas Co.
30. Isolate all domestic and industrial water piping with approved isolating suspension clamps. Piping shall not come in contact with building structure.

B. Pipe schedules "D"

1. Wherever domestic water lines are not shown and not sized on drawings, sizing shall conform with Appendix "A" of the Uniform Plumbing Code and in addition be sized to hold the velocity in branches to not over 7 feet per second as calculated by the table entitled "Demand weight of fixtures in fixture units", and charts A-2 through A-7. Building water supply pipe shall not be smaller than the largest branch. Submit layout piping diagram for review.
2. Pitch pipe lines so as to be free of sags, traps, or unnecessary bends as required for proper drainage and elimination of air as follows:
 - a. Potable water systems shall be drainable. Provide plugged date type drain valves at all low points.
3. Rough-in cold water outlets to all fixtures on the right hand side.
4. In water piping systems for which copper tubing is specified, use IPS red brass pipe for all connections to faucets, flush valves, hose bibs, compression stops, or similar items requiring rigid piping.
5. Shock Absorbers.

Install shock absorbers at the downstream end of each header serving a battery of fixtures and near the shut off valve for each item of equipment with quick closing automatic valves. Size and location of shock absorbers shall be as recommended by Plumbing and Drainage Institute Standard P.D.I. WH201.

C. Pipe schedules "G".

1. Wherever drainage lines are not shown or are not sized on the drawings, arrangement and sizing shall conform to the requirements of the current edition of the Uniform Plumbing Code as a minimum. Submit layout piping diagram for review.

2. Pitch pipe lines to be free of sags, traps or unnecessary bends as required for proper drainage and elimination of air as follows:
 - a. 3" and smaller: 1/4 inch per foot downwards towards main. 4" and larger: 1/4 inch per foot downwards towards main, unless it is impractical due to the depth of the main sewer, structural conditions or to the arrangement of any building or structure to obtain a slope of 1/4 inch per foot, then slope at 1/8 inch per foot.
 - b. Vents: 1/4 in./ft. upwards away from fixture trap, storage tank or equipment.
3. Install vent piping to provide proper ventilation of the plumbing and grade to provide for its drainage. Buried sewer, waste and drain piping shall be continuously supported along the full length of the pipe. Bell holes shall be provided to keep bells from resting on the bottom of the trench. Where the trench is excavated below the required grade, it shall be refilled with sand to include the lower half of the pipe.
4. Set rough outlets for all fixtures exactly to the measurements furnished by the manufacturer or as indicated. Fixtures set in batteries shall have their rough outlets set in straight lines at equal spacing.
5. Terminate sanitary plumbing vents 7" above the roof.
6. Downspouts or storm drainage leaders.
 - a. Furnish and install downspouts or storm drainage leaders, unless otherwise shown or specified, as work of this section up to and including roof drains.
 - b. Turn lower ends of downspouts or storm drainage leaders located in multi-story buildings with basement or excavated pipe space under first floor to the horizontal by means of cast iron 1/8 bend and "Y" branch with cleanout.
 - c. Provide a cast iron sanitary tee with 2" brass cleanout plug in lower end of downspouts or rainwater leaders located in multi-story buildings with first floor slab on the ground. Locate tee so that cleanout plug is approximately 6" above floor slab. Turn to the horizontal with a long sweep 90 degree bend below the slab, where building construction will permit.
 - d. Sheet metal downspouts or storm drainage leaders will be furnished and installed in the sheet metal section. Where outside sheet metal downspouts or storm drainage leaders connect to storm drainage systems, provide all connections under this section in accordance with the following:
 - (1) Furnish and install a boot on downspouts or storm drainage leaders in paved areas and loading dock area. The boot shall be a 5'-0" length of standard weight galvanized steel pipe with one-half of a standard coupling on the lower end. The upper end of the boot shall be slipped over the sheet metal downspout or storm drainage leader approximately 2" in such a manner as to provide a snug fit and prevent entrance of foreign materials, and the lower end shall be caulked into a cast iron, tapped, sanitary tee with 2" brass cleanout plug. Cleanout plug shall be above finished grade and tee shall be caulked into the storm drainage line.
 - (2) In locations where downspout or storm drainage leader boots are not used, furnish and install a cast iron tee as specified above. Insert the end of the downspout into the hub of the tee and make this joint tight with dry jute and lead. The lead shall not be caulked, and sufficient jute shall be used so that lead will not enter the tee when joint is being poured.

E. Pipe schedules "D"

1. Use thread-to-sweat adapters wherever a threaded connection to copper tubing is required.

3.02 INSTALLATION OF VALVES

A. General.

1. Valves shall be full line size. Automatic valves are excepted.
2. All valves shall have proper clearances for handle operation, and shall close tight at the specified test pressure.
3. All pump discharge check valves shall be non-slam.
4. On 3-piece construction ball valves, remove center section of the valve prior to soldering to prevent any damage to the teflon seats. Reinstall center section after soldering.

B. Arrangement.

1. Install valves in the systems so located, arranged and operated as to give complete regulation of all apparatus, equipment, and fixtures.
2. Install valves for accessibility and easy maintenance.
3. Install valves with stems horizontal or vertically upright.
4. Install globe valves in refrigerant gas lines with stems horizontal.
5. Chain operators: Provide valves 4" and larger installed 7 feet and higher in equipment rooms with chain operators with chains swagged to 5-6" above the floor and hooked up out of the way.
6. Wrenches: Plug valves (cocks): Provide 12" wrench for valves 2" and smaller, 18" wrench for 4" valves, and 36" wrench for valves 6" and larger.
7. Provide valve box at each valve or cock in ground. Set cover flush with finished grade except in planted areas set 1" above ground.
8. Balance valves. Install balance valves where shown and on each circulating return branch where two or more branches occur on domestic hot water system.
9. Gas valves. Provide lubricated gas shut-off valve in gas supply to each building, so arranged that gas supply can be turned on or off to any individual or separate building. Locate valve outside building it supplies so that it will be readily accessible at all times.
10. Provide readily accessible lubricated gas shut-off valve in gas supply to each gas burning appliance an ahead of union connection thereto, and in addition to any valve on appliance. Locate within 3'-10" of appliance, except range connectors may be within 6'-0".
11. Compression stops. Install stop valve or compression stop on water supply lines to each plumbing fixture, including hose faucets and showers, installed under this contract, to permit repairs with shutting off water mains. Unions are not required adjacent to compression stops.

12. Hose bibbs. Mount with outlet 18" above floor or finished grade, unless shown otherwise.

C. Location.

1. In all branches and headers of water piping serving a group of two or more plumbing fixtures.
2. On both inlet and outlet of all apparatus and equipment.
3. For shutoff of branch mains.
4. For flushing and sterilizing the systems.
5. Where shown on the drawings.
6. Ahead of each automatic valve for water service.

3.03 PIPE SUPPORTS

A. Installation.

1. Securely support all piping from building construction with manufactured iron hangers, brackets, trapezes, guides, anchors and sway braces to maintain pipe alignment and prevent sagging, noise and excessive strain due to uncontrolled movement under operating conditions.
2. Relocate any hangers as necessary to correct unsatisfactory conditions that may become evident when system is put into operation.
3. Supporting of pipe by wire, rope, wood or other makeshift devices will not be permitted.
4. Burning of holes in beam flanges or narrow members will not be permitted.
5. Where calculated maximum travel exceeds one inch, provide rollers at all non-suspended type supports and on all but one of the largest pipes on trapeze supports.
6. Where rods exceed 12" in length for pipes 2" and larger and all trapezes, provide lateral sway bracing at every third hanger. Equip each with a longitudinal sway brace. Sway brace rods shall either be two hanger rods set at 45 degrees on both sides without a vertical hanger or 1-1/2" x 1-1/2" x 1/8" angle iron to 2" pipe size and 2"x 2" x 1/4" for larger pipe, set on 45 degrees. Secure bracing to pipe an structure as for hangers. Fit all hanger rods not sway braced at the top with a swivel.
7. Fasten hanger rods to structural steel members with beam clamps with retaining clips; to concrete with steel or malleable iron inserts.
8. For existing concrete construction, hang rods with self-drilling anchors of same size as rods. Rods 1/2" diameter and less may be secured with percussion driven studs, if approved by Structural Engineer.
9. Sheet lead, lead wool or wood plugs will not be accepted as a substitute for cinch anchors as a means of attaching materials and equipment to concrete.
10. Support cast iron, plastic and glass drainage pipe at each floor.
11. Supports for insulated pipe shall be outside the insulation. Protect pipe insulation at every hanger, support or guide with inserts and shields. The galvanized steel shield

shall be applied between the hanger or support and the pipe insulation. Provide saddles at all rollers for insulated pipe not equipped with inserts and shields.

12. Equip all piping not otherwise vibration isolated with pipe isolators at all supports in contact with pipe. Equip the support rollers for saddle equipped piping not otherwise vibration isolated with waffle pattern Type "P" isolators with rubber isolated bolting when base mounted and Type "H" when rod hung.
13. When poured-in-place construction is employed, deliver inserts or other hanger devices to be cast in slabs for installation under the Concrete Section. Provide complete layout information in ample time for casting in slabs and without delaying project.
14. Support of larger pipe shall be as detailed on the drawings.

B. Manifolding:

1. Parallel runs of piping, except for fire protection, may be supported on trapeze hangers, spaced as required for the smallest pipe carried.
2. Support piping in chases on channel framing.
3. For piping over 2" construct framing of welded assemblies of steel shapes. Provide calculations that the design will carry five times the weight of thrust of the pipe.

C. Support spacing:

1. Maximum spacing for horizontal piping supports shall be as follows:

<u>Material</u>	<u>Size</u>	<u>Spacing</u>
Steel or Brass pipe	3/4" and smaller	6 ft.
Steel or Brass pipe	1" and 1-1/4"	8 ft.
Steel or Brass pipe	1-1/2" to 3"	10 ft.
Steel or Brass pipe	4" and larger	14 ft.
Copper tubing	1" and smaller	6 ft.
Copper tubing	1-1/4" and larger	8 ft.
C.I. Soil Pipe	All sizes	5 ft. & ea.joint

2. Where building structure does not permit the specified spacing, provide additional adequate struts or blocking. Location and details shall be submitted to the Architect for approval.
3. Support piping at each change of direction, at ends of branches, at base and top of riser pipes and drips, and wherever necessary to prevent sag, bending, or vibration, in addition to above listed hanger spacing.

3.04 PIPE ANCHORS

A. Shot driven anchors.

1. Supports may be secured to the concrete structure by shore anchors as long as the pin does not penetrate the concrete more than 3/4 inch and it is rated for the load it will carry, if approved by the Structural Engineer. Submit calculations.
2. For loads that exceed the shore anchor rating, use drilled anchors.

B. Drilled anchors.

1. Drilled anchors shall be of the self-drilling expansion type with self-cutting annular broaching grooves, or they may be of the non-drilled type with expansion tip.
2. Anchors shall have a recommended load with a minimum of safety factor of four. Submit calculations.

3.05 PIPE JOINTS

A. General.

1. Remake any leaky joints with new materials. The use of thread cement, caulking or patch welding to make the old joint tight is absolutely prohibited.

B. Solder and brazed joints.

1. Cut square; remove burrs and clean both the pipe or tubing and inside of female fitting to a bright finish with steel wool, wire brush, sandpaper or emery cloth. Apply solder flux with brush to tubing. Remove internal part of solder-end valves prior to soldering.
2. Joining for copper tubing and brass pipe shall be as follows:
 - a. Domestic piping 3" and smaller: 95-5 Tin-Antimony Grade 5A.
 - b. Drainage piping: 95-5 Tin Antimony.
 - c. For all reinforced non-ferrous piping connections, water piping larger than 3", steam condensate, all chilled water and heating hot water using type "L" copper, or type "K" copper, and all refrigerant piping: Use over 1100 DEG F brazing alloy, ASTM B250, Class BCUP-5. Sil-FOS 15% silver brazing alloy, Harris Stay-Silv 15 or approved equal.

C. Screwed Piping.

1. Cut square and clean with machine cutter, hack saw or carborundum pipe wheel. Wheel cutters are not acceptable. Deburr with file or pipe reamer. Do not ream to exceed I.D. of pipe and thread to ANSI B2.1 requirements.
2. Use Teflon tape, Armit #250, "Tyte-Unite" or Enterprise "Threadseal" sealing compound on outside threads for joining all services, except refrigerant piping, and Acorn #3500 for cleanouts.
3. Litharge and glycerin may be used for sealing threads of compressed air piping and shall be used for refrigerant piping.
4. No more than two full threads shall remain exposed after making up joints.
5. Do not wrap pipe threads and slip joints with string, paper, putty or similar fillers. Threaded joints must be made tight with tongs or wrenches. Piping in finished areas shall bear no tool marks. Caulking of any kind will not be permitted.

D. Welded Piping.

1. Oxyacetylene or electrical arc process.
2. Weld in accordance with and by welders who have qualified under the latest Edition, American National Standard Code for pressure piping ANSI/ASME B31.1, Chapter 5, and subsequent Addenda. Welder qualifications shall be issued by an independent

testing laboratory or by the
Los Angeles City Testing Laboratory.

3. Remove foreign matter from pipe ends before tacking or welding.
 4. Align ends concentric and tack weld.
 5. Weld and reinforce to full thickness of pipe. Welds shall be continuously fused to pipe and to prior pass weld, shall have full penetration with out slag inclusions or porosity. Fillet type welds for flanges and socket fittings shall have a throat dimension not less than the pipe wall thickness.
 6. Welding rods: Oxwall No. 1-HT Class EG010, or equal.
 7. Fabricated fittings are not acceptable
 8. Connections:
 - a. Slip-on flanges shall be both face and back welded.
 9. Hammer each pass clean of slag and scale.
 10. The Owner reserves the right to inspect and to x-ray test any welds per latest Edition, American National Standard Code for Pressure Piping ANSI/ASME 3.1 Chapter 6, and subsequent Addenda.
- E. Cast Iron Drainage Pipe.
1. Service weight hubless cast iron with stainless steel couplings.
- F. Cast Iron and Concrete Water Pipe.
- Bolted or Neoprene rubber or elastomeric ring joints, when approved, are acceptable. Submit catalog cuts for approval. At cast iron fittings, lead caulked joints are acceptable. Tyler "Tyton" compression joints or equal.
- G. Cast Iron Drainage Pipe.
1. No-hub pipe and fitting with neoprene sleeve ASTM-C-564 and stainless steel or cast iron clamp.
- H. Grooved pipe couplings:
1. Housing fabricated in two or more parts of malleable or ductile iron castings. Coupling gasket or molded synthetic rubber, ASTM D735, Grade No. R615BA. Coupling bolts, oral neck track heavy type with hexagonal heavy units, ASTM A183.
 2. Cut pipe square and ream full size. Grooving and installation shall be in accordance with the coupling manufacturers latest published recommendations.
- I. Stainless Steel Tubing: Cut tubing square and remove Burrs. Make up compression joint following manufacturers assembly specifications exactly.
1. Tube may be bent provided tube fabricating and bending equipment is used, including tubing benders, radius blocks, sawing vise, deburring tools, clamp blocks, slide blocks, and mandrels. Such equipment shall be used by workmen skilled in the bending techniques. Deformed tubing shall be removed and replaced with new tubing.

3.06 ACCESS TO EQUIPMENT

- A. General.
 - 1. Install all piping, equipment and accessories to permit access for maintenance.
 - 2. Any relocation of piping, equipment and accessories required to provide maintenance access shall be accomplished at no additional cost to the Owner.
- B. Access.
 - 1. Provide access doors where any valves, motors and equipment requiring access for servicing, repairs, or replacement are located in walls, chases or above ceilings.
 - 2. The location of access doors shall be coordinated with and installed by the applicable trade installing walls or ceiling.
 - 3. Contractor shall arrange for the necessary openings in the building to allow for admittance of all apparatus.

3.07 INSTRUMENTS

- A. Installation of thermometers.
 - 1. Immediately prior to installation, demonstrate accuracy and calibration by placing all thermometer bulbs in a common media for fifteen minutes minimum.
 - 2. Locate thermometers for ease of reading and removing. Locate in such a way that bulb projects into the flowing fluid stream. Increase pipe size as necessary to accomplish this without increasing flow resistance.
 - 3. Install thermometers with separate sockets. Fill space between bulb and socket with conductive grease.
 - 4. Where thermometers are required but are not readily visible to view, install remote reading instruments.
 - 5. Pipe mounted thermometer schedule:

Location (whether shown on plans or not) Range (Deg.F)

Boiler/Heat exchanger: In both
water inlets and both 30 to 240 deg.
water outlets.

Chilled water coils (single):
In water inlet and outlet 0 to 100 deg.
connection.

Chilled water coils (bank):
In water inlet 0 to 100 deg.
and each coil outlet.

Heating hot water coils (single):
In water inlet and outlet 30 to 240 deg. connections.

Heating hot water coils (banks):
In water inlet header and 30 to 240 deg.
each coil outlet.

Water chiller:

Chilled water and condenser
water inlet and outlet 0 to 100 deg.
connections.

B. Installation of pressure gauges.

1. Install pressure gauges installed on insulated pipe or equipment with extension nipples.
2. Locate gauges for ease of reading and removing.
3. Install all gauges with shut-off needle valves, Crane No. 88, for steam and liquids; seal cap valves for refrigerant service.
4. Install gauges on steam lines with siphons.
5. Mount gauges on reciprocating machinery on a resiliently mounted gauge board.
6. Install one gauge between the suction and discharge lines of pumps and inlet and outlet of heat exchangers, coils and control valves with shut-off valve on each side and interconnecting piping made up flexibly. Gauge connections shall be at the connection to equipment and for pumps shall use the manufacturers connection when provided.
7. The pressure gauge shall be selected with the actual operating pressure of the system is at the middle third of the dial range.

3.08 SLEEVES, CORE DRILLING AND ESCUTCHEONS

A. Sleeves.

1. General.
 - a. Provide pipe sleeves where each pipe or prefabricated pipe conduit passes through floors, walls, or ceilings, whatever the construction.
 - b. Provide minimum of 1/2" clearance around all sides of pipe and extend full thickness of the construction. Where piping is to be insulated, allow for full thickness of insulation, plus 1/2" clearance all around.
 - c. Cast iron sleeves: Secure waterproofing membrane under flashing clamp. Caulk annular space watertight.
 - d. Steel or concrete sleeves: Dry pack in place and caulk annular space.
 - e. Extend sleeves in equipment room floors 2" above finish floor with annular space caulked watertight.
 - f. Extend sleeves in waterproofed floors 1 inch above floor. Use fire retardant material in sleeves through fire separations.
2. Locations and types.
 - a. For walls below grade or floor slabs on grade, provide permanent sleeves of clay pipe, concrete pipe or cement asbestos pipe. Where sleeves can not be installed, such as at connections to floor drains, take necessary precautions to assure that drains or pipes are not in contact with reinforcing steel. Caulk space between pipes and pipe sleeves with oakum and mastic and make

watertight.

- b. For all other walls, ceilings, roof and floor slabs provide USS No. 24 gauge steel or fiberboard sleeves, as made by Miracle Can Company, or metal deck and wall sleeves as made by Adjusto-Crete Manufacturing Company, or Sperzel "CreteSleeves."
- c. Secure sleeves to metal or wood forms so that they will not become displaced during pouring of concrete. Fill sleeves on decks with sand.
- d. Remove sleeves from openings after forms have been removed from concrete.
- e. Cut proper sized holes in concrete to replace metal sleeves that are crushed or knocked out of position during pouring of concrete.
- f. Provide sleeves through all other (non-concrete) construction of the same materials as pipe of size and length as hereinbefore required.
- g. Where piping must pass through floor beams or footing walls, fasten sleeves in the forms. Locate these in the middle third of the beam and as near the center as practical. The inside diameter shall not be more than 1/2" larger than the outside diameter of the pipe and the Contractor shall be responsible for setting each sleeve at the exact location and elevation required, and at the correct angle to conform with the grade of the piping.

B. Core Drilling.

- 1. Size core drilling holes adequately to allow for dry packing sleeves in place; to allow for insulation to extend through holes; to allow for fireproof caulking of clearance around pipes to prevent direct contact between pipes and structures.
- 2. Locations of core drilling shall be approved by the Architect prior to drilling.

C. Escutcheons.

- 1. Provide chromium plated escutcheons with screw or spring clamping device on all piping that penetrates floors, walls and ceilings where exposed to view. Escutcheons shall completely cover opening.

3.09 STRAINERS

A. General.

- 1. Strainers shall be full line size.
- 2. Valve blow-down connection with a gate or ball valve sized same as the connection. Plug valves not piped to drain.

B. Location.

- 1. Ahead of each automatic control valve for both steam and water service.
- 2. Where shown on the drawings.
- 3. At each pump inlet.

3.10 FLASHING

- A. Flash each pipe passing through the roof with 4-pound sheet lead with full length sleeves or with vari-pitched one-piece flashing with steel reinforcing boots. Joints shall be lead burned with smooth, neat finish, and bases shall extend 8" away from the sleeves or boots.
- B. Seal tops of flashings and counterflash with cast iron counterflashing units having permanently fastened lead caulked or threaded joints.
- C. Flash engine exhaust piping as shown in detail on the drawings. Use ventilating thimble around exhaust pipe passing through walls, partitions, ceilings, or roofs which are constructed of combustible materials. Extend thimble at least nine inches on one side of the wall or other construction and nine inches on other side. Thimble diameter at least six inches larger than the exhaust pipe. Provide drip cap to protect upper end of roof thimble.

3.11 EQUIPMENT SUPPORTS

- A. General.
 - 1. Provide all necessary steel framing supports for equipment for a complete and satisfactory installation.
 - 2. Fit suspended equipment with minimum of three steel rods and bolt base mounted equipment without isolators to floor or platform with one rod or bolt per weight of equipment not to exceed the following. Provide minimum of four sway brace rods at 45 degrees for each item of suspended equipment. Securing rods to the structure shall be as required for pipe hangers.

<u>Rod or Bolt Size</u>	<u>Equipment Weight</u>
3/8"	50 pounds
1/2"	120 pounds
5/16"	225 pounds
3/4"	300 pounds
7/8"	950 pounds

- B. Approval.
 - 1. Submit drawings of miscellaneous supports for approval.

3.12 PIPE WRAPPING

- A. Cleaning and wrapping all underground steel piping.
 - 1. Piping shall be machine coated and wrapped as follows:

Clean
 Prime
 Coal tar enamel
 Fiberglass inter wrap .020"
 Coal tar enamel
 Kraft paper

3.13 CLEANING OF NON PLUMBING PIPING

- A. See Section 23 25 00: Water Treatment

3.14 STERILIZING POTABLE WATER PIPING

- A. After the hot and cold water systems are complete, all fixtures connected, the system flushed out completely and filled with water, the shut-off valve to the water main shall be closed, all

fixture outlets opened slightly and a solution of sodium hypochlorite introduced at the tee located near the water service shut-off valve. The solution shall consist of one gallon of 5 percent sodium hypochlorite to 200 gallons of water or the equivalent thereof. Introduce solution by means of a pump until an Orthotolidin test at each outlet shows residual chlorine. The solution shall be allowed to remain in the system 24 hours, after which, flush the entire system of water piping. Deliver a certificate of performance, signed by the person who did the work and the Contractor, to the Architect.

3.15 STERILIZING DEIONIZED, REVERSE OSMOSIS, AND DISTILLED WATER SYSTEMS

- A. Flush the system clean using the specific process water to be contained in the system until it can be shown that no contaminants exist other than the normal leaching of manufacturing solvents.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION

PART 1 - GENERAL

Division 1 requirements apply to this Section.

1.01 SUMMARY

A. The work includes, but is not limited to the following:

1. Identification of the following:

- a. Valves.
- b. Equipment.
- c. Ductwork.
- d. Piping.
- e. Apparatus.

2. Preparation of the following:

- a. Charts of pipe mounted devices.
- b. Identification charts.

B. Related Sections:

- 1. Section 22 05 00: Basic Materials and Methods
- 2. Section 22 13 00: Drainage System
- 3. Section 22 11 00: Domestic and Industrial Water System
- 4. Section 22 40 00: Plumbing Fixtures
- 5. Section 22 25 00: Water Treatment
- 6. Section 23 80 00: Air Conditioning and Air Handling Equipment
- 7. Section 23 31 00: Air Transmission and Distribution System

1.02 SUBMITTAL DATA

A. Requirements: In addition to the requirements of Section 23 00 00, GENERAL PROVISIONS, the submittal material shall include six (6) copies of descriptive data for all products and materials including, but not limited to, the following:

1. Descriptive data.

- a. Valve tags.
- b. Apparatus nameplates.
- c. Nameplates.
- d. Stencils.
- e. Pipe identification.
- f. Chart frames.

2. Shop drawings.

- a. Identification charts.

PART 2 - PRODUCTS

2.01 PRODUCTS

A. Tags for pipe trim.

1. Tags for heating, ventilating and air conditioning valves and other pipe devices such as strainers, flex connections, etc., shall be 22 ga. min. thick by 2" square, brass inscribed with a 3/4 inch high identification number with No. 18 brass jack chain.
2. Tags for all other service valves and other pipe devices such as strainers, flex connections, etc., shall be 22 ga. min. thick by 2" diameter brass inscribed with a 3/4 inch high identification number with No. 18 brass jack chain.
3. Numbers identifying trim shall be engraved or stamped or a combination.

B. Apparatus identification.

1. Nameplates for apparatus not installed inside control electrical cabinets shall be black Lamacoid nameplates with beveled edges and white lettering engraved through the black layer.
2. Nameplates for apparatus installed inside control or electrical cabinets shall be with beveled edges and 1/8" minimum high letters and numerals embossed on aluminum or plastic tape labels.

C. Equipment identification: Equipment identification shall be black phenolic nameplates with 1/2 inch high white cut letters.

D. Warning signs for hazardous equipment or materials shall be red phenolic plates with 1/2" high white cut letters and beveled edges.

E. Pipe identification:

1. Piping markers shall be snap-on- outdoor grade acrylic plastic. Snap-on pipe markers shall be Setmark as manufactured by Seton Nameplate Corporation, Tel. No. (800) 451-7084, Westline Products or approved equal. Markers shall be printed on background colors, with arrows for direction of flow. Each marker shall completely band the diameter of the pipe with or without insulation.

Size of Legend Letters and
Length of Color Field

Outside Diameter of Pipe or Covering	Length of Color Field	Size of Letters and Arrows
Inches	Inches	Inches
3/4 to 1-1/2	8	1/2
1-1/2 to 2	8	3/4
2-1/2 to 6	12	1-1/4

- F. Ductwork identification: Identification of wrapped ducts shall be on metal plates attached to the insulation tie wires. Identification of metal ducts shall be stenciled with 2" black lettering and 1" X 6".
- G. Chart Frames: Self-closing satin finished extruded aluminum valve chart frames with glass window Style 37386.

PART 3 - EXECUTION

3.01 PIPE TRIM IDENTIFICATION

A. General

1. All valves and pipe mounted devices shall have numbered identification tags.
2. Secure tags to valves and devices. Secure around insulation for cock, ball valves and other fully insulated devices.
3. For valves that are equipped with chain operators, provide an additional tag and secure to the hook or clip that supports the swagged chain.

3.02 APPARATUS IDENTIFICATION

A. General

1. Provide nameplates for the following types of apparatus:
 - a. Each starter, disconnect switch provided under the work of Division 22 and 23.
 - b. Each panel or cabinet mounted instrument.
 - c. Each panel or cabinet mounted control and item of electrical interlock equipment.

3.03 EQUIPMENT IDENTIFICATION

A. General

1. Provide nameplates for, but not limited to, the following types of equipment:
 - a. Fans.
 - b. Filter banks.
 - c. Pumps.
 - d. Packaged equipment.
 - e. Water heater.
 - f. Air handling equipment.
2. Mechanically secure nameplates in place next to the manufacturer's nameplate wherever possible.
3. Identify equipment out of view behind plenum or other access doors in equipment and other unfinished rooms on the face of the access door.

3.04 PIPE IDENTIFICATION

A. General

1. Identify all exposed and concealed but accessible piping whether insulated or not by content, size of pipe, and the direction of flow indicated, with snap-on markers. As a minimum, identification shall be the abbreviations scheduled in the legend or shall be as scheduled hereinafter.
2. Install identifying markers adjacent to all valves on each piping system.

B. Furred spaces: Piping installed in inaccessible furred spaces will not require identification except at valve access panels where valves and piping shall be identified.

C. Locate piping identification markers so as to be readily visible from any reasonable point of observation. Where two (2) or more pipes run parallel, the printed legend and other markers shall be applied in same relative location. All identification at eye level, shall be along center line of pipe, above eye level on the upper quarter of pipes. Where view is unobstructed from two directions, two sets of identification shall be applied visible from each direction. Apply the legend, flow arrow, etc., at all valve locations, or at all points where piping enters and leaves a partition, walls, floor, or ceiling and at intervals of 20 feet or less.

D. Schedule

1. Legend

<u>CONTENTS OF PIPE</u>	<u>LEGEND</u>	<u>COLOR</u>	<u>NOTE</u>
<u>FUEL SYSTEMS</u>			
Fuel Gas	Fuel Gas	Y	#
<u>PLUMBING & SANITARY SYSTEMS</u>			
Domestic Cold Water	Cold Water	G	#
Domestic Hot Water (105 degrees)	Hot Water	Y	#
Domestic Hot Water Return (105 degrees)	Hot Water Return	Y	#
Indirect Drains	Drain Water	G	#
Sanitary Vent	Vent	-	-
Sanitary Soil or Waste	Sanitary Sewer	G	#

2. Notes on schedule.

- a. Symbol # indicates Flow Arrow.

3. Colors.

- a. Symbol G indicates green background color with white letters and arrows.
- b. Symbol Y indicates yellow background color with black letters and arrows.

3.05 CEILING TILE IDENTIFICATION

Above removable ceiling tile, provide colored tape or ribbon marking to indicate location of all valves, dampers, damper motors, or other equipment so that ceiling installers may install colored buttons to indicate and identify these items.

3.06 IDENTIFICATION CHARTS

A. General

1. Permanently identify all piping systems, controls, valves, apparatus, etc.

B. Valve charts

1. Prepare charts and diagrams for each piping system, indicating by identifying the number of each valve and other pipe mounted device in the system, and it's location and function.

C. Pipe charts

1. Prepare identification charts for piping systems in accordance with the pipe identification schedule.

D. Mounting of charts

1. Mount one of each chart in wood or aluminum frame with clear glass front and mechanically secure on wall where designated by the Architect.

E. Binding of charts

1. Bind copies of each chart in Operating Instructions Manual.

END OF SECTION

SECTION 22 07 00

INSULATION

PART 1 - GENERAL

Division 1 requirements apply to this Section.

1.01 SUMMARY

- A. The work includes, but is not limited to the following:
 - 1. Insulation of piping systems.
 - 2. Insulation of air duct system.
 - 3. Insulation of equipment.
- B. Related Sections:
 - 1. Section 22 05 00: Basic Materials and Methods
 - 2. Section 22 11 00: Domestic and Industrial Water System
 - 3. Section 23 80 00: Air Conditioning and Air Handling Equipment
 - 4. Section 23 31 00: Air Transmission and Distribution System

1.02 SUBMITTAL DATA

- A. Requirements: In addition to the requirements of Section 23 00 00, GENERAL PROVISIONS, the submittal material shall include six (6) copies of descriptive data for all products and materials including, but not limited to, the following:
 - 1. Descriptive data:
 - a. Piping insulation.
 - b. Ductwork insulation.
 - c. Equipment insulation.
 - d. Adhesives.
 - e. Fasteners.
 - f. Sound ratings.
 - 2. Shop drawings:
 - a. Removable type insulation.
 - 3. Requirements of this section apply to all sections in this Division, except as may be specifically modified in those sections.
 - 4. Requirements of this section are in addition to any similar or more comprehensive requirements in other sections of this Division.

1.03 INSPECTION OF CONDITIONS

- A. Examine related work and conditions before starting work of this section. Report in writing to Architect conditions which will prevent proper execution of this work. Starting work in this section

without reporting unsuitable conditions to Architect constitutes acceptance of conditions by the Contractor. Any required removal, repair, or replacement of this work caused by unsuitable conditions shall be done at no additional cost to Owner. Particular attention to be applied to ready service access to balancing dampers, etc.

1.04 CODES AND STANDARDS

- A. ASTM E84 - "Test for Surface Burning Characteristics of Building Materials".
- B. NFPA 255 "Test for Surface Burning Characteristics of Building Materials".
- C. California Building Code, as applicable.

1.05 QUALITY ASSURANCE

- A. Identification of Materials. All packages or standard containers of insulation, jacket material, cements, adhesives, and coating delivered for use, and all samples required for approval shall have a manufacturer's stamp or label attached giving the name of the manufacturer and brand and a description of the material.
- B. Fire Hazard Rating. Insulation materials, adhesives, coatings, and other accessories shall have a fire hazard rating, not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed in accordance with ASTM E84, NFPA 225, or UL 723.
- C. Applicator Qualifications. The application of all insulation materials, accessories and finished shall be in accordance with the manufacturer's recognized installer, with State of California C-2 License. Submit proof of license to Owner's Representative.

1.06 COORDINATION

Coordinate with other Sections in this Division for installation of the work under this Section.

PART 2 - PRODUCTS

2.01 INSULATION

A. General:

- 1. Refer to the individual Mechanical Sections of specifications for location and type of insulating system required.
- 2. If not specifically required otherwise in the individual sections, service and type shall be as follows:

Piping Service	Thickness	Type
Domestic Hot Water Supply & Return	1"	P-1
Domestic Hot Water Supply & Return (up to 120°F)	1"	P-5
Refrigerant Suction	1-1/2"	P-2
Refrigerant Suction	1"	P-5
Condensate Drains	3/4"	P-2

*Insert thickness shall match pipe insulation.

** Not in two hour rated enclosure.

Duct Service, Wrapped

Supply Air Ducts - Concealed	2"	D-1

Return Air Ducts - Concealed	2"	D-1

Supply Air Ducts - Exposed

outdoor/indoor	2"	D-2

Return Air Ducts - Exposed

outdoor/indoor	2"	D-2

Duct and Plenum Service, Lined

Supply Air Ducts*	1-1/2"	DL-1

Return Air Ducts	1-1/2"	DL-1

* All ducts within ten feet of any fan, or as indicated on the drawings shall be lined.

** Thickness same as height of plenum seams, or 1- 1/2", whichever is thicker.

3. Installed products shall be in accordance with the requirements of NFPA Standards No. 90A and No. 90B and UL classification with maximum of flame spread 25, fuel contribution 50, and smoke development 50.

2.02 PIPE INSULATION

A. Type P-1 Insulation, to 450 Degrees F. Temperature:

1. Insulation shall be one-piece preformed glass fiber insulation with integral all-purpose fire retardant, glass yarn scrim laminated, white jacket, "K" factor shall be 0.23 maximum at 75 degrees F. mean temperature.

2. Manufacturer: Insulation shall be Manville

Micro-Loc AP-T, Owens-Corning Fiberglass, P.P.G., CTM, Certain-Teed, Armstrong or approved equal. Adhesive shall be Benjamin Foster 85-20.

B. Type P-2 Insulation, Low Temperature:

1. Insulation shall be one-piece preformed fiber glass with integral all-purpose fire retardant, glass yarn scrim laminate, white vapor barrier jacket, "K" factor shall be 0.22 maximum at 75 degrees F. mean temperature.

2. Manufacturer: Glass fiber insulation shall be Manville Micro-Loc AP-T, Owens Corning Fiberglass or Certain-Teed, Armstrong or approved equal. Adhesive shall be Benjamin Foster 85-20.

C. Type P-5, Polyolefin Foam Pipe Insulation, 210°F and below:

1. Insulation shall be closed cell polyolefin foam pipe insulation with maximum flame spread of 25 or less and maximum smoke development of 50 or less. "K" factor shall be 0.24 at 75°F mean temperature. No vapor barrier jacket is necessary if the polyolefin foam insulation has a water vapor transmission rate of .02 perm-inch or less. No weatherproof jacketing is necessary if the insulation is U.V. stabilized and the manufacturer warrants its outside use without jacketing.

2. Manufacturer: Insulation shall be IMCOA IMCOLOCK/IMCOSHIELD or approved equal. Adhesive shall be IMCOA Fuse-Seal System.

2.03 DUCT AND PLENUM INSULATION

A. General:

1. Pins for securing insulation shall be either percussion welding type or shall be cemented in place type by Sticklips Type B, Goodlow E. Moore, Omark-Graham or S.K.M. Pins shall be 1-1/2" diameter or 1-1/2" square with beveled corners type washer for securing insulation. Pressure sensitive type adhesives are not acceptable.

B. Type D-1 Insulation - Ductwork Concealed:

1. Insulation shall be inorganic glass fiber flexible blanket with facing of aluminum foil reinforced with fiberglass yarn scrim laminated to 40-5016 Kraft. Insulation shall have a "K" factor of 0.29 maximum at 75 degrees F. mean temperature, 0.75 PCF, density.
2. Manufacturer: Insulation shall be Manville R series Microlite, with FSK aluminum foil facing, CTM, Owens-Corning Fiberglass, Certain-Teed, or approved equal. Adhesive shall be Benjamin Foster 81-99.
3. Insulation shall be extended over the point of connection on flexible duct to maintain vapor barrier continuity.

C. Type D-2 Insulation - Ductwork Exposed:

1. Insulation shall be 6-lb. density inorganic glass fiber, non-flexible with pre-sized glass cloth vapor barrier jacketing. Insulation shall have a "K" factor of 0.22 maximum at 75 degrees F. mean temperature.
2. Manufacturer: Insulation shall be Manville Spin Glas 800 Series, Owens-Corning Fiberglass, Certain-Teed or approved equal. Adhesive shall be Benjamin Foster 81-99.

D. Type DL-1 Lining:

1. Lining shall be 1-1/2 lb. density semi-rigid fiber glass blanket coated one side with a fire resistant acrylic water base containing a biocide that will not support microbial growth.
2. Lining shall have a "K" fiber factor of 0.25 maximum at 75 degrees F. mean temperature and noise reduction coefficient of 0.70 or higher based on Type "A" mounting.
3. Manufacturer: Lining shall be Manville Permacote, Owens-Corning Fiberglass, Certain-Teed, P.P.G., or approved equal.

2.04 ADHESIVES

- A. Pipe: Benjamin Foster, Goodlow E. Moore Co., Permacel, 3M Co., Swift Chicago Mastic, or approved equal.
- B. Ducts and Plenums: Benjamin Foster Goodlow E. Moore Co., "Tuff Bond No. 6", Permacel No. PA-310, 3M Co. "Insulation Adhesive" Swifts No. 7228 for brush, 7336 for spray or Chicago Mastic 17-461 or approved equal.

2.05 WEAR PROTECTIVE JACKETING

- A. Canvas jacketing shall be eight ounces per square foot weight, fire resistant treated and UL labeled for flame spread less than 25 and smoke development less than 50.
- B. Fiberglass jacketing shall be 7.8 ounces per square foot in weight.

- C. Lagging adhesive shall be Arabol 60-89-05, Foster 30-36 Tuff Bond 21 W or 21 C, or approved equal.

2.06 WEATHERPROOF PIPE JACKETING

- A. Jacketing shall be .016" thick corrugated aluminum or .010" thick stainless steel with kraft paper and asphalt backing. Jacketing for high temperature pipe insulation may be without backing. Jacketing shall be fitted with a locking type longitudinal seam.
- B. Fittings shall be jacketed with factory formed aluminum two piece as recommended by the manufacturer.
- C. Jacketing shall be Manville "Metal-On," Pabco "Alumi-Shield," Owens-Corning "Kaylo-Klad," Childers, or approved equal.

PART 3 - EXECUTION

3.01 APPLICATION OF PIPING INSULATION

- A. General:
 - 1. All piping shall be insulated. Unions which are integral with valves shall be insulated. All flanges, union, fittings and valves shall be insulated with preformed insulation with PVC pre-molded one piece fitting cover. Manville Zeston 2000. Readily removable insulation on certain items shall be as specified hereinafter.
 - 2. All insulation seams shall be placed on top or opposite to exposed or visible side of insulation.
 - 3. Pipe surfaces shall be cleaned of dirt, grease and other foreign substances and be dry.
 - 4. All insulation for pipe temperatures under 450 degrees and located in equipment rooms or otherwise exposed to view inside the building shall be canvas jacketed.
 - 5. All insulation for pipe temperatures 450 degrees F. or higher and located in equipment rooms or otherwise exposed to view inside the building shall be glass cloth jacketed.
 - 6. All weather exposed piping and equipment insulation shall be protected with metal jacketing.
 - 7. Take special care, where glass fiber insulation butts flanges, or is discontinued, to taper insulation to pipe to allow for the finish jacket to completely seal off the end of the insulation. Extend insulation on valve bodies up to the valve bonnet. Protect insulation at supports or hangers by means of pipe saddles or with steel shields. Fill the void in saddles with insulation and seal all joints.
 - 8. Insulation materials in return air plenum above ceiling shall be non-combustible material or Class I rating 25-50-50 for flame spread and smoke developed.
- B. Type P-1 and P-2 Insulation shall be applied as follows:
 - 1. All joints shall be tightly butted together.
 - 2. Adhere longitudinal laps and butt strips of jacket with factory applied pressure sensitive tape system, Manville AP-T.
 - 3. Insulate all fittings and elbows with preformed mitered sections of same insulation as piping with PVC premolded, one piece fitting cover, Manville Zeston 2000, with jacket.

4. Strainer bodies, valves, flanges, unions and pressure reducing valves shall be insulated with readily removable sections of E-1 or E-2 insulation for applicable temperatures, for easy removal of insulation when servicing.
5. Jacket the removable section with glass cloth and insulating cement and secure in place with 1/2-inch wide mechanically fastened plastic or aluminum strapping.
6. Provide Type P-4 insert section and shield or a saddle at each support.
7. Provide vapor barrier mastic coating to form an isolating vapor seal between the piping insulation jacket and the pipe at butt joints of insulation at fittings, flanges, valves, hangers and at 21-foot intervals on continuous pipe run.
8. For all exposed piping and piping in Mechanical Rooms, all insulation shall be covered with 8-oz. canvas jacket pasted in place with silicate of soda. Lap of canvas jacket shall be next to wall or ceiling. Canvassed piping shall be sized with Benjamin Foster or Arabol lagging adhesive. Ends shall be canvassed and sealed. Canvas and adhesive shall comply with NFPA 90A.

E. Type P-4 Rigid Insert Sections:

1. Install insert sections on insulated piping centered under each hanger. Vapor barrier and jacketing shall be continuous over insulation. Insulation shield shall be provided per Section 15050, para. 2.09, E.

F. Type P-5:

1. Insulation shall be applied as follows:
 - a. All joints shall be tightly butted together and sealed with IMCOA Fuse_Seal System.
 - b. Adhere longitudinal laps with factory applied pressure sensitive tape system, IMCOA IMCOLOCK.
 - c. Fittings, flanges and valve bodies shall be insulated with insulation of same thickness as the adjacent.
 - d. Refrigerant suction piping shall not be insulated until the system has been pressure tested and operated for three eight hour days to assure no leaks develop.
 - e. Secure exposed and concealed piping by using plastic or metal hanger shields. Install support devices such as cork, wooden dowels, plastic (polyethylene) dowels between the insulation and the hanger.

3.02 APPLICATION OF JACKETING

A. Canvas Jacketing.

1. Apply jacketing soaked with lagging adhesive for a shrink tight fit. Lap ends 1-inch with a 1-inch longitudinal lap of 1-inch located out of sight. When dry, apply one brush coat of lagging adhesive.

B. Glass Cloth Jacketing.

1. Apply jacketing with adhesive stretched tight. Lap 1-inch. Longitudinal lap shall be 1-inch and located out of sight. Apply one brush coat on lagging adhesive.

C. Metal Jacketing.

1. Butt the jacket end joints with aluminum sealing bands over sealing compound, and secure with aluminum strapping. Secure an additional aluminum strap at center of each section. The distance between a joint sealing band and a securing band shall not exceed 18-inches. The longitudinal seam shall be of Pittsburgh-lock type. At ells and tees, insulation and jacket shall be factory fabricated fittings or shall be mitered and butted to form a 90-degree turn, or tee, secured with additional aluminum bands, as required.

3.03 APPLICATION OF DUCT AND PLENUM INSULATION

A. General:

1. Clean all duct surfaces of dirt, grease and other foreign substances.
2. Cement for stick-in-place type pins shall be an adhesive especially

B. Type D-1 (Concealed):

1. Cut insulation long enough to avoid the reduction of insulation thickness at the duct corners.
2. Butt edges tightly together.
3. Adhere insulation to ductwork with fire resistant adhesive spot applied on 1-foot centers with insulation conforming to duct surfaces uniformly and firmly.
4. In addition to adhesive, secure insulation on ducts 24-inches and wider on the bottom side with mechanical fasteners on maximum 18-inch centers. Clip protruding pin ends flush with the washers.
5. Vapor seal pins and clips with vapor barrier mastic or 3-inch wide pressure sensitive tape which match the insulation facing.
6. Secure insulation in place with No.16 gauge galvanized wire ties spaced not over 12-inches on center. Wire ties shall be placed within 2-inches on both sides of each standing seam and reinforcement.
7. Seal all joints with minimum 3-inch wide vapor barrier pressure sensitive tape or 3-inch wide tapes and fire resistant adhesives.
8. Patch all cuts and tears same as the sealing of the joints.
9. Wrap insulation entirely around duct with all joints lapped at least 3-inches.

C. Type D-2 (Exposed):

1. Cut insulation to the exact size to snugly fit the duct exterior without voids, overlaps, buckles and reduction of thickness at the corners.
2. Tightly butt longitudinal seams and edges tightly together.
3. Secure insulation to ducts with adhesive spot applied on 1-foot centers and pin spaces on 12-inch centers with a minimum of two rows per side.
4. Cut off protruding ends of pins flush with washer.
5. Vapor seal pins and washers with white prefinished fastening caps.
6. Seal all joints and seams with a fire retardant vapor barrier adhesive reinforced with a 3-inch wide vapor barrier tape to match the jacketing.

7. Cut off insulation at standing duct joints and reinforcing angles. Cover joints or angles with an additional layer of insulation adhered with fire retardant adhesive and edges finished with 3-inch wide vapor barrier tape to match the jacketing.
8. Weatherproof the entire exterior surface with one coat of arabol type lagging adhesive, and cover entirely with galvanized sheet metal or aluminum for waterproofing, for ductwork above roof or exposed to weather.

D. Type DL-1 Lining.

1. Adhere duct liner to interior metal surface with 100% coverage of liberally applied fire resistant adhesive.
2. On ducts over 20-inches in width or depth, additionally secure the liner with either bolts and washers or pins with washer, on 16-inch maximum centers. Locate fasteners within 2-inches of lining leading edge of each section and within 3-inches of all cross joints. Bolts shall be 1/8-inch diameter.
3. Heavily coat all edges of the liner with fire resistant adhesive. Recoat all butt joints.
4. Accurately cut the liner to assure closing corners and tightly butting joints.
5. Coated surface shall face the air stream.
6. Repair breaks and abrasions with adhesive and mechanical fastening to assure a continuity of the surface.
7. Install insulation in square turns so as to cover all interior surfaces before the duct-turns are installed.

END OF SECTION

SECTION 22 08 00

EQUIPMENT AND SYSTEMS TESTS

PART 1 - GENERAL

Division 1 requirements apply to this Section.

1.01 SUMMARY

- A. The work includes, but is not limited to the following:
 - 1. Pressure testing of piping systems.
 - 2. Pressure testing of ductwork.
 - 3. Balancing water systems.
 - 4. Balancing air distribution systems.
- B. Related Sections
 - 1. Section 22 13 00: Drainage System
 - 2. Section 22 11 00: Domestic and Industrial Water System
 - 3. Section 23 80 00: Air Conditioning and Air Handling Equipment
 - 4. Section 23 31 00: Air Transmission and Distribution System

1.02 QUALITY ASSURANCE

- A. Qualifications of Agency and Personnel: Obtain the services of a qualified independent testing organization, acceptable to the Architect, to perform the testing and balancing work as herein specified. The testing organization shall submit proof that it meets the technical standards for membership in the AABC as published in the AABC; or, the organization is a member of the Associated Air Balance Council; or, certified by the National Environmental Balancing Bureau (NEBB). The testing organization shall not be affiliated with the installing mechanical contractor.
- B. Performance Criteria: Work shall be performed in accordance with the approved Testing, Adjusting and Balancing (TAB) Agenda.
- C. Test Equipment Criteria: The basic instrumentation requirements and accuracy/calibration required by AABC Section II or the NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.

1.03 THE TESTING, ADJUSTING AND BALANCING AGENDA:

- A. Definition: The proposed procedures and proposed forms, diagrams and reports for documenting the testing, adjusting and balancing work.
- B. Preparation: By the testing, adjusting and balancing agency for review and approval by the Architect.
- C. The Agenda shall include one complete set of the AABC or NEBB publications listed in Paragraph 1.05 C, applicable publications.
- D. The agenda shall also include the following detailed narrative procedures, system diagrams and forms for test results.
 - 1. Specific standard procedures required and proposed for each system.

2. Specified test forms for recording each procedure and for recording sound and vibration measurements. Additional test forms for any variable flow systems shall be developed by TAB agency and submitted for review and approval.
3. Systems diagrams for each air, water and steam system. Diagrams may be single line. In addition to the information recorded by standard AABC or NEBB procedures, report the following information:
 - a. Air handling units: Prepare pressure profile and show design and actual CFM (outside air, return air, supply air). Measure and record each mode (minimum outside air and 100% outside air) where economizer cycle is specified. Record pressure drops of all components (coils, heat recovery devices, filters, sound attenuators, louvers, dampers, fans) and compare with design values. Pressure profile and component pressure drops are performance indicators and are not to be used for flow measurements.
 - b. Duct distribution systems: Prepare pressure profiles from the air handling unit to the extremities of the system. As a minimum, show pressures at each floor, main branch, and air flow measuring device. Make pitot tube traverses of all trunk lines and major branch lines where required for analysis of distribution system. Air flow measuring devices installed in ductwork, if available, may be utilized. Record residual pressures at inlets of volume controlled terminals at ends of system. Show actual pressures at all static pressure control points utilized for constant or variable flow systems.

1.04 SUBMITTAL DATA

- A. Requirements: In addition to the requirements of Section 23 00 00, GENERAL PROVISIONS, the submittal material shall include six (6) copies of descriptive data for all products and materials including, but not limited to, the following:
 1. Descriptive Data:
 - a. Statement of qualifications of independent testing agency.
 - b. Air flow measuring devices.
 - c. Pressure gauges.
 - d. Thermometers.
 - e. Other testing instruments.
 - f. Certificates of calibration of test instruments.
 2. Sample Forms:
 - a. Complete forms proposed for use in compiling and recording test data.
- B. Work Certification: Submit the name of the organization proposed to perform the work described in the Section for review within 35 days after contract award. Include in the submittal the certified qualifications of all persons responsible for supervising and performing the actual work.
- C. Upon approval of the testing, adjusting and balancing agency, submit agenda for approval.
- D. After completion of tests submit complete test reports for approval. Where test results differ from specified design conditions, indicating a contract deficiency, include explanatory comments in report. Contractor shall submit final reports prior to requesting the final inspection for the project.

1.05 APPLICABLE PUBLICATIONS

- A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referred to by the initials of the organization.

- B. American Society of Heating Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE) Latest Edition.
- C. Associated Air Balance Council (AABC):
National Standards for Field Measurement and Instrumentation Total System Balance, Fourth Edition.
- D. American Society of Mechanical Engineers (ASME):
- E. American Society for Testing and Materials (ASTM):
B4486-74.....Paste Solder
B88-78.....Seamless Copper Water Tube,
B280-76.....Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
D635-50.....Rate of Burning and/or Extent and Time of Burning of Self-supporting Plastics in a Horizontal Position,
D1693-70.....Environmental Stress-Cracking of Ethylene Plastics,
- F. National Fire Protection Association (NFPA):
70-1987.....National Electric Code
90A-1985.....Installation of Air Conditioning and Ventilating Systems
- G. Scientific Apparatus Makers Association (SAMA): Standard PMC 20, 1-1973. Process Measurement and Control Terminology
- H. Underwriters Laboratories (UL)
- I. National Environmental Balancing Bureau (NEBB)

1.06 PRODUCT HANDLING

- A. Protection: Protect installed work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements at no additional cost to the Owner.

1.07 COORDINATION

- A. Coordinate all activities in accordance with provisions of Section 23 00 00.

PART 2 - PRODUCTS

2.01 PRODUCTS

- A. General: Products and materials shall be described in the pertinent Sections of the Mechanical Specifications.

PART 3 - EXECUTION

3.01 REQUIREMENTS

- A. General

1. Contractor shall notify the Architect at least 48-working day hours in advance of the time when any test is to be performed.
 2. As required hereinafter, the Contractor will arrange and pay for special testing agencies. The Contractor shall provide, install and remove on completion of tests all special fittings, openings and other devices as needed to perform the tests. Furnish all labor as necessary to start, operate, adjust and modify all equipment and systems for both testing and the verification of tests.
 3. For tests not requiring a testing agency, provide all equipment and instruments required for testing, including fittings for additional openings.
 4. Verification. All test shall either be observed by or the tests rerun and the results verified in the presence of, and approved by a representative of the Architect, at their option as required herein.
 5. Prepare a formal report as required herein.
- B. At least fourteen (14) days before specified occupancy or date of completion of overall contract, the Contractor shall put all heating, ventilating, and air conditioning equipment into operation and shall continue the operation of same during each work day, for not less than 5-eight-hour periods, until all adjusting, balancing, testing, demonstrations, and instructions on the systems have been completed. Final instructions and demonstrations and preparation of reports shall be done during the two week period. When an individual building is ready for occupancy, all above equipment relative to that portion of the work shall be put into service, tested and adjusted.
- C. Coordinate testing, adjusting and balancing procedures with any phased construction requirements for the project so that usable increments of finished work may be accepted for beneficial occupancy. Systems serving partially occupied phases of the project may require balancing for each phase prior to final balancing.
- D. Conduct final procedures after system has been completed and is in full work order. Put all HVAC systems into full operation and continue operation of the systems during each working day. Accomplish testing, adjusting and balancing procedures in accordance with the agenda approved by Architect.

3.02 PIPING PRESSURE TEST

- A. Perform engineering tests required to demonstrate that the operation of the mechanical systems and their parts are in accordance with the Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be made in the presence of the Inspector, the Architect or the Engineer, and the representatives of any governmental agency having jurisdiction. Work shall not be concealed or covered until required approvals are obtained.
- B. Should the Contractor refuse or neglect to perform any test required by the Specifications, the Owner may perform such tests and the Contractor shall pay charges in connection therewith.
- C. Pressure gages used in testing shall have one pound graduations; vacuum gages shall have one inch mercury graduations. Air shall be bled from lines requiring hydrostatic or water tests.
- D. Systems shall be pressure tested in accordance with the Pipe Test Schedule below. Pipe test shall show no loss in pressure after a minimum duration of four hours at the test pressures indicated. Where local codes require higher test pressures than specified herein for Fire Sprinkler Systems, the local codes shall be followed.
- E. Fuel gas lines shall be tested twice: first with piping exposed, before backfilling trenches or

lathing; second with pipe in finished arrangement, ground backfilled (paved where required) and walls finished. Test each joint with soap suds.

- F. Refrigerant piping may be tested using a halide detector or calibrated electronic testing equipment.
- G. Piping systems may be tested as a unit or in sections as directed by the Engineer, but the entire system shall successfully meet the requirements specified herein, before acceptance by the Engineer.
- H. Repair of damage to the pipes and their appurtenances, or to any other structures resulting from or caused by these tests, shall be performed by the Contractor.
- I. Provide a pressure gauge located at the highest point of the system being tested with a shut-off valve and bleeder valve so arranged to check gauge operation.
- J. Test welded joint on piping under 100 psi air pressure with soap suds prior to hydrostatic test.
- K. Subject all welded joints on high pressure systems to hammer test while under hydrostatic pressure.

3.03 PIPE TESTING SCHEDULE

System Tested	Test Pressure (psig)	Test With:
Durham system, glass or plastic acid waste, vent and roof drain (except pipes running under a slab or underground)	Fill with water to top of highest vent, allow to stand two hours, or longer, as directed by Inspector. Minimum head required for any joint shall be 10-feet in building. Extend stack 15-feet above the highest horizontal line to be tested.	Water
Cast-iron soil, waste and interior downspout, condensate drain from air conditioning equipment	15	Water
Domestic water piping (metallic)	200	Water
Gas piping (steel welded)	100 (both tests)	Air

3.04 PROJECT COMPLETION TEST

- A. Upon completion of the mechanical work, or such a time prior to completion as may be determined by the District, all mechanical equipment and systems shall be operated and tested

for a period of at least five consecutive, 8-hour days to demonstrate the satisfactory overall operation of the building or project as a completed unit. The tests shall include the operation of the heating, ventilating, and air conditioning equipment and systems for a period of not less than two, 8-hour, days at not less than 90% of full specified heating and cooling capacities.

- B. The tests shall commence after preliminary balancing and adjustments to equipment and systems have been completed, and all running equipment have been checked and thoroughly lubricated.
- C. Immediately before starting tests all air filter media shall be replaced.
- D. An accurate means of measuring air flow and temperatures shall be used to balance the air supply, return, and exhaust systems, so that uniform temperatures occur in every room and design air flow is obtained through the registers, diffusers, and grilles.
- E. Systems shall be adjusted to provide air flows shown including maximum fresh air and maximum return air. Dampers shall be checked for proper settings and operation. Air and water inlet and leaving temperatures at coils shall be checked. Complete operational data including air flows, room temperatures, fan speeds, motor currents, plenum and duct static pressures shall be tabulated.
- F. Welding done on this project may be subject to radiographic inspections at random in accordance with requirements specified in Section 15050.

3.05 POST CONTRACT TESTS

- A. If the required full load operating conditions cannot be obtained at the time of project completion test, due to unfavorable outdoor temperatures or conditions, the Contractor shall return to the job site when requested by the Architect and operate and test the equipment and systems at such times of the year when proper loading of the system can be accomplished. Such tests shall be conducted within a one-year period from the completion date. The Contractor will be notified at least 10 days prior to the start.

3.06 AIR AND WATER BALANCE; DUCT AND PLENUM PRESSURE TESTING

- A. All testing and balancing shall be performed in complete accordance with AABC National Standards for Field Measurements and Instrumentation, Form No. 12173, Volume Two, as published by the Associated Air Balance Council, or NEBB TAB report forms as published by National Environmental Balancing Bureau (NEBB). All methods and procedures listed in and applicable to Sections on Air and Hydronic Balancing, shall be included and performed, and recorded as though repeated herein.
- B. The testing agency shall visit the job site when fabricated ductwork is delivered and when hanging is in the very early stages and a second time when the installation is well along but before any closing-in, to verify to their satisfaction that all fittings, air volume control devices and water regulating valves are of a type, are properly fabricated and are installed per Specifications and that they will be able to balance the systems as required herein.
- C. All instruments used for air and water balancing shall be furnished and operated by a representative of the testing agency. Provide for the continuous, uninterrupted operation of all systems during the test period.
- D. Make adjustments to valves, dampers, etc.; change drives, add or modify work for compliance with Plans and Specifications.
- E. Make all air volume adjustments by using the manual dampers provided at each branch takeoff. Leave face dampers at inlets and outlets in the full open position unless it is impossible to provide a branch duct of sufficient length to permit the installation of manual dampers. Furnish artificial resistance, equal to dirty filters to the clean filter bank by partially blanking off the filter face area.

- F. Adjust air flow at each inlet and outlet to within 5% of that shown on the Drawings. If volumes within 5% are impossible and with the engineers written approval, the systems may be balanced so that all outlets read within 5% of a fixed percentage of the required air volume.
- G. Procedures shall be as follows:
1. For constant air volume (CAV) reheat, variable air volume (VAV) reheat, exhaust and return air systems, make a single series of tests.
 2. For multizone system, make two series of tests, one with all zones calling for cooling and a second with all zones calling for heating.
 3. Set all zone thermostats for full cooling except where thermostats are not part of the system.
 - a. For VAV systems, set the automatic volume dampers to full open position on supply, return and exhaust systems.
 - b. For multizone systems, measure the air temperature at one outlet for each zone. Adjust the mixing dampers and record final temperatures. Note: Seal damper frames to reduce any hot damper leakage until outlet temperature do not vary by more than two degrees.
 - c. For CAV reheat and single zone systems, record the air temperature for one outlet for each zone.
 4. Set all manual dampers to the full open position including fire dampers and the face dampers at registers and diffusers. Face dampers shall not be utilized for balancing to control air volume unless no other means is possible.
 5. All supply, return and exhaust fans shall be running. For multizone systems adjust the hot and cold plenums to maximum and minimum design respectively.
 6. Measure the total air volume for each fan. Obtain a rough measurement of the total air volume by measuring the average face velocity through the cooling coils or the filters and calculating the CFM. Wherever possible, provide a temporary plenum and/or straight duct section for exhaust fans discharges.
 7. Change fan speeds as necessary to obtain approximately 5% above design air volumes.
 8. Adjust and readjust the manual balancing dampers and fan speeds until all supply, return and exhaust inlet and outlets are within the required percentage of the design air volumes. Readjust fan speed until at least one series of manual dampers from fan to outlet is in the full open position.
 9. Adjust the fan volume automatic controls and dampers to start to close with any sensed decrease in air flow or increase in static as required by the control system.
 10. Set all room thermostats for full heating except where thermostats are not a part of the system.
 11. Repeat steps 4 and 9 for multizone systems.
 12. Return thermostats to their normal setting as required by the controls.
 13. For variable air volume system, set automatic dampers at minimum position to start heating mode. Minimum position shall be as indicated on the VAV box schedule or control usually at 50% of maximum supply air. Make readings of minimum supply air

CFM.

- H. Adjust and record the outside air volume for systems equipped with return-air-exhaust fans. Set outside air to minimum requirements. Verify that supply and return total air volumes remain unchanged when operating on either 100% outside air and exhaust or on minimum outside air.
- I. Record and check the following items at each coil.
 - 1. Temperature of inlet air or water.
 - 2. Temperature of leaving air, water or refrigerant.
 - 3. Air and water pressure drop of each coil.
- J. Paint or otherwise permanently indicate the final or permanent position of each manual damper handle.
- K. Record all fan motor nameplate voltages and amperes and the final actual voltage and amps. Record all pulley and belt sizes.
- L. For closed circuit water circulating systems:
 - 1. Read and record the water volume for each coil, both heating and cooling, either by means of the flow measuring device installed or by installing pressure taps on either side of each coil control valve and utilizing pressure drop and the C_v of the valve, record the gallons per minute. With all automatic valves full open to the coils, adjust the coil flow cocks to deliver either the design volume or an equal percentage of design if design is not possible due to diversity. With all valves full open to by-pass, adjust by-pass so that the most physically remote valves pass the minimum flow required by the chiller manufacturer, the boiler manufacturer or the pump manufacturer, whichever is greater.
 - 2. Read and record pump operating suction and discharge pressure, motor nameplate volts and amperes measured voltage and amperes, chiller and condenser pressure drop, pump curve, chiller, condenser and tower GPM from pressure drop curves or tables. Attach copies of curves or tables.

3.07 OPERATIONAL TEST

- A. Before starting or operating any equipment systems, make a thorough check to determine that all systems have been flushed and cleaned as required and that all equipment has been properly installed, lubricated and serviced. Check factory instructions to see that recommended lubricants have been used in all bearings, gearboxes, crankcases, and similar equipment. Use particular care in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Check equipment for any damage that may have occurred during shipment, after delivery, or during installation. In the event of any damage, replace the equipment or renew or repair to the complete satisfaction of the owner.
- B. Test the performance of all components of equipment under all possible variations of loads, flow conditions, temperatures, etc., which can be simulated on the job by utilizing any of the heating or cooling equipment which is furnished as part of the contract work.
- C. Replace or revise any equipment, systems or work found deficient during tests as required, to the entire satisfaction of the owner. The Contractor shall be responsible for the complete coordination of the piping, wiring diagrams, or control diagrams with the equipment requirements.
- D. Make any final adjustments or balancing found necessary to be made to the equipment or systems, to place them in acceptable operating condition and to the specified performance during any or all of the tests.

- E. Provide, maintain, and pay all costs for equipment, instruments, and operating personnel as required for all tests.
- F. Operate each chiller at steady rate, at full rated capacity for one hour and at minimum required capacity for one half hour. Provide an artificial load by means of portable heaters, temporary heat exchangers, piping, valves, etc., as necessary to accomplish this.

3.08 REPORT

- A. After tests have been approved on the entire system or any portion thereof, the Contractor or the testing agency, as applicable, shall certify in writing the time, data, name and title of the person approving the test. This rough field data shall also include the description and what portion of the system has been approved. The person making the inspection shall sign the certification.
- B. Maintain a complete record of the rough field data of all testing that has been approved, and make available at the job site to all authorities concerned.
- C. The testing company or contractor shall prepare a formal typewritten report, indexed, with stiff covers to contain all the required test data.
- D. The report shall reference all readings to locations on a schematic sketch of the ductwork and piping systems.
- E. Deliver a copy to the Architect for review.
- F. After review, verification and acceptance, one copy of each of these test reports will be furnished to the Contractor for inclusion in each operating instruction manual.

3.09 SOUND TESTING

- A. Perform and record sound measurements as required.
 - 1. Take readings in rooms as designated by the Architect.
- B. Take measurements with a calibrated sound level meter and octave band analyzer of the accuracy required by AABC or NEBB.
- C. Sound reference levels, formulae and coefficients shall be according to ASHRAE handbook, Systems Volume; Chapter: Sound and Vibration Control, latest edition.
- D. Determine compliance with specifications as follows:
 - 1. Where sound pressure levels are specified, including the NC criteria in Section 15240: Sound Vibration and Seismic Control.
 - a. Reduce the background noise as much as possible by shutting off unrelated audible equipment.
 - b. Measure octave band sound pressure levels with specified equipment "off".
 - c. Measure octave band pressure levels with specified equipment "on".
 - d. Use the difference in corresponding readings to determine the sound pressure due to equipment.

DIFFERENCE: 0 1 2 3 4 5 - 9 10 or More

FACTOR: 10 7 4 3 2 1 0

Sound pressure level due to equipment equals sound pressure level with equipment "on" minus factor.

- e. Plot octave bands of sound pressure level due to equipment for typical rooms on a graph which also shows noise criteria (NC) curves.
2. When sound power levels are specified:
- a. Perform steps 1.a. thru 1.d., as above.
 - b. For indoor equipment: Determine room attenuating effect, ie., difference between sound power level and sound pressure level. Determine sound power level will be the sum of sound pressure level due to equipment plus the room attenuating effect.
 - c. For outdoor equipment: Use directivity factor and distance from noise source to determine distance factor, ie., difference between sound power level and sound pressure level. Measured sound power level will be the sum of sound pressure level due to equipment plus the distance factor.
3. Where sound pressure levels are specified in terms of dbA, measure sound levels using the "A" scale of meter. Single value readings will be used instead of octave band analysis.
- E. Where measured sound levels exceed specified level, the installing Contractor or equipment manufacturer shall take remedial action approved by the Architect and the necessary sound tests shall be repeated.

END OF SECTION

SECTION 22 11 00

DOMESTIC AND INDUSTRIAL WATER SYSTEM

PART 1 - GENERAL

Division 1 requirements apply to this Section.

1.01 SUMMARY

A. The work includes, but is not limited to the following:

1. Complete domestic water supply system including:

- a. Valved connection to water purveyor piping.
- b. Required connection to plumbing fixtures and equipment requiring same.
- c. Pumping systems.

B. Related Sections:

- 1. Section 22 08 00: Equipment and Systems Tests
- 2. Section 22 05 53: Identification
- 3. Section 23 00 00: Basic Materials and Methods
- 4. Section 22 07 00: Insulation
- 5. Section 22 13 00: Drainage System
- 6. Section 22 40 00: Plumbing Fixtures

1.02 SUBMITTAL DATA

A. Requirements: In addition to the requirements of Section 23 00 00, GENERAL PROVISIONS, the submittal material shall include six (6) copies of descriptive data for all products and materials including, but not limited to the following:

1. Descriptive data.

- a. Piping.
- b. Partition stops.
- c. Detector checks.
- d. Wall hydrants.
- e. Trap primer valves.
- f. Water hammer arrester.
- g. Valves (gate, check, regulating, pressure, etc.).
- h. Thermostatic mixing valve.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Domestic water piping.
 - 1. Piping shall be Schedule "D" as specified in Section 22 05 00 Basic Materials and Methods.
 - 2. Hot water pipe insulation shall be Type P-1 as specified in Section 22 07 00 Insulation.

2.02 PARTITION STOPS

- A. General.
 - 1. Partition stops shall be cast bronze body with close-pressure type replaceable cartridge.
 - 2. Stops shall be manufactured by Chicago Faucet or Brasscraft.
- B. Partition stops.
 - 1. Fixtures with concealed supplies shall have stops specified with fixture.
 - 2. Fixtures with exposed water supplies and stops shall be polished chrome plated loose key stop type for the following:
 - a. Water closet Chicago Faucet No. 375-LK (3/4").
 - b. Lavatory or sink, Chicago Faucet Co. No. 1017 (3/8").Approved equal by Brasscraft.
 - 3. Fixtures with both supplies and stops concealed in wall: Longneck built-in compression stops, with flange, with extension as required and Chicago No. 1771 (1/2" or 3/4"), or loose key, with exposed parts chrome plated. Chicago Faucet No. 1771 (1/2" or 3/4") or approved equal by Brasscraft.
 - 4. Security fixtures with both supplies and stops located in accessible pipe spaces: rough brass finish as manufactured by Chicago Faucet, or approved equal by brasscraft.

2.03 TRAP PRIMER

- A. Trap Primer:
 - 1. Type TP-1: Corrosion resistant brass body, threaded end inlet and outlet. Trap primer valve shall be as manufactured by Precision Plumbing Products. PR-500 Prime Rite.

2.04 WATER HAMMER ARRESTER:

- A. Water Hammer Arrester:
 - 1. Type WHA-1: Spun closed copper tube chamber with a 60 PSI air charge above a triple O-Ring delrin piston. Three high-heat, Buna-N O-Rings pressure packed and lubricated with Dow-Corning No. 111 FDA approved silicon compound. Sioux Chief "Hydra-Rester"

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

- A. Install piping in accordance with Section 22 05 00 Basic Materials and Methods.
- B. Pressure test in accordance with Section 22 08 00, Equipment and Systems Test.
- C. Insulation.
 - 1. Piping insulation installation shall be as specified in Section 22 07 00 Insulation.

END OF SECTION

SECTION 22 13 00

DRAINAGE SYSTEM

PART 1 - GENERAL

Division 1 requirements apply to this Section.

1.01 SUMMARY

A. The work of this section includes, but is not limited to the following:

1. Building waste and vent systems.
2. Storm drainage.
3. To extend beyond 5'-0" exterior building wall.

B. Related Sections:

1.	Section 22 08 00:	Equipment and Systems Tests
2.	Section 22 05 53:	Identification
3.	Section 22 05 00:	Basic Materials and Methods
4.	Section 23 05 13:	Electric Motors and Controllers
5.	Section 22 11 00:	Domestic and Industrial Water System
6.	Section 22 40 00:	Plumbing Fixtures

1.02 SUBMITTALS

A. Requirements: In addition to the requirements of Section 23 00 00, GENERAL PROVISIONS, the submittal material shall include six (6) copies of descriptive data for all products and materials including, but not limited to the following:

1. Descriptive data.
 - a. Drains.
 - b. Cleanouts.
 - c. Floor sinks.
 - d. Piping materials.
 - e. Pipe hangers and supports.
 - f. Access panels.
 - g. Control panels with wiring diagrams.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General.

1. Piping systems shall be as specified in Section 22 05 00 Basic Materials and Methods.

2. Piping materials shall be as follows:
 - a. Building waste and vent piping: Schedule "G".
 - b. Storm drainage piping: Schedule "H".

2.02 DRAINS AND FLOOR SINKS

A. General.

1. Drains and floor sinks, where installed in construction with waterproof membrane, shall be provided with flashing clamp device with corrosion resistant clamping bolts.
2. Model numbers listed do not necessarily include required sump receiver, clamps and lugs. Modify as required to include these items.
3. Drains requiring trap primer connection shall be provided with trapped bosses.
4. Drains and floor sinks shall be as specified or equal by J.R. Smith, Zurn, Wade, or Josam.

B. Floor Drains: Drains shall be of the following types.

1. FD-1 - Cast iron body and flashing collar with nickel bronze adjustable strainer head. Drain shall have vandle proof screws and trap primer connection. Strainer shall be square pattern for ceramic tile floors and round pattern for other finishes: Smith 2010, Zurn Z-415, Wade W-1100-JK.
2. SH.D-1 - Cast iron body and flashing collar with 5" nickel bronze adjustable strainer head. Drain shall have vandle proof screws. Strainer shall be square pattern for ceramic tile floors and round pattern for other finishes: Smith 2010, Zurn S-415, Wade W-110-JK.
3. FS-1 - Cast iron floor sink, 12" square, 8" deep with seepage flange, flashing collar, aluminum dome bottom strainer, acid resistant porcelain enamel inside and nickel bronze rim and 1/2 and 3/4 grate. J.R. Smith 3150, Zurn ZN-1805.

C. Roof drains (and overflow drains). These drains, if not poured in place, shall be provided with underdeck clamp and sump receiver. Also provide extension collars where required. Drains shall be size 4" unless otherwise indicated on plans, and shall be of the following type:

1. RD-1: Cast iron, roof drain with combined flashing clamp and gravel stop, corrosion resisting clamping units, cast iron dome strainers, and caulk bottom outlet. The gravel stop shall have eight overflow grooves 1/4" wide by 1" deep located 45 degrees apart:

J.R. Smith 1010, Zurn Z-100.
2. OFD-1: Cast iron, overflow drain with flashing clamp, 2" water dam collar, corrosion resisting clamping units, cast iron dome strainer, caulk outlet, under deck clamp, and extension to suit thickness of roof insulation.

J.R. Smith 1080, Zurn Z-100 with water dam.
3. RR-1: Cast iron roof receptor with solid water dam and cast iron dome bottom strainer secured with stainless steel vandle proof screws.

J.R. Smith 3970

D. Gutter Drain.

- 1. GD-1 - Duco cast iron body with bonnet flashing clamp and bronze top secured with brass screws. J.R. Smith figure 1620, Wade W-3240 BD, Zurn Z-180.
- E. Area Drain.
 - 1. AD-1 - Cast iron body and flashing collar with 10" diameter adjustable nickel bronze strainer head.
- J.R. Smith 2005-A

2.03 CLEANOUTS

- A. General.
 - 1. Cleanouts shall be provided in the system located to provide accessibility to all runs of pipe.
 - 2. All cleanout bodies shall be cast iron. Each cleanout plug assembly shall consist of a cadmium plated cast iron plug with untapered thread and a tapered portion which makes a watertight seal against a lead seat, or tapered brass plug which screws into a cast iron collar.
 - 3. Cleanouts shall be as specified by J.R. Smith or equal by Zurn or Wade.
- B. Exterior Cleanouts (in unpaved areas).
 - 1. Cleanouts shall be combination "Y" and 1/8 bend brought up to 6" below grade and terminated with a heavy brass plug.
- C. Interior cleanouts.
 - 1. Floor type shall be cast iron sectional, adjustable with nickel bronze scoriated cover, rim and extra heavy brass plug. When installed in floors with waterproof floors cleanout shall be provided with flashing flange and clamping device J.R. Smith 4023, Wade 6000-75, Zurn Z-1420.
 - 2. Wall type shall be tapped tee with extra heavy brass plug
- D. Exterior cleanouts.
 - 1. In paved areas shall consist of cleanout assembly with cast iron ferrule and extra heavy brass plug located in cast iron housing with scoriated cast iron cover marked "C. O." (J.R. Smith 4235).
 - 2. In unpaved areas, UPC code pattern with brass plug.

2.04 CLEANOUT ACCESS COVERS

- A. General.
 - 1. Access covers shall be as specified by J.R. Smith or equal, Zurn or Wade.
- B. Cleanout access covers.
 - 1. Recessed cleanout access covers shall be type 304 stainless steel, face-of-wall type 12" square, hinged with vandal proof keylock. (Smith 4760).
 - 2. Flush-to-wall.
 - a. Coverplates for flush-to-wall cleanouts shall be polished round stainless steel access coverplate with vandalproof stainless steel counter sunk screw.

(Smith 4710).

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPING

A. General.

1. Piping installation shall be made in accordance with Section 22 05 00 Basic Materials and Methods.

B. Testing.

1. Pressure test shall be in accordance with Section 22 08 00 Equipment and Systems Tests.

3.02 FLOOR SINKS

A. Floor sink installation.

1. Provide floor sinks with cast iron "P" traps.
2. Set floor sinks flush with finished floors.

3.03 INSTALLATION OF DRAINS

A. Floor drains.

1. Provide floor drains with cast iron "P" traps.
2. Vent all floor drains.
3. Provide clamping rings for drains installed in floors with membranes.
4. Set flush with finish floor.

B. Roof drains.

1. Provide underdeck clamps for all roof drains except drains that are poured in-place in concrete roofs.
2. Provide "MG" couplings at connection of roof drain to drain leader.

3.04 INSTALLATION OF CLEANOUTS

A. General.

1. Cleanouts shall be provided in accordance with CPC Title 24 and the Los Angeles County Plumbing Code and in accordance with the following requirements.

B. Horizontal runs.

1. Provide every horizontal run of soil and waste piping with a cleanout at its upper terminal and at intervals of 100 ft., and at end of line serving battery of 3 or more fixtures.
2. Cleanout fittings located in fill below slab floors shall be accessible through cleanout boxes set flush with the finished floors.

3. Provide sewer cleanouts by means of combination "Y" and 1/8 bend at intervals of 100 feet.
 4. All cleanouts must be made accessible.
- C. Underground cleanouts.
1. Except as otherwise noted, cleanouts in unpaved areas shall be brought to within 12" of the finished grade, covered over with earth fill and location indicated by a 12" x 12" x 2" concrete slab marked "SEWER".
 2. Extend cleanouts occurring below asphalt paving or concrete walks to the surface and terminate with cleanout assembly, set flush with finished grade.
- D. Floor cleanouts.
1. Cleanouts in floors shall have an adjustable cast iron housing with bronze or nickel bronze frame and cover appropriate to surrounding finishes; or cast iron frame and cover in unfinished cement floors.
- E. Wall cleanouts.
1. Cleanouts in walls shall be set with centerline or opening perpendicular to wall within 3" of finish line wherever possible and covered with cover plates as specified.
 2. Beneath plate provide 22-gauge galvanized steel sleeves from pipe to wall opening with mastic seal around pipe.
 3. Where distance from surface of wall to cleanout exceeds 3", install 8" x 8" access doors for cleanouts up to 2" and 12" x 12" access doors for cleanouts larger than 2" or any cleanout set at an angle behind the wall.
 4. Install a cleanout in the vent above the fixture tee at each urinal.
- F. Header cleanouts.
1. Offset cleanouts serving a header for more than one fixture above the overflow rim of highest fixture.
- G. Cover plate.
1. All cover plates shall be secured with vandalproof screws. Cover plates in paved areas, concrete or terrazzo floors and walls shall be round. Cover plates in wood or tile floors shall be square, unless otherwise shown on drawings.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

Division 1 requirements apply to this Section.

1.01 SUMMARY

A. The work includes, but is not limited to the following:

1. Plumbing fixtures.
2. Plumbing brass.
3. Fixture supports.

B. Related Sections:

1. Section 22 05 00: Basic Materials and Methods
2. Section 22 13 00: Drainage System
3. Section 22 11 00: Domestic Water System

1.02 SUBMITTAL DATA

A. Requirements: In addition to the requirements of Section 23 00 00, GENERAL PROVISIONS, the submittal material shall include six (6) copies of descriptive data for all products and materials including, but not limited to, the following:

1. Descriptive data.
 - a. Plumbing fixtures including dimensions and pictorial detailing.
 - b. Plumbing brass and trim.
 - c. Drinking fountains.
 - d. Fixture supports.
 - e. Accessible fixture insulation.
2. Shop drawings.
 - a. Fixture backing.
 - b. Roughing-in drawings showing measurements for installation.

PART 2 - PRODUCTS

2.01 PLUMBING FIXTURES

A. General:

1. Fixtures shall be free from imperfections, true to line, angles, curves and color; smooth, water-tight, and quiet in operation. Fixtures shall be installed complete with trim.

2. Fixtures shall be stock items listed in the manufacturer's current catalogue sheets.
 3. All fixtures specified to be of vitreous ware, shall be vitreous china of the best quality, non-absorbent and fired so that the whole mass is thoroughly fused and vitrified producing a material white in color, which when fractured will show a homogeneous mass, close grained and free from pores. The fixtures shall be white, thoroughly fused and united to the body, without discoloration, chips, or flaws and free from cracks. Warped or otherwise imperfect fixtures will not be acceptable.
 4. Plumbing brass: All brass and exposed piping and trim shall be institutional grade, chromium plated unless specified otherwise. Provide brass escutcheons on supplies and wastes. Trim shall be identical for each category of fixture.
 5. Plumbing supplies shall be rough-in ready preformed type "L" copper tube stub outs, with spun closed ends. Do not use red brass or galvanized nipples.
 6. Flush valves shall be chromium plated brass, diaphragm type with vacuum breaker and screwdriver stops. Water closet flush valves shall be provided with resilient seat bumpers.
 7. Flush valves for accessible water closets and urinals shall be equipped to meet with A.D.A. Requirements.
 8. Trap installations, exposed above the floor, shall have chromium plated brass escutcheons plates, casings and Uniform Code Pattern traps.
 9. Where stop valves are required in exposed piping, they shall be short stem, polished chromium plated type.
- B. Plumbing fixtures: Trim and accessories shall be of manufacturer as follows:
1. Fixtures: Acorn.
 2. Sinks (stainless steel): Acorn.
 3. Flush Valves: Sloan.
 4. Seats: Acorn.
 5. Supplies: Chicago Faucet, American Standard, Kohler.
 6. Preformed stubouts: Sioux Chief.
 7. Stops: Chicago Faucet or Brasscraft.
 8. Traps: American Standard, Kohler or McGuire.
 9. Fixture supports: J.R. Smith or Zurn.
 10. Drinking fountains: Haws
- C. WC-1: Acorn "Dura-Ware" #2100 Series: Wall mounted. Elongated bowel, 14 gauge, type 304 stainless steel, high efficiency 1.28 GPF, Back Spud: Flush Valve: Sloan Hydraulic Royal Model #952-1.28, concealed, high efficiency, 1.28 GPF, diaphragm type, rough brass for back spud.
- WC-2: Acorn "Dura-Ware" #2100 Series: Wall mounted. Elongated bowel, 14 gauge, type 304 stainless steel, high efficiency 1.28 GPF, Back Spud: Flush Valve: Sloan Hydraulic Royal Model

#952-1.28, concealed, high efficiency, 1.28 GPF, diaphragm type, rough brass for back spud.

- D. L-1: Acorn penal-ware 18" #1652lrb-1-dms-03-m-h1: Wall mounted, 14 gauge, type 304 stainless steel; faucet: Chicago Faucet Model #807-e12-665pab: Deck mounted, single hole single inlet metering faucet, with 0.35 gpm flow rate, vandal resistant non-aerating spray head, set to run at least 10 seconds a cycle below dek thermostatic mixing valve Chicago Faucet model #131-anbf: Chicago Faucet #1017-abcp loose key angle stops & supplies; #327-xcp grid drain, 1-1/4"x1-1/2" p-trap, insulate trap, trap arm & supplies. install @ a.d.a. approved height. Access compliant faucets for lavatories: force to activate controls shall be no greater than 5 pounds. Self-closing metering, when specified, to remain open 10 seconds minimum when activated an
L-2: Acorn penal-ware 18" #1652lrb-1-dms-03-m-h1: Wall mounted, 14 gauge, type 304 stainless steel; faucet: Chicago Faucet Model #807-e12-665pab: Deck mounted, single hole single inlet metering faucet, with 0.35 gpm flow rate, vandal resistant non-aerating spray head, set to run at least 10 seconds a cycle below dek thermostatic mixing valve Chicago Faucet Model #131-anbf: Chicago Faucet #1017-abcp loose key angle stops & supplies; #327-xcp grid drain, 1-1/4"x1-1/2" p-trap, insulate trap, trap arm & supplies. install @ a.d.a. approved height. Access compliant faucets for lavatories: force to activate controls shall be no greater than 5 pounds. Self-closing metering, when specified, to remain open 10 seconds minimum when activated. :tivated.
- E. Water Heater: Commercial electriflex if upright electric water heater. Steel tank heavy gauge fully automatic controls, vitraglass lining, 2" non-cfc foam insulation, 3/4" cw & hw connections, w/4" t&p relief valve: single phase, 2 elements @ 4500 watts each, simultaneous operation, 9,000 total watts connected. Provide wall mounted "holrite" #hr-80-360 seismic restraints system: provide "holdrite" quickstand #40-s-30 series 30" platform square pan, California State approved.
- F. Drinking Fountain
- Type DF-1: Haws Model #3612 (hose bib locking), steel outdoor dual station fountains with bottle filling station with rounded corner design, heavy-duty steel powder-coated finish with vandal resistant bush button activation, vandal resistant bubbler w/ integral hood guard and contour-formed rounded basin. Bottle filler shall include a laminar flow w/ min. splash and provide 1 gpm fill rate fountain. Shall refer to architecture and civil plans for fountain locations on site.
- G. Sinks:
- S-1: Elkay #S1C18x18-2: 54"x23.8"x43.8"h 14" deep bowl (2) hole on 8" centers punching, 18 gauge, 300 series stainless steel: faucet: Chicago Faucet #wbw-l9e1-369abcp, wall mounted 8" fixed centers cold & hot water manual faucet, 9-1/2" swing spout, provide with 1.5 gpm flow, Chicago Faucet #1086-abcp angle stop w/supply tube and loose key. 1-1/4"x1-1/2" p-trap.
- S-2: Elkay #S1C18x18-2: 54"x23.8"x43.8"h 14" deep bowl (2) hole on 8" centers punching, 18 gauge, 300 series stainless steel: faucet: Chicago Faucet #wbw-l9e1-369abcp, wall mounted 8" fixed centers cold & hot water manual faucet, 9-1/2" swing spout, provide with 1.5 gpm flow, Chicago Faucet #1086-abcp angle stop w/supply tube and loose key. 1-1/4"x1-1/2" p-trap.
- H. Floor Drain
- FD-1: J.R. Smith #2005-y(udc)-a-p050: no-hub outlet, duco cast iron with flashing collar, underdeck clamp and adjustable strainer, 5"Ø nickel broze grate, vandal proof screws. Prove 1/2" trap primer connection.
- I. Floor Sinks
- FS-1: J.R. Smith #3100-y: duco cast iron, acid resistant interior, 8-1/2" top with 1/2 grate & trap primer connection.

J. Hose Bibbs

HB-1: Acorn Model #8160 Series, recessed hose box with wall flange. Single temperature with non-removable vacuum breaker. Box shall be 18 gauge, type 304 stainless steel w/ satin finish. Flange shall be 16 gauge stainless steel, satin finish, valve shall be cartridge-operated w/ vandal resistant lock shield bonnet and removable loose key handle and screwdriver operated stop. Door shall be 16 gauge satin finish w/ removable hinge and cylinder lock.

K. Urinals

UR-1: Acord "Dura-Ware" #2158-W-1-0.125-FVB0: wall mounted, 16-gauge type 304 stainless steel: flush valve: Sloan hydraulic Royal Model #955-0.125, concealed, high efficiency, 0.125 gpf, diaphragm type, rough-in brass for back spud.

UR-2: Same as UR-1. Install at accessible height.

PART 3 - EXECUTION

3.01 PLUMBING FIXTURES

A. Fixture installation.

1. Installation of fixtures, hose faucet or other plumbing item, shall be as recommended by the manufacturer except as specified herein or indicated on the drawings.
2. Set fixtures level, in contact with the floor or wall and equally spaced when installed in battery of more than two.
3. Rough-in supplies level, equally spaced and symmetrical with the fixture.
4. Rough-in wastes in alignment with the fixture drain. Offsetting trap and waste is not acceptable.
5. Install flush valves level with flush connections vertically. Offsetting and misalignment is not acceptable.
6. Flush valves for accessible water closets shall be located on wide side.
7. Use formed wax sealing gaskets to mate watertight joints between toilet bowls and closet rings. Waste outlets of urinals shall be sealed with epoxy or felt gaskets furnished by the manufacturer.
8. Provide brackets or supports for water heaters and softeners.
9. Secure hangers for fixtures set against concrete or masonry walls into tamp-in type anchors or 2-unit cinch anchors. Do not use wooden plugs.
10. Provide all holes in fixtures intended for use in their supports with fasteners.
11. Screw security caps, cover plates, faucet handle screws and other removable trim snug tight to reduce theft.

B. Grouting.

1. Grout all wall and floor mounted fixtures water tight where fixture is in contact with wall or floors. Caulking similar to "Polyseamseal" by Interpace is acceptable.

C. Caulking.

1. Caulk all deck mounted trim at the time of assembly, including fixture and casework mounted.
2. Caulk all self-rimming sinks installed in casework.

D. Trim.

1. Makeup trim will be installed with care and with the proper tools in order that no tool marks show after installation.
2. Porcelain plaster caps shall be securely cemented in place over floor flange bolts entirely covering washer and bolt hole.

E. Fixture backing.

1. Provide backing for wall hung fixtures including electric water coolers. Fixtures to backing with 1/4" bolts and nuts of solid brass.
 - a. Stud walls: Install min 4x continuous blocking in between wood stud.

F. Accessible Fixture Insulation

1. Provide one piece preformed trap and hot water supply riser insulation as manufactured by "Trap Cap" or approved equal.

END OF SECTION

DIVISION 23

HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

SECTION 23 00 00

GENERAL PROVISIONS

PART 1 - GENERAL

Division 1 requirements apply to this Section.

1.01 SUMMARY

A. Requirements: Requirements and standards described herein are generally common to the following Sections of work:

1.	Section 22 08 00:	Equipment and Systems Tests
2.	Section 22 05 53:	Identification
3.	Section 22 05 00:	Basic Materials and Methods
4.	Section 23 05 48:	Vibration Isolation and Seismic Restraints
5.	Section 22 07 00:	Insulation
7.	Section 22 13 00:	Drainage System
8.	Section 22 11 00:	Domestic and Industrial Water System
9.	Section 22 40 00:	Plumbing Fixtures
10.	Section 23 25 00:	Water Treatment
11.	Section 23 80 00:	Air Conditioning and Air Handling Equipment
12.	Section 23 31 00:	Air Transmission and Distribution System
13.	Section 23 90 00:	Building Management System

B. Related Sections:

1.	Division 1:	Temporary Utilities, Shop Drawings and Submittals.
2.	Division 3:	Cast-in-Place Concrete
3.	Division 7:	Door, Wall, Air Louvers and Screens.
4.	Division 26:	Electrical, except items specifically noted to be provided with associated equipment of Divisions 21, 22 & 23.

C. Related Work in Division 23:

1. Low voltage wiring with conduit for mechanical controls, including final connections as indicated on wiring diagrams unless otherwise noted.
2. Providing access panels per Section 22 05 00.

D. All mechanical system shall be complete, tested, and demonstrated to be in perfect operating condition.

E. In the event the District should choose to enter upon and use any portion of the work (beneficial occupancy) prior to the completion of operational testing, capacity testing, air balance testing and the giving of operating instructions on any of the Mechanical Systems, but after the passing of the established completion date, the contractor shall adequately staff the project to operate (manually, if necessary) and maintain the equipment and systems until such time as they have been demonstrated to the Owner to acceptably meet all the contract requirements.

1.02 EQUIPMENT AND MATERIALS, GENERAL

A. Submittals Required:

1. Prior to the start of any work, six (6) copies of a list of all materials and equipment covered by Division 22 and 23 shall be submitted by the Contractor in conformance with the requirements of Division 1 and reviewed by the Architect. Contractor shall allow ample time for checking and processing and shall assume all responsibility for delays incurred due to rejected items. No installation of material concerned shall be made until stamped submittals have been obtained from the Architect. Acceptance of material and equipment submittals shall in no way obviate compliance with the plans and specifications.
2. Additionally, each item proposed shall be referenced to the section, page, and paragraph of the specifications. For each item proposed, give name of manufacturer, trade name, and the catalog performance data for all equipment, including all applicable optional items as specified. Lists shall be complete for the project and shall be submitted at one time, bound in sets in three ring loose leaf stiff covered binders, indexed, with tabs for easy reference. All sets shall be identical.
3. Additional items to be included in submittals:
 - a. Test and air/hydronic balancing report.
 - b. List of proposed optional materials and equipment.
 - c. Valve Charts.
 - d. Control Diagrams and sequence of operation.
 - e. Scheme for identification of Mechanical equipment, piping, ductwork and apparatus.
 - f. Sterilization test reports.
 - g. Test data & reports.

B. Requirements of equipment which increases the scope of the work.

1. The contract plans indicate the installation of the equipment of one set of manufacturers. Other acceptable manufacturers are named in these specifications.
2. If the installation of the particular equipment the Contractor has submitted under Division 15 requires changes in material or labor from that required in the contract plans and specifications, such drawings shall be submitted as shop drawings.
3. Any changes in piping, wiring, controls, or installation procedures required by the equipment shall be made at no additional cost to the Owner, and with no reduction in scope.

C. Equipment Layout Shop Drawings:

1. The Contractor shall submit "Equipment Layout Drawings" for each equipment room or area containing items of equipment furnished under this section.
2. Layout drawings shall consist of a plan view of the room, to scale, showing the projected outline of all equipment, complete with indication of all required clearances including those needed for removal of service. The location of all floor drains, piping, ductwork, electrical, plumbing, supports and other equipment shall be indicated. Sectional views shall be furnished as required to show overhead clearances.

3. Submit dimensioned drawings of ductwork and related accessories and equipment with sizes and location of ducts, diffusers, grilles, registers, automatic fire dampers, access panels, etc.
4. Construction drawings or part thereof shall not be used for shop drawing submittals. Contractor shall prepare and draw their own shop drawings and submit for review and approval.
5. Contractor shall review the drawings thoroughly including construction drawings by other disciplines prior to preparation of shop drawings and coordinate equipment, ductwork and piping layout with any obstructions.
6. Request for information (RFI) generated by the contractor will not be entertained unless shop drawings are submitted.

D. Operation and Maintenance Manuals:

1. Manual shall be indexed with tabs for easy reference bound in 3 ring binders and shall include valve charts, piping diagrams, control diagrams, cleaning reports, test reports, service instructions and parts list of all machinery.
2. This manual shall be submitted for approval at least 30 days before final inspection. Failure to submit the diagram and service manual will delay final inspection and acceptance of the work.
3. Four (4) copies of the manual shall be delivered to the Architect on or before the date of the final inspection, and each copy of the service manual shall be identical.
4. After review by the Architect, the control diagrams shall be mounted in a neat frame with suitable backing, under clear glass and installed where directed.
5. Where applicable, the following specified information, together with any pertinent data, shall be included in the service manual.
 - a. Part numbers of all replaceable items.
 - b. Manufacturer's cuts and rating data or curves.
 - c. Lubrication and other maintenance data.
 - d. Test reports.
 - e. ASME data sheets for each pressure vessel.
 - f. Serial numbers of all principal pieces of equipment.
 - g. Supplier's names, addresses and phone numbers.
 - h. Control diagrams, electrical interlock wiring diagrams and descriptive sequence of operation, for both package equipment and field installed controls and interlocks.
 - i. Valve chart indicating location on job.
 - j. Refrigerant type and charge (lbs.).
 - k. Cleaning report.
 - l. Warranty information and certificates of each equipment and installation.

1.03 REFERENCES

- A. References made herein, or in any of the Mechanical Sections listed above, to standards, codes specifications, or recommendations of various technical societies, trade organizations, or governmental agencies are to the edition in effect at the time of the proposal, including all addenda.
- B. Furnish, for the use in the Construction field office, one copy of each field installation standard referred to in these specifications. Government codes accepted.
- C. Code changes: If code changes occur between time of proposal and date of permit issue, and the Contractor has unnecessarily delayed the acquisition of his permits, the Contractor shall hold the Owner free from additional expense resulting from such code changes.

1.04 RECORD DRAWINGS

- A. Two complete sets of mechanical drawings will be provided as record drawings, which shall be separate, clean, blue line prints reserved for the purpose of showing a complete picture of the work as actually installed.
- B. These drawings shall also serve as workprogress report sheets and the Contractor shall make any notations, neat and legible, thereon daily as the work proceeds. These drawings shall be available for inspection at all times and shall be kept at the job at a location designated by the Architect.
- C. All buried service piping and indicated future connections outside of any building shall be located both by depth and by accurate measurement from a permanently established landmark such as a building or structure. Measurements shall be verified by the Architect prior to backfilling.
- D. At completion of the work, these record drawings shall be signed by the Contractor, dated and returned to the Architect.

1.05 SURVEY OF SITE

- A. Before submitting proposals for this work, each bidder shall become familiar with plans and specifications and shall have examined the premises and understand the conditions under which he will be obliged to operate in performing his contract. No allowance will be made subsequently in this connection for any error through negligence on the part of the Contractor.

1.06 CODES

- A. All work performed under this section of the specification is under the following listed jurisdictional agencies and will be so inspected for code compliance.

ADA	Americans with Disabilities Act.
ANSI	American National Standards Institute.
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers.
ASME	American Society of Mechanical Engineers.
ASTM	American Society of Testing Materials.
AWS	American Welding Society.
AWSC	American Welding Society Code.
AWWA	American Water Works Association.
CEC	California Energy Commission.

NFPA	National Fire Protection Association.
OSHA	Occupational Safety & Health Administration
SFM	State Fire Marshall
SMACNA	Sheet Metal & Air Conditioning Contractor National Association.
UL	Underwriters Laboratories, Inc.
UBC	Uniform Building Code
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
CCR	State of California Code of Regulations
ETL	Electronic Testing Laboratories

- B. Materials, equipment and their installation shall comply with the requirements of the General Safety Orders, Department of Industrial Relations, State of California.
- C. All reference codes and standards shall be the latest edition.

1.07 PERMITS AND LICENSES

- A. Refer to the "General Conditions" of these specifications regarding these items. The Contractor shall pay for all permits, licenses and inspections required by work under this section. All work shall be regularly inspected and certificates of approval shall be delivered to the representative of the District.
- B. Obtain and pay for a State Industrial Accident "Permit to Operate" for each pressure vessel.
- C. Contractor shall arrange with public utility agency, or private utility companies, and pay for all required fees for all utility services for this project, such as gas, sewer, water, storm drain, industrial waste, etc.

1.08 DRAWINGS/SPECIFICATIONS

- A. For purposes of clarity and legibility, the drawings are essentially diagrammatic and although size and location of equipment is drawn to scale wherever possible, Contractor shall make use of all data in all of the contract documents and verify this information at building site. Contractor shall fully inform himself regarding the peculiarities and limitations of the spaces available for the installation of work and materials furnished under this Division.
- B. Drawings indicate required size and termination of pipes and ducts and suggest proper routes of piping and duct to conform to the structure, to avoid obstructions and to preserve clearance. However, it is not the intention to indicate all necessary offsets and it shall be the responsibility under this section to install ductwork and piping in such a manner as to conform to structure, avoid obstructions, preserve headroom, keep openings and passageways clear and make all equipment requiring inspection, maintenance and repair, accessible without further instructions or extra cost to the Owner.
- C. Check with other divisions of the work so that no interferences shall occur and in order that grade lines may be established for the work. No extras will be allowed for changes made necessary by interference with the work of other trades.
- D. Drawings and Specifications: Specifications are intended to cover all labor, materials, equipment and standards of mechanical workmanship to be employed in work shown on drawings, called for in these Specifications, or reasonably implied by terms of same. Drawings and specifications are intended to supplement one another and part of work that may be mentioned in one and not represented in other, shall be done the same as if it has been mentioned or represented in both. Large scale drawings shall take precedence over layouts and shall scale details. Omission from specifications or drawings of any minor details of construction, installation, materials, or essential specialties shall not relieve Contractor from

furnishing same in place complete.

1.09 WARRANTY AND DAMAGE RESPONSIBILITY

- A. Furnish to the District a written warranty against defects in materials and workmanship for one year after acceptance of the project. The Contractor shall be responsible for damage to the grounds, buildings, or equipment, and the loss of refrigerants, fuels, or gases caused by leaks or breaks in pipes or equipment new or existing resulting from the work of this Division.

1.10 ABBREVIATIONS

- A. Abbreviations:

AC	Alternating Current
AABC	Associated Air Balance Council
ACFM	Actual Cubic Feet per Minute
ADA	American with Disability Act
ADC	Air Diffusion Council
AFD	Automatic Fire Damper
AFI	Air Filter Institute
AGA	American Gas Association
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
API	American Petroleum Institute
ARI	Air Conditioning and Refrigeration Institute
ASA	American Standards Association
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
BTU/HR	British Thermal Unit per Hour
C	Centigrade
CAC	California Administrative Code
CFM	Cubic Feet per Minute
CI	Cast Iron
CISPI	Cast Iron and Soil Pipe Institute
DC	Direct Current
DEG	Degree
DSP	Dry Standpipe
EFF	Efficiency
ETL	Electronic Testing Laboratory
F	Fahrenheit
Fig	Figure
FIA	Factory Insurance Association
FCV	Flow Control Valve
FM	Factory Mutual Association
FS	U.S. Government, Federal Specification
FT	Feet
HOA	Hand-Off-Automatic
HP	Horsepower
HVAC	Heating Ventilating and Air Conditioning
LB	Pounds

IBR	Institute of Boiler and Radiator Manufacturers
I.D.	Inside Dimension
IPS	Inside pipe size
LWCO	Low water cut off
MIL	U.S. Government, Military Specification
MIN	Minimum
NBS	National Bureau of Standards
NC	Noise Criteria
NEBB	National Environmental Balancing Bureau
NEMA	National Electrical Manufacturers Association
NEC	National Electric Code
NFPA	National Fire Protection Association
NFC	National Fire Codes
NO _x	Nitrous Oxide
NSF	National Sanitation Foundation
O.B.D.	Opposed Blade Damper
O.D.	Outside Dimension
OFE	Owner Furnished Equipment
OSHA	Occupational Safety and Health Administration
OS & Y	Outside Screwed and Yoke
PCR	Pumped Condensate Return
P.D.	Pressure Drop
ph	Acid Concentration Level
PPIC	Plumbing and Piping Industry Council
PPM	Parts per Million
PSI	Pounds per Square Inch
PSIG	Pounds per Square Inch, Gauge
PVC	Polyvinyl Chloride
RPM	Revolution per Minute
SAMA	Scientific Apparatus Makers Association
SCFM	Standard Cubic Feet per Minute
SEER	Seasonal Energy Efficiency Ratio
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SWP	Standard water pressure
TAB	Test, Adjusting and Balancing
UBC	Uniform Building Code
UL	Underwriters Laboratories
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
USDA	United States Department of Agriculture
USS	United States Steel
VAC	Volts Alternating Current
VVT	Variable Volume-Variable Temperature
WG	Water Gauge
WOG	Water, Oil, Gas
WSP	Wet Standpipe

1.11 DEFINITIONS

- A. Definitions: Terms used herein and in the individual mechanical sections of the specification are defined as follows:
1. This Division: The Mechanical Division of the Specifications; a portion of the specifications that includes all the Sections of the specifications listed herein under "Work of This Section".
 2. Individual Mechanical Section: Any one of the sections of the specifications listed

under "Work of This Section", herein.

3. Other Divisions: The portion of the specifications that does not include the Mechanical Division.
4. Similar to: An alternative item of material or equipment which, in the opinion of the Architect, matches the named item as to arrangement, materials, function and performance. The performance shall match or exceed that scheduled or advertised for the named item.
5. Utility Services: Those existing active, functioning systems, both primary and secondary, which provide a facility and its occupants with heating, cooling, ventilating and sanitary functions.
6. Concealed: Hidden from sight as in trenches, chases, hollow construction or above furred spaces, or exposed to view in tunnels, attics, shafts, crawl spaces or other unfinished areas.
7. Accessible: Possible for a 6'-0", 180 pound person to approach adequately and with sufficient work room to service, repair or replace concealed equipment.
8. Exposed: Not concealed as defined above except machinery and fan rooms.
9. Riser: A vertical pipe or duct having a vertical length greater than one story height.
10. Drop: A vertical pipe or duct that does not penetrate a floor.
11. Up-Feed Connection: A vertical pipe or duct that penetrates a floor, but has a vertical length of less than one story height.
12. Main: A pipe or duct which branches.
13. Branch: A pipe or duct which does not rebranch.
14. Header: A pipe or duct of constant size that serves a battery of closely spaced inlet or outlet connections.
15. Piping: Includes pipe, fittings, valves, hangers, and all pipe mounted devices that make up a system.
16. Unfinished space: A room or space that is ordinarily accessible only to building maintenance personnel. A room listed in the finish schedule as having exposed and unpainted construction for walls, floors and ceiling. A room specifically mentioned as "Unfinished".
17. Finished Space: A room or space that is not Unfinished as described above. Any space ordinarily visible to a regular occupant, including exterior spaces.

1.12 SAFETY PROVISIONS

- A. All equipment and piping with temperatures above 140-degrees F or temperature below 25-degrees F, so located as to endanger personnel or create a fire hazard, shall be properly guarded or covered with insulation of the type specified. All bolts, gears, chains, pulleys, couplings, projecting setscrews, keys, and other rotating or reciprocating parts shall be enclosed or properly guarded. Guard rails, etc., required for the safe operation and maintenance of the equipment shall be provided.

1.13 CERTIFICATION OF WELDERS

- A. Where welding is required by work of this Division, such work shall be performed only by welders qualified and certified by a recognized, approved agency. Such certification shall bear date not more than twelve months prior to date of starting work under this Division, unless welder has been constantly employed by Contractor since last certification.
 - 1. Pipe welding shall comply with the latest revision of applicable code, ASME Boiler Construction Code, American Welding Society Processes, ASME Code for pressure piping, and State and Federal requirements. Before welding is performed, contractor shall submit to Architect evidence of compliance of welding procedure and operators's qualifications according to provisions of governing codes. Standard procedure Specifications and operations qualified by National Certified Pipe Welding Bureau shall be considered as conforming to requirements of these Specifications.
 - 2. Welders shall have State of California C-60 License.

1.14 PRODUCT DELIVERY STORAGE AND HANDLING

- A. During loading, transporting and unloading, exercise care to prevent damage to materials. Use padded or strap slings as appropriate for handling materials. Lift equipment by lift points provided or recommended by manufacturer. Do not drop pipe, fittings, valves and specialties. Upon receipt, inspect materials for defects or for compliance with Contract Documents. Tag, stencil or permanently identify materials to adequately identify specialty items. Do not allow stainless steel to contact carbon steel during delivery, storage, handling or during or after installation.
 - 1. Store all materials on site in enclosures or under protective covering to keep clean and dry. Do not store materials directly on ground. Store stainless steel on wood.
 - 2. Store loose materials such as fittings, gaskets, bolts, nuts, small valves, traps, and specialties in bins of sufficient number to provide proper separation. Protect ends of large fittings, valves and pipe from weather and abuse. Properly grease all machined surfaces.
 - 3. Remove rust spots from stainless steel by brushing with stainless steel brush.

1.15 DISTRICT FURNISHED EQUIPMENT

- A. Where items are called for to be District Furnished Equipment (DFE) and installed by the Contractor; the Contractor, for the purpose of bidding, may assume that all items will be available to the contractor at the site (installation location) and their delivery by the Owner will be timed so as not to delay the normal construction progress.
- B. The Contractor shall be responsible for exercising due care in the handling of any DFE items; the installation, operation instructions and warranty conditions. Unless otherwise noted, all DFE shall be considered new and in operable condition.
- C. The Contractor shall be responsible for any damage to any new DFE once the item is accepted by him. The Contractor shall not be held liable for damage to any DFE that occurred prior to the Contractor accepting it for installation, this includes obvious and hidden damage.

1.16 SEISMIC RESTRAINTS

- A. Contractor shall be responsible for all anchors and connections of mechanical work to the building structure to prevent damage as a result of an earthquake, including piping, manufactured equipment, and the integrity of shop fabricated and field fabricated materials

and equipment. Reference details per "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems" as published by SMACNA and PPIC, latest edition.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The products, assemblies, and methods shall be as described in the pertinent Mechanical Sections of the work.
- B. Substitutions: Refer to Division 1 for requirements. Products of manufacturer's not specified under other Sections of Division 22 and 23 or listed herein are classified as substitutions. Substitutions shall be equal to as specified or indicated on the drawings and must be duly noted as a substitution when submitted for approval.
- C. Materials: New and of recent manufacturer, and of quality as specified herein and consistent with building design and intent.
- D. Appliances, Fixtures and Equipment: Current models for which replacement parts are available.
- E. Manufacturer: Unless otherwise provided, all mechanical items shall be substantially the same as the specified item manufacturer, which on date of opening of bids, have been in successful commercial use and operation for not less than one year in projects and units of comparable size.

2.02 MANUFACTURED PRODUCTS

- A. Manufacturer's names and model numbers on the drawings are to establish type and class of material and equipment and, except for "or equal" requirements of the general conditions, products shall be by one of the manufacturers named by the specifications which shall include the names on the drawings as if therein written. When no names are listed in the specifications, any manufactured product equal to the manufacturer named on the drawings and which complies with the specifications may be acceptable.
- C. The scheduled capacity requirements take precedence over the listed manufacturer's equipment size.
- D. Wherever possible, all materials and equipment used in the installation of this work will be of the same brand or manufacture throughout for each class of material or equipment.
- E. All rotating equipment shall operate in perfect dynamic balance.
- F. Each item of manufactured equipment shall bear the manufacturer's non-ferrous metal nameplate. The manufacturer's name, model number, serial number and capacity ratings shall be permanently stamped or etched thereon.
- G. No item of material or equipment shall be installed for any purpose in any manner not recommended by the manufacturer in his published literature. If recommended manufacturer installation requires additional pipe, ductwork or accessories it shall be installed by the contractor without additional cost to the Owner.
- H. Every vessel not uninterruptably vented to atmosphere is a pressure vessel and shall be ASME code constructed to the system test pressure. Furnish a registration certificate from the National Board of Boiler and Pressure Vessel Inspectors for each vessel.

2.03 ALTERNATE EQUIPMENT

- A. Equipment layout, piping connections, etc., are based on units as scheduled on the Drawings. If alternate or substitution equipment is used, it is the responsibility of this Contractor to make necessary modifications to provide an operating installation, including electrical requirements, controls, all service clearances around the equipment and shall be in complete conformance with the Uniform Mechanical and Plumbing code and all specifications and recommendations of the manufacturer without any additional cost to the Owner.

PART 3 - EXECUTION

3.01 CONFERENCE

- A. Immediately upon award of the contract and before any work is started, the Contractor shall arrange for a meeting with the Architect or his representative and with a representative of the Owner concerning the work under these sections.

3.02 SUPERVISION

- A. The Contractor shall furnish the services of a competent superintendent experienced in the work of each section, who shall be constantly in charge of the progress of the work, together with all necessary journeymen, helpers, and laborers required to properly unload, erect, connect, adjust, start and operate and test the work involved. Quality workmanship shall be performed by competent mechanics skilled in their trades.

3.03 PROTECTION, CARE AND CLEANING

- A. The premises shall be maintained as required by Division 1.
- B. Materials and Equipment:
 - 1. Effectively protect materials and equipment to be installed on the project against moisture, dirt, and damage during the construction period, to the satisfaction of the District. Special care shall be taken to provide protective covering of bearings, open connections to pumps and tanks, coils, and similar equipment that are particularly vulnerable to grit and dirt.
 - 2. Keep interior of all ductwork free of dirt, grit, dust, insulation, and other foreign materials at all times. Do not operate air distribution equipment until building is cleaned and air filters installed in order to prevent soiling of diffusers, ducts, air handling equipment and buildings.
 - 3. Drain and flush piping to remove grease and foreign matter. Thoroughly clean out valves, traps, strainers and boilers and demonstrate the cleanliness to the District. See Section 23 25 00 for cleaning of piping system.

3.04 EXCAVATION AND BACKFILL

- A. General:
 - 1. Do all excavation and backfill required to install the work of this Division both inside and outside.
 - 2. Perform all excavation and backfilling in accordance with that specified under Division 31 Earthwork.
- B. Excavation: Bury piping outside the building to a depth of not less than 36" below finish grade unless noted otherwise.

- C. Backfilling: Do not backfill until after final inspection and approval of the piping installation by all legally constituted authorities.

3.05 FORMING, CUTTING AND PATCHING

- A. Provide all sleeves, inserts and openings necessary for the installation of the Mechanical Work.
- B. Special forming, recesses, chases, curbs, etc., as necessary for the proper reception and installation of the mechanical equipment will be provided in the structure under another section. The contractor shall examine all drawings to ascertain that proper provisions have been made for the work. If such provisions are not made in time, the Contractor shall bear all extra costs incurred in later cutting and patching to accommodate this work.

3.06 INSTALLATION OF EQUIPMENT

- A. All concrete floor mounted equipment located in machinery rooms shall be set on housekeeping pads extending a minimum of six inches or as required beyond all sides of the equipment and secured using bolts and expansion shields. All bases shall be four inches high, minimum. The housekeeping pads and bases shall be of concrete with 1/2-inch reinforcing bars at 12" centers each way and where applicable dowelled into the concrete floor. Bases out of doors on grade shall be constructed as above except they shall be 12" high and extend a minimum of 6" below grade. For wood construction, bases shall be of wood with dimensions as for concrete. For bases located on roofs, flashing shall be as detailed on the Architectural drawings. See Structural drawings for details of equipment bases, pads and platforms.
- B. Equipment shall be secured in place using fasteners as recommended by SMACNA's "Guideline for Seismic Restraints of Mechanical Systems" latest edition. Bolt sizes as a minimum shall be per the following schedule:

Bolt Size Inches	Equipment Weight Per Bolt, Pounds
3/8	50
1/2	120
5/16	225
3/4	300
7/8	950

- C. All concrete work unique to the work of this Division and not a part of the structure, shall be done in complete accordance with the requirements of Division 3 "Cast in Place concrete". Work shall include furnishing all dimensioned drawings for bases, pads, openings, etc., and finishing and installing all anchor bolts, inserts, etc. Coordinate with General Contractor.

3.07 EXISTING UTILITIES AND SERVICES

- A. Location and character of principal existing utilities, including dimensions as shown on the drawings for convenience only, are believed complete and correct, but shall be subject to verification by the Contractor, as the Architect assumes no responsibility for their correctness.

3.08 SEISMIC RESTRAINT CODE REQUIREMENTS

- A. California Code of Regulations, Title 17 and 24; NFPA.

3.09 ELECTRICAL WORK

- A. Furnish a complete electrical interlock wiring diagram and describe sequence of operation to show all field wiring for operating the particular equipment the contractor proposes to install. The diagram shall identify the wire color and the connection terminals of each item of equipment furnished for complete operating systems.
- B. Any additional line or low voltage electrical wiring and conduit required over that shown in the Electrical Division of the work as required for complete and perfectly operating systems, shall be furnished under this Division in complete conformance with the requirements of the Electrical Division.

3.10 PAINTING

- A. Painting:
 - 1. All finish painting of mechanical equipment will be as specified in Division 9, Painting, unless otherwise indicated.
 - 2. All equipment shall be provided with factory applied prime finish, unless otherwise specified.
- B. Touch-Up:
 - 1. If the factory finish on any equipment furnished by the Contractor is damaged in shipment or during construction of the building, the equipment shall be refinished by the Contractor to the satisfaction of the District.
 - 2. One can of touch-up paint shall be provided for each different color factory finish which is to be the final surface of the product.
- C. Concealed Materials: All uncoated cast iron or steel that will be concealed or will not be accessible when installations are completed, shall be given one heavy coat of black asphalt before concealment.

3.11 OPERATING INSTRUCTIONS

- A. After all systems have been completely installed, verified to be operating perfectly and all tests completed and accepted, arrangements shall be made to operate all systems for a period of one week. Ten (10) days advance written notification of this period shall be given the District. During this period, the Contractor may make necessary minor but not interruptive adjustments. At this time, he shall instruct the District's operating personnel in the operation and maintenance of the various items of equipment.
- B. The Contractor shall furnish, without additional cost to the District the services of competent instructors who will give full instruction to the Owner's designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements of the equipment or system specified.
- C. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. The number of man-hours of instruction shall be a minimum of 8 hours in increments, as scheduled by the owner's Representative.

3.12 EMERGENCY REPAIRS

- A. The District reserves the right to make temporary repairs a necessary to keep equipment in operating condition which shall neither void the Contractor's guarantee bond nor relieve the

Contractor of his responsibility during the bonding period.

3.13 INTERRUPTION OF EXISTING UTILITIES OR SERVICES

- A. The Contractor shall submit to the Architect for approval a written schedule for the shutdown, removal, installation and connection of materials. Any shutdown of utility services shall be coordinated with the District. Prior written notification of seventy-two (72) hours minimum shall be given for any such shutdowns.

3.14 INITIAL LUBRICATION, ADJUSTING AND FILLING OF SYSTEM

- A. Before operating any of the mechanical systems, lubricate equipment bearings and check belts, pulleys, and other moving parts of alignment and tolerances in accordance with equipment manufacturer's operating instructions. Flush piping and liquid systems and fill with operating fluids. After tests, adjust valves and other parts of the work for quiet operation. Clean strainers by removing and washing basket or screen. Change lubricating oil in compressors. Suppress all vibration and noise.

3.15 STARTUP

- A. Startup of all major equipment, including chillers, boilers, air handling equipment, variable speed drives, computer room air conditioning units and other special equipment shall be performed by manufacturer's start-up technicians. Contractor shall be responsible for procuring such service.

3.16 WATER STERILIZATION

- A. The entire domestic water piping system shall be sterilized before being turned on for use by the Owner. The Plumbing Contractor shall request an inspection by the Board of Health Department and shall deliver certification to the District.
- B. The entire deionized, reverse osmosis, and distilled water systems shall be sterilized before acceptance by Owner.

END OF SECTION

SECTION 23 05 48

VIBRATION ISOLATION & SEISMIC RESTRAINTS

PART 1 - GENERAL

Division 1 requirements apply to this Section

1.01 SUMMARY

A. The work of this Section includes, but is not limited to the following:

1. Vibration isolation elements for piping and equipment.
2. Equipment isolation bases.
3. Seismic restraints for piping and equipment.

B. Related Sections:

1.	Section 22 05 00:	Basic Materials and Methods
2.	Section 22 11 00:	Domestic and Industrial Water System
3.	Section 23 80 00:	Air Conditioning and Air Handling Equipment
4.	Section 23 90 00:	Building Management System

1.02 SUBMITTAL DATA

A. Requirements: In addition to the requirements of Section 23 00 00, GENERAL PROVISIONS, MECHANICAL, the submittal material shall include six (6) copies of descriptive data for all products and material including, but not limited to, the following:

1. Catalog Cuts and data sheets on specific vibration isolators and seismic restraints to be used showing compliance with the specifications.
2. List showing items of equipment, piping, etc., to be isolated and seismically restrained, the isolator type and model number selected, isolator loading and deflection, and reference to specific drawing showing frame construction where applicable. Also provide seismic restraint details.
3. Dimensioned drawings showing equipment frame construction for each machine including dimensions, structural frame sizes, support point locations, etc.
4. Written approval of the frame design to be used, obtained from the equipment manufacturer.
5. Dimensioned drawings showing methods for suspension, support, restraint, guides, etc., for piping and ductwork, etc..
6. Dimensioned drawings showing methods for isolation of pipes, etc., piercing slabs, beams, etc.
7. Seismic restraint calculations.

1.03 CODE REQUIREMENTS

A. As a minimum, seismic restraints shall be in accordance with State and Local Code requirements. Specified requirements which exceed code shall govern.

- B. The "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems" as published by SMACNA are acceptable as meeting the requirements of Title 24, State of California, latest edition.

1.04 MANUFACTURER'S RESPONSIBILITY

A. General

1. Vibration isolation and seismic control manufacturer shall have the following responsibility.
 - a. Determine vibration isolation and seismic restraint sizes and locations.
 - b. Provide piping and equipment isolation systems and seismic restraints as scheduled or specified.
 - c. Guarantee specified isolation system static deflection.
 - d. Provide installation instructions and drawings.
 - e. Provide calculations by a licensed structural engineer substantiating seismic restraint capability to comply with Title 17, Table T-17-23J, State of California.
 - f. Provide approved resilient restraining devices as required to limit equipment and piping motion in excess of 3/8".
 - g. Provide installation instructions, dimensioned drawings, and field supervision to assure proper installation and performance.

1.05 DESIGN REQUIREMENTS

- A. Design requirements: It is the intent of this Specification to provide the necessary design for the avoidance of excessive noise or vibration in the building due to the operation of machinery or equipment, or due to interconnected piping, ductwork, or conduit and to seismically restrained piping, ductwork and equipment per State of California Code of Regulations T-24, Part 2 against seismic force in any direction.
1. All vibration isolators shall have either known undeflected heights or other markings so that, after adjustment, when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is provided according to the design.
 2. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer, and must be linear over a deflection range of not less than 50 percent above the design deflection.
 3. The ratio of lateral to vertical stiffness shall be not less than 0.9 nor greater than 1.5.
 4. All neoprene mountings shall have a shore hardness of 40 to 65, after minimum aging of 20 days or correspondence oven aging.
 5. Design isolators to suit vibration frequency to be absorbed and the load imposed. Isolator units to have adequate area distribution to obtain proper resiliency under machine load and impact without permitting excessive movement when started.
 6. Wave motion through the isolator shall be reduced to the following extent: Isolation above the resonant frequency shall follow the theoretical prediction based upon an undamped single degree of freedom system with a minimum isolation of 50 decibels above 150 cycles per second.

7. Vibration isolation spring diameter shall be no less than their deflected height. Select spring with a 50 percent overload safety factor.
8. Unless otherwise specified, all equipment mounted on vibration bases shall have a minimum operating clearance of 1" between structural steel base and floor or support base beneath. Check clearance space to ensure that no scrap of hardware has been left to possibly short circuit isolation base.
9. Where necessary because of height limitations, provide structural steel bases with height saving brackets. Isolators shall have a method for leveling and where spring isolators are used and shall have gussets on both sides of the isolator.
10. Design isolators for positive anchorage against uplift and overturning.
11. Provide and install under this Section of the Specification structural steel required to properly support and seismically restrain equipment.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATION

A. General

1. Whether shown, scheduled, or not, all mechanical equipment of two or more horsepower shall be isolated from the structure by means of resilient vibration and noise isolators supplied by a single manufacturer. Equipment installed on slab on grade shall be isolated with noise pads only. The isolator manufacturer's submittal shall include the complete design data on the isolators, including O.D., free, operating, and solid heights of the springs, free and operating heights of the neoprene or fiberglass isolators. Cast iron will not be acceptable in isolators.
2. All hardware shall be cadmium or zinc plated. All bases installed outdoors shall be either hot dip galvanized, cadmium plated, or neoprene coated.
3. Seismic restraints. All isolated equipment shall be equipped with seismic restraints. Restraints shall be capable of withstanding a force of 1g in all directions. Seismic restraints shall be supplied by isolator manufacturer. Restraints and snubber equipped isolator shall be bolted to the floor and to the equipment with full hole size bolts.
4. Springs shall be designed so that they will not fail when they are compressed to solid. At solid, the springs shall not exceed 85% of its theoretical yield point.
5. Unless otherwise specified herein, free standing, stable, open springs shall provide the scheduled static deflection and have the capacity to provide an additional 40% travel without coils becoming solid.
6. Manufacturer: Vibration isolation equipment shall be manufactured by M.W. Sausee, as scheduled on the drawings, Caldyn, Mason or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION OF VIBRATION ISOLATION DEVICES

A. General

1. Install in accordance with manufacturer's written instructions. Vibration isolators must not cause any change of position of equipment or piping resulting in piping stress of

misalignment.

2. Mechanical equipment shall be isolated from the building structure by means of noise and vibration isolators as scheduled on the drawings.
3. All piping and vertical risers shall be isolated from the building structure by means of noise and vibration isolation guides and supports.
4. All piping and ductwork to be isolated shall freely pass through walls and floors without rigid connections. Penetration points shall be sleeved or otherwise formed to allow passage of piping or ductwork and maintain 3/4" to 1 1/4" inches clearance around the outside surfaces. This clearance space shall be tightly packed with fiberglass, and caulked air tight after installation of piping or ductwork.
5. All piping 1-1/4" and over located in mechanical equipment rooms, and for a minimum of fifty (50) feet or 100 pipe diameters, whichever is greater, from connection to vibrating mechanical or electrical equipment, shall be isolated from the building structure by means of noise and vibration isolation hangers.
6. No rigid connections between equipment and building structure shall be made that degrades the noise and vibration isolation system herein specified.
7. Electrical circuit connection to isolated equipment shall be looped to allow free motion of isolated equipment.
8. The contractor shall not install any equipment, piping or conduit which makes rigid contact with the "building", unless permitted in this specification. Building included, but is not limited to slabs, beams, columns, studs and walls.
9. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following work, such as plastering, or electrical, to avoid any contact which would reduce the vibration isolation.
10. Bring to the Architect's attention prior to installation any conflicts with other trades which will result in unavoidable rigid contact with equipment or piping as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
11. Bring to the Architect's attention any discrepancies between the specifications and field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the contractor's expense.
12. Obtain inspection and approval of any installation to be covered or enclosed, prior to such closure.
13. Diagonal thrust restraints shall consist of spring hangers with the same deflection as specified for the spring mountings. Diagonal restraints shall be attached at the centerline of thrust.
14. Correct at no additional costs, all installations which are deemed defective in workmanship or materials.

B. Equipment Isolators

1. Mount floor mounted equipment on concrete housekeeping pads, of sufficient size to accommodate the anchorage of seismic restraints, over complete floor area of equipment. Mount vibration isolating devices and relating inertia blocks on concrete

pad. Key housekeeping pads with pins as required to be integral with the structural slab.

2. Each fan and motor assembly shall be supported on a single structural steel frame. Flexible duct connections shall be provided at inlet and discharge ducts.
3. The machine to be isolated shall be supported by a structural steel frame or concrete inertia base, as scheduled on the drawings.
4. Brackets shall be provided to accommodate the isolator. The vertical position and size of the bracket shall be specified by the isolation manufacturer.
5. The minimum operating clearance between the equipment frame or rigid steel base frame and the housekeeping pad shall be 1 inch. The minimum operating clearance between concrete inertia frames and housekeeping pads shall be 2 inches.
6. The equipment structural steel or concrete inertia base shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the machine or isolators.
7. The isolators shall be installed without raising the machine and frame assembly.
8. After the entire installation is complete and under full operational load, the isolator shall be adjusted so that the load is transferred from the blocks to the isolator. When all isolators are properly adjusted, the blocks or shims shall be barely free and shall be removed.
9. Isolation mounting deflection shall be (minimum) as specified or scheduled on the drawings.
10. Position all seismic restraints with equipment in operation for proper operating clearance and bolt seismic restraints to housekeeping pad.
11. Install equipment with flexibility in wiring connections.
12. Verify all installed isolator and mounting systems that permit equipment motion in all directions. Adjust or provide additional resilient restraints to flexibly limit start-up equipment lateral motion to 1/4 inch.
13. Prior to start-up, clean out all foreign matter between bases and equipment. Verify that there is no isolation short circuits in the base, isolators or seismic restraints.

C. Piping Isolators

1. All piping except fire standpipe system are included under this Section.
2. Isolate all water piping outside the shafts, in Mechanical Room and with in 50 feet of rotating equipment and pressure reducing stations.
3. The isolators shall be installed with the isolator hanger box attached to, or hung as close possible to, the structure.
4. The isolators shall be suspended from substantial structural members, not from slab diaphragm unless specifically members, not from slab diaphragm unless specifically permitted.
5. Hanger rods shall be aligned to clear the hanger box.
6. Horizontal suspended pipe 2 inches and smaller shall be suspended by Vibrex type

"HSS isolator with a minimum 0.25" static deflection. Pipe larger than 2 inch shall be supported by Vibrex type "RMXA" isolators with a minimum 1.0 inch static deflection.

7. Horizontal pipe floor supported at slab shall be supported by Vibrex type "RMLS", with a minimum static deflection of 1.0 inch or same deflection as isolated equipment to which pipe connects, whichever is the greater.
8. Vertical riser pipe supports shall utilize Vibrex type "RMLS".
9. Vertical riser guides, if required, shall avoid direct contact with building.
10. Pipe anchors, where required shall utilize resilient pipe anchors, Vibrex type "RPA" or equivalent, to avoid direct contact of piping with building.
11. Pipe Extension and Alignment connectors: Provide connectors at pump suction and discharge, riser takeoffs, cooling and heating coils, and elsewhere as required to accommodate thermal expansion and misalignment.

D. Position Isolators:

1. Close to building structure.
2. Between building structure and supplementary steel if required.
3. Suspend isolators from rigid and massive support points.
4. Supplementary steel to be sized for a maximum deflection of 0.08 inch at center span.
5. Seismic restraint spacing shall be in accordance with hanger spacing.
6. Provide seismic restraints for all piping in equipment rooms on roof, in shafts and in ceilings of occupied spaces.
7. Support water piping in shafts and floor supports entering shafts with Vibrex type "RPG" isolators. (2 layers)
8. Guide and anchor piping in shafts as required with approved mounting designs incorporating "RP" pad to prevent direct contact with building structure.

3.02 INSTALLATION OF SEISMIC RESTRAINTS

A. Equipment

1. Position all seismic restraints with equipment in operation for proper operating clearances.
2. Weld or bolt seismic restraints to seismic anchor plate.
3. Seismic restraints.
 - a. Each corner or side restraints shall incorporate minimum 1/4" thick resilient pad limit stops.
 - b. Restraint shall be made of plate, structural members or square metal tubing in a welded assembly incorporating resilient padding.

B. Piping

1. Seismic restraints spacing and details shall be in accordance with "Guidelines for Seismic Restraints" as published by SMACNA, and as indicated below.

2. Provide seismic restraint for all piping in equipment rooms, in shafts, and in ceilings of occupied spaces.
3. Seismic restraints not covered by SMACNA shall be as follows:
 - a. Suspended cast iron soil, waste, vent and storm water piping shall have transverse bracing at 20 ft. maximum spacing and longitudinal bracing at 40 feet maximum spacing.

3.03 INSPECTION

- A. Contractor shall arrange and pay for the services of a certified representative of the vibration isolation manufacturer to visit the jobsite for the purpose of checking the installation of the devices. In the event that the isolators do not meet specified requirements in the opinion of the above representative, or the equipment fails to meet specified requirements, the Contractor shall make revisions to the vibrations isolators as required with no additional cost to the Owner.
- B. Submit a certified written report to the commissioned Owner's Representative signed by the above isolation manufacturer representative indicating that all devices have been installed properly and are operating as specified.

END OF SECTION

SECTION 23 09 23

ENVIRONMENTAL CONTROLS AND ENERGY MANAGEMENT SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Environmental controls and energy management systems, including equipment, materials, installation, start-up, testing, documentation and training according to construction documents. The project drawings establish the scope of HVAC controls work in conjunction with the scope of work indicated in Section 23 0900: HVAC Instrumentation and Controls. This Section complements the requirements of Section 23 0900, and construction drawings for controls and system communications.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 01 4523: Testing and Inspection.
 - 3. Section 01 7900: Maintenance and Operations Staff Demonstration and Training.
 - 4. Section 01 9113: General Commissioning Requirements.
 - 5. Section 21 1313: Fire-Suppression Sprinkler Systems.
 - 6. Section 23 0500: Common Work Results for HVAC.
 - 7. Section 23 0513: Basic HVAC Materials and Methods.
 - 8. Section 23 0800: HVAC Systems Commissioning.
 - 9. Section 23 0813: Environmental Controls and Energy Management Systems Commissioning.
 - 10. Section 23 3000: Air Distribution.
 - 11. Section 23 7000: Air Handling Units.
 - 12. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.
 - 13. Section 26 0500: Common Work Results for Electrical.
 - 14. Section 26 0513: Basic Electrical Materials and Methods.
 - 15. Section 26 0519: Low-Voltage Wires (600 Volt AC).
 - 16. Section 26 0526: Grounding and Bonding.

1.02

REFERENCES

- B. The latest version of applicable codes, standards, and references. Inspections and tests shall be in accordance with the following applicable codes and standards, except as provided otherwise herein.
1. International Electrical Testing Association – NETA.
 2. National Electrical Manufacturers Association – NEMA.
 3. American Society for Testing and Materials – ASTM.
 4. Institute of Electrical and Electronics Engineers – IEEE.
 5. American National Standards Institute – ANSI.
 6. National Electrical Safety Code – NESC.
 7. California Building Code – CBC.
 8. California Electrical Code – CEC.
 9. California Mechanical Code – CMC.
 10. Insulated Cables Engineers Association – ICEA.
 11. Occupational Safety and Health Administration – OSHA.
 12. National Institute of Standards and Technology – NIST.
 13. National Fire Protection Association – NFPA.
 14. American Society of Heating, Refrigerating, and Air-Conditioning Engineers – ASHRAE
(The HVAC Commissioning Process, ASHRAE Guideline).
 15. International Building Code – IBC.
 16. International Mechanical Code – IMC.
 17. InterNational Electrical Testing Association (NETA) Acceptance Testing.

1.03

SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. Shop Drawings shall include but not limited to:
1. Cover page with legend, common notes, symbol schedule, and drawing index.
 2. Complete point to point environmental controls and energy management network communication diagram(s) for Distributed Digital Controls (DDC) of each system:

- a. Identify all components.
 - b. Indicate conduit and wire characteristics, sizes and quantities.
 - c. Provide bill of materials.
3. Floor plans showing control panels and intercommunication wiring.
 - a. Show system(s) interface connections.
4. Valve Schedules where required.
5. Operations and Maintenance Manuals.
6. As-built submittal drawings.
7. Installation Instructions of each control device.
8. PC Workstation.
9. Software flow diagram of each unique system sequence of operation.
10. Software licenses and electronic keys.
11. Supplemental local or factory training schedule for post warranty support.
12. A complete list of recommended spare parts with pricing for the Owner's use in keeping the environmental control system downtime to a minimum.
13. Composite CD-ROM with AutoCAD drawings in a ".dwg" format.

1.04 QUALITY CONTROL

- A. Contractor shall have adequate experience installing systems of similar size and complexity with the control product line proposed for this project.
 1. Qualifications of Installer: Minimum five years experience installing products and systems of similar scope and complexity.
 2. Installer shall submit certification from the equipment manufacturer indicating that installer is an authorized representative of the equipment manufacturer and is trained on network applications.
 3. Installer shall maintain a fully equipped service organization capable of furnishing repair service to the equipment and shall maintain a spare set of major parts for the system at all times.
 4. Installer shall furnish a letter from manufacturer of equipment certifying equipment has been installed according to factory standards and that system is operating properly.
 5. Contractor shall have completed and commissioned a minimum of 10 service agreements that provide similar support services to those needed for this project.

6. System startup and testing shall be performed under the direct observation of the Project Inspector and OAR.
- B. Materials and equipment installed shall be new.
- C. System installation shall not begin until Shop Drawings are submitted and reviewed by the Architect or Engineer of Record.
- D. Components for Direct Digital Control (DDC) shall comply with ASHRAE standards.
- E. The installer shall provide the system components required by code and for the life safety of the service personnel.
- F. System shall be able to interface with open protocol BACnet systems.
- G. Provide components required by code for the system to perform the required sequence of operations. Install, test and adjust the system accordingly.
- H. System components shall operate per industry standards. The standards shall be as defined by ASHRAE, SMACNA, AABC, NEBB, TABB, and the literature of the manufacturers listed in this Section.
- I. Provide Field Engineering Tools for user modification of the system.

1.05 WARRANTY

- A. Components, system software, and parts shall be guaranteed against defects in materials, fabrication, and execution for three years from date of system acceptance. Provide labor and materials to repair, reprogram, or replace components at no charge to the Owner during the warranty period. Corrective software modifications shall be updated on user documentation and archived software disks.
- B. The Installer shall provide one year labor warranty.
- C. Provide a list of applicable warranties for equipment and components, this list shall include warranty information, names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.
- D. Respond to the Owner's request for warranty service within four hours during normal business hours. Submit records of the nature of the call, the work performed, and the parts replaced or service rendered.

1.06 TRAINING

- A. Provide a competent instructor who is factory trained and has comprehensive knowledge of system components and operations to provide full instructions to designated personnel in the system operation, maintenance, and programming. Training shall be specifically oriented to installed equipment and systems.
 1. Provide four hours of onsite owner familiarization and training for the installed system. Training shall include system overview, time schedules, override commands, emergency operation, and programming and report generation. Owner employees attending this training session shall be provided with the following documentation:

- a. System layout point to point connection diagram.
 - b. System components cut sheets.
 - c. Operations and maintenance data.
2. Programmer and maintenance training shall include database entry; trend logs application programs, diagnostic routines, reporting, failure recovery and calibration.
- a. Provide a 16 hours training session as follows:
 - 1) Training session shall accommodate a minimum of 20 personnel and be facilitated at a location no more than 50 miles from the Project Site. Obtain Owner's approval for training locations exceeding 50 miles. In such cases, the Contractor shall be responsible for transportation expenses.
 - 2) Training shall cover instruction, theory, and expose the trainees to system's features, components, architecture, operations, programming, report generation, communications, and any other pertinent information required for the operations and maintenance of the system.
 - 3) Instructor(s) shall give the trainees the opportunity to practice on a simulated or actual (installed) system.
 - 4) The training session shall cover, but not be limited to the following instruction modules or sessions:
 - a) System Architecture:
 - (1) System layout and components interrelations and hierarchical structure.
 - (2) Controllers interfacing and functions.
 - (3) Server functionality and data management, error messages, and alarm conditions.
 - (4) Connectivity and communication losses.
 - b) User Operations:
 - (1) Familiarization and navigation with the EMS operating System.
 - (2) Window panes, menus, navigation buttons, alarm response windows, system passwords and accessibility features and options, monitoring and managing data points (inputs, outputs, numeric values, time and date, strings).
 - (3) Views: Provide sufficient information as to train staff on how and where to access programs, functions,

adjust or alter diagnostic points and related data, override messages, reports and actions taken.

- c) Trending: Setting trend(s) intervals, accessing data trends and history logs for diagnosis points or groups, and reporting. Working with trended data graphical displays, including but not limited to hiding points, setting display types and colors, viewing and setting scales.
- d) Graphics: Standard symbols and color codes, graphics customization, how and where to access and manage the system with the graphic displays, including changing points and values, using HOA switches and viewing results, mapping to or with other graphic sources and functions, including groups, navigation, sequence of operations, and displays and reports.
- e) Alarms: Reading and interpreting alarms, acknowledging and silencing alarms, routing and setting priorities, viewing and responding e-mailed and paged alarms.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Environmental controls and energy management systems shall be approved products of Alerton, Automated Logic, Honeywell, , TAC, Trane, Carrier, or equal.

2.02 SYSTEM ARCHITECTURE

- A. The system shall be capable of providing a peer-to-peer network of distributed stand-alone DDC controllers that meet ANSI/ASHRAE Standard 135 for open protocol communications.
- B. The primary network communications bus for DDC systems shall be industry standard Ethernet protocol operating at 100MBPS. Secondary bus configuration shall be MS/TP with a minimum speed of 38Kb. A maximum of 32 controllers shall be connected to any one MS/TP bus.
- C. The supplied computer software shall employ object-oriented technology (OOT) for representation of data and control devices within the system. For each global, system or unitary controller, provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3 with the ability to support data read and write functionality.
- D. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed three seconds for network connected controllers or user interfaces.
- E. Projects requiring standalone controls shall not include workstations or DDC network controllers.
- F. The system shall be able to interface with subsystems that utilize ANSI/CEA-709.1: Control Network Protocol Specification.

2.03 USER INTERFACE WORKSTATION

- A. The Operator Workstation shall include a computer with an Intel processor, keyboard, mouse, 24 inch LCD color display and the latest version of Microsoft Windows operating system software. The workstation shall connect to the network through an internal 10/100MBPS Ethernet interface card. Provide a Graphical User Interface (GUI) application program for intuitive operation of the network system.
- B. Software licensing shall be provided for local or remote unlimited simultaneous users of the system, unlimited future point expansion, user graphical display generation and non-vendor controllers. Licenses and electronic keys shall be included with the M&O manuals for project acceptance. Conditional Licenses will not be acceptable.
- C. The system shall be programmed to email selected alarms to designated response personnel.
- D. Provide a Web Server to automatically convert system displays on the workstation to an Internet page readable from standard PC browsers. The server shall be a separate device to provide security protection for the building system from outside hackers.
 - 1. Coordinate individual system components IP addresses, switch port assignments, security settings such as but not limited to SNMP alarm delivery, HTTPS/SSL settings, VLAN assignment and authorized IP address ranges with the Owner's Information Technology Division. Coordination activities with ITD shall be executed through the OAR.
 - 2. Provide IP address label on the interior of each cabinet door or equipment.
 - 3. The system shall support the ability to notify school or Owner designated personnel by SMS or Email messages, utilizing the Owner's mail server when problems or situations that require immediate attention arise.
- E. Operator Workstation shall display data associated with the project as called out on drawings or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstation shall display data using three-dimensional graphic representations of mechanical equipment. System shall be capable of displaying graphic files, text, trend data and dynamic object data together on each display screen with animation of equipment operation.
- F. Controllers shall be programmed using graphical software tools that allow connection of function blocks for visual sequencing of control logic. Function blocks shall display real time data and be animated to show status of data inputs and outputs when in real time operation. Animation shall also show change of status on logic devices and countdown of timer devices in a graphical format.
- G. Operator Tracking Log shall record operator changes to the system for future review. This shall include, but not be limited to setpoint changes, time schedule overrides, alarm limits, etc.
- H. The system shall be equipped with a battery back-up source capable of providing 30 minutes of operation (computer and monitor) in the absence of normal power, to allow for an orderly shut down and data back-up.

2.04 GLOBAL CONTROLLER

- A. Building controllers shall incorporate the functions of a 3-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 100MHz), master slave token passing (MS/TP) LANs, a point-to-point (PTP/RS-232) connection and telephone modem.

- B. Provide global control strategies for the system based on information from any point objects in the system. Programming shall be object-oriented using graphical control function blocks. Global strategies shall include, but not limited to unit scheduling, electrical demand limiting, optimized start-stop of equipment, central plan reset control, etc.
- C. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative). Battery shall provide up to five minutes of powerless operation for orderly shutdown and data backup.
- D. Each building controller shall support a minimum of 250 BACnet Schedule Objects and 250 BACnet Calendar Objects.
- E. Each building controller shall log a minimum 1,000 trend logs. Any point object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation. Building controller shall periodically upload trended data to networked operator's workstation for long term archiving if desired. Archived data shall be available for use in third-party spreadsheet or database programs.
- F. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes events such as analog object value changes, binary object state changes and various controller communication failures. Each alarm may be automatically dialed out to a telephone pager or emailed to any Internet PC computer.
- G. Provide a 1.5 KVA UPS with battery back-up capability to provide a minimum of 30 minutes of operation (computer and monitor) for orderly shutdown and data backup. Make connections and test the system for proper operation in the presence of the Project Inspector.
- H. The global controller shall be equipped with electrical demand limiting capacity interface features capable of receiving KW demand pulse signals from the facility utility meter.
 - 1. The system shall include a demand-limiting program with at least two types of load shedding. The following options shall be available:
 - a. Shed/Restore equipment in digital format. It shall include at least 5 priority levels of equipment shedding. Load shedding on a given priority level shall include two methods. In one the loads shall be shed and restored in a "first-off/first-on" mode and in the other; the loads shall be shed/restored in a linear fashion.
 - b. Adjust operator selected control setpoints in analog format based on energy usage when compared to shed and restore settings.
 - c. Shedding may be implemented independently on each and every zone or piece of equipment connected to the system.
 - d. Status of every load shed shall be capable of being displayed on every operator terminal connected to the system. Statuses shall be displayed along with the English description of each load.

2.05 APPLICATION (system and unitary) DDC CONTROLLERS.

- A. Application controllers shall include universal inputs with 10-bit resolution that accept 3K and 10K thermistors, 0 to 10VDC, 0 to 5 VDC, 4 to 20 mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three inputs that accept pulses. Controller shall also include support and modifiable programming for interface to intelligent

room sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs shall be switch selectable as either 0–10VDC or 0–20mA. Software shall include scaling features for analog outputs. Application controller shall include a supply voltage to power external sensors.

- B. Program sequences shall be stored in EEPROM or flash memory. No batteries shall be needed to retain logic program. Controller shall execute program sequences 10 times per second and be capable of multiple PID loops for control of multiple devices. Calculations shall be completed using floating-point math. Programming of application controller shall be completely modifiable in the field over the installed BACnet LANs or remotely via modem interface.
- C. Central Plant Controllers shall interface to chiller gateways. Point objects shall reside in the central plant controller. Hand-Off-Auto switches shall be provided for direct wired output control circuits.
- D. Controllers for VAV boxes shall include one onboard airflow sensor microprocessor driven and pre-calibrated at the factory. Pre-calibration shall be at 16 flow points as a minimum. Factory calibration data shall be stored in EEPROM. Calibration data shall be field adjustable to compensate for variations in VAV box type and installation. Calibration parameters shall be adjustable through intelligent room sensor. Operator workstation, portable computers and special hand-held field tools shall not be needed for field calibration. Boxes shall be controlled using pressure independent control algorithms and flow readings shall be in CFM
- E. Controllers for Dual Duct boxes shall include two onboard airflow sensors and function similar to the VAV box controller. Multiple VAV box controllers or controllers with remote airflow sensors are not acceptable.

2.06 TEMPERATURE SENSORS

- A. Temperature sensors shall be 10K ohm thermistor factory-calibrated to within 0.5 degrees F, totally interchangeable with housings appropriate for the application.
- B. Wall sensors shall be installed 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells filled with thermal compound. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.

2.07 HUMIDITY SENSORS

- A. The humidity sensor shall be a solid-state device that is factory calibrated to provide a linear output with an accuracy of 3.0 percent from 0 to 90 percent RH. A metal fabric filter shall protect the humidity-sensing element.
- B. Duct humidity sensors shall utilize a sampling tube enclosure that is accessible for maintenance personnel.
- C. Room and duct sensors shall incorporate a temperature sensor in the same enclosure when required.

2.08 PRESSURE SENSORS

- A. Differential and pressure sensors shall have a tensioned stainless steel diaphragm to form a variable capacitor that produces a linear output with an accuracy of 1.0 percent of full scale. The unit shall be able to withstand 10 PSIG over pressurization.
- B. Differential pressure switches shall utilize a diaphragm operated snap-acting switch with a setpoint range of 0.05 to 2.0 inches WC.
- C. Steam pressure sensors shall be mounted on a pigtail siphon with manual shutoff ball valve.

2.09 CARBON DIOXIDE (CO₂) SENSORS

- A. Carbon dioxide concentration levels shall be sensed by non-dispersive infrared technology. A corrosion-free sensing chamber shall be used for accurate, stable CO₂ sensing. An LCD shall display sensed CO₂ concentration.
- B. Sensor shall be gold plated and have a range of 0-3000 PPM at +/- 5 percent accuracy for long-term calibration stability. Both analog and binary relay output circuits shall be available on the sensor. An automatic background calibration algorithm shall reduce required maintenance.
- C. Acceptable Manufacturers: Telaire, Honeywell, Controls, or equal.

2.10 ELECTRONIC VALVES

- A. Control Valves ½ inch to 2-inch shall be characterized stainless steel ball valves with actuators sized to close off against twice the maximum fluid pressure. Valve body shall be NPT screwed for 2-way or 3-way application. A push button release shall be provided for manual operation.
- B. Control Valves 2 ½-inch and larger shall be butterfly type with actuators sized to close off against twice the maximum fluid pressure. Valve body shall be flanged for 2-way or 3-way application. Contacts shall be provided to mechanically indicate the full open and full closed position of the valve.
- C. Steam Valves shall be globe valves suitable for 35-PSI inlet steam service. Valve bodies shall be NPT screwed or flanged with spring-return normally closed valve actuators.
- D. Acceptable Manufacturers: Belimo, Honeywell, , or equal.

2.11 DAMPER ACTUATORS

- A. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
- B. Actuators shall be sized for 200 percent of the design torque requirements.
- C. Damper actuators shall incorporate a release mechanism to manually position the damper for maintenance or emergency override.
- D. Damper Actuators located outdoors shall have a clear plastic weather shield specifically designed for the application.
- E. Acceptable Manufacturers: Belimo, Honeywell, Johnson Controls, or equal.

2.12 CURRENT SWITCH

- A. Current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. A multi-turn setpoint adjustment shall set the trip point status. An LED shall indicate the on or off status.

2.13 CONTROL RELAY

- A. The relay shall be contained in a plenum rated NEMA 1 enclosure with a ½" NPT conduit fitting. Coil voltage shall be 24 or 120 VAC with a contact rating of 10A. An LED on the enclosure cover shall indicate the relay is energized.

2.14 ENCLOSURES

- A. Controllers, power supplies and relays shall be mounted in NEMA 1 enclosures when located in a clean dry indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.
- B. Enclosures for outdoor applications shall be rated NEMA 3R and be mounted on the north exposure of the controlled unit.
- C. Enclosures shall have hinged, locking doors with common keying for control panel on the Project Site.
- D. Enclosures shall have permanently affixed to the door an engraved nametag identifying the equipment served. The nametag shall be a minimum 1 inch by 3-inch with ½ inch lettering.

PART 3 – EXECUTION

3.01 CONTROLS INSTALLATION

- A. Wiring methods for control system shall be as defined in the Division 26 specifications. Wire types shall conform to manufacturers' recommendations.
- B. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room. Control panel assemblies must be UL listed.
- C. Provide software and hardware required to provide controls and monitoring of diagnostic points indicated in specification Section 23 8000.
- D. Coordinate with Division 26 electrical installer so that "Hand/Off/Auto" selector switches are installed to override automatic interlock controls when switch is in the "Hand" position. Safety shutdown interlock wiring shall disable the equipment regardless of the position of the H-O-A switch.
- E. Coordinate with Division 26 electrical installer to interface the lighting control systems with the energy management system to perform the following functions as required:
 - 1. Demand limiting or load shedding.
 - 2. Energy use monitoring.
 - 3. Alarm reporting.

4. Preventive maintenance scheduling, reminding and tracking.

3.02 ROOM SENSORS INSTALLATION

- A. Room sensors shall be wall mounted at a 48-inch height above finished floor. Room sensors are not permitted on outside walls, at chalkboards, between shelving, in recesses or above heat producing equipment. Coordinate with Division 26 for sensor or thermostat mounting adjacent to light switches.

3.03 COORDINATION

- A. Coordinate the work with other aspects of mechanical, electrical, fire-life safety and security systems, and photo voltaic systems to obtain a complete and operating system in accordance with the contract documents.
- B. Meet with the OAR and school principal and other school staff to determine when each zone or building will be occupied so scheduling of the operation of heating, ventilating and air conditioning equipment may be provided at the proper times.

3.04 DDC CONTROL SYSTEM ADJUSTMENTS

- A. Make adjustments under operating conditions to provide sequence of operation for each control system per design intent. If required operating conditions cannot be obtained prior to completion date of the contract due to outdoor seasonal temperatures, return to the job site when requested by the Owner and re-adjust control system when outdoor temperatures will permit proper operating conditions. Start re-adjustment within seven calendar days after notification.

3.05 PERFORMANCE AND ACCEPTANCE:

- A. Test and calibrate each device including but not limited to the following for proper operation, connection, signal value or response.
 1. Building Controllers.
 2. Custom Application Controllers.
 3. Application Specific Controllers.
 4. Input / Output Devices. (Sensors, actuators and monitoring devices)
 5. Operator Interfaces.
- B. Verify that systems are standalone and operable upon network failure.
- C. Verify that systems return to normal operation automatically upon resumption of network operation or return of power.
- D. Test each system for functions of the required control sequence of operation either by normal control operation or forced operation as required. Log and submit results.
- E. Test the network for connectivity, data transmission rates, input/output responses, and other appropriate parameters Failure modes, including network failure, individual control system failure, and power outages, shall be simulated and responses logged, with any effects on network operation noted and corrected.
- F. Test each preprogrammed time and holiday schedule.

- G. Commissioning requirements of Divisions 01, 23, and 26 apply to this Section.
- H. Schedule of Responsibilities: Refer to Appendix A. The schedule identifies the responsibilities of the Contractor for the installation of the environmental controls and energy management system. Deviations and clarifications of this schedule only if allowed by the OAR, provided trade contractor coordination and schedule requirements are met. Submit a record copy of the Schedule of Responsibilities to the OAR at the commencement of this Section's Work.

3.06 WIRING AND INFRASTRUCTURE

- A. Provide necessary wiring, terminations, connections and conduit infrastructure for the complete system as indicated in the construction documents.
- B. Exterior cables whether above or below ground level shall be rated for exterior applications. When entering a building provide a code sized pull box with necessary hardware to transition exterior rated cables to interior applications.
- C. Underground EMS cables are permitted to be installed with lighting control wiring in underground applications. Provide innerduct to separate EMS cables from lighting control system cables.

3.07 DATA LOGGING REQUIREMENTS

- A. The system must be capable of storing the system's collected and diagnosis data for a minimum of seven days.
- B. Program the system for a standard seven day schedule including holydays.

3.08 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off Project Site.

3.09 PROTECTION

- A. Protect Work of this Section until Substantial Completion.

END OF SECTION

APPENDIX A

SCHEDULE OF RESPONSIBILITIES

	ITEM	FURNISH BY	INSTALL BY	POWER BY	CONTROL WIRING BY
1	Magnetic Motor Starters:				
	a. Automatic controlled, with or without HOA switches.	E	E	E	DDC
	b. Manually controlled	E	E	E	N/A
	c. Manually controlled furnished as factory wired unit equipment	M	M	E	E
	d. Special duty type (part winding, multi-speed, etc.)	M	See Note 1	E	See Note 1
	e. Adjustable frequency drives with or without manual bypass.	DDC	E	E	DDC
	f. Domestic booster pump. Motor Controls	M	M	E	See Note 2 DDC
2	Line voltage contactors.	E	E	E	DDC
3	Control relay transformers (other than starters).	DDC	DDC	E	DDC
4	Control and Instrumentation panels	DDC	NI	E	DDC
5	Automatic control valves, automatic dampers and damper operators, solenoid valves, insertion temperature and pressure sensors including wells	DDC	M	E	DDC
6	Control interlock wiring between chillers, pumps, cooling towers, fans and air handling units and other miscellaneous mechanical equipment.	DDC	DDC	E	DDC
7	Duct Smoke Detectors	E	M	E	E
8	Dampers				
	a. Control Dampers	M	M	N/A	DDC
	b. Smoke Dampers and Combination Fire/Smoke Dampers	M	M	E	E
9	Airflow Stations with transmitter.	M	M	E	DDC
10	Air terminal devices (I.e., VAV and fan powered boxes).	M	M	E	DDC
11	Intelligent Devices and Control Units provided with packaged mechanical equipment such as: Large VAV and constant volume package units Boilers and Chillers.	M	M	E	NI
12	Intelligent Devices and Control Units not provided by equipment manufacturer such as: Air handling units, Heat pumps, AC units (small < 20 tons), Air terminal units (VAV boxes)	DDC	DDC	E	DDC
13	Intelligent Devices and Control Units provided with electrical systems such as: Occupancy / motion sensors, Lighting Control Panels, Switches and dimmers, Switch Multiplexing Control Units, Door Entry Control Units.	E	E	E	DDC
14	Gateways for proprietary non-BACnet equipment	M	M	E	DDC
15	Communications network devices such as Routers, Bridges and Repeaters.	DDC	DDC	DDC	DDC
Abbreviations					
DDC		DDC Contractor (controls contractor)			
M		Mechanical Contractor			
E		Electrical Contractor			
N/A		Not Applicable			

Notes:

1. Magnetic motor starters (special duty type) shall be set in place under electrical division except when part of factory wired equipment, in which case they shall be set in place under mechanical division.
2. Where a remote motor disconnect is required in addition to the one provided integral to a Variable Frequency Drive (VFD), controls contractor shall provide the necessary control interlock between the disconnects.

SECTION 23 31 00

AIR TRANSMISSION AND DISTRIBUTION SYSTEM

PART 1 - GENERAL

Division 1 requirements apply to this Section.

1.01 SUMMARY

A. The work includes, but is not limited to the following:

1. Low pressure ductwork.
2. Diffusers, registers and grilles.
3. Dampers.
4. Air filters.
5. Terminal air units.
6. Access panels.

B. Related Sections:

1.	Section 22 08 00:	Equipment and System Tests
2.	Section 22 05 53:	Identification
3.	Section 22 05 00:	Basic Materials and Methods
4.	Section 23 05 48:	Vibration Isolation and Seismic Restraints
5.	Section 22 07 00:	Insulation
6.	Section 23 80 00:	Air Conditioning and Air Handling Equipment

1.02 SUBMITTALS

A. Requirements: In addition to the requirements of Section 23 00 00, GENERAL PROVISIONS, the submittal material shall include six (6) copies of descriptive data for all products and materials including, but not limited to the following.

1. Descriptive data.
 - a. Grilles, registers and diffusers.
 - b. Terminal air units.
 - c. Dampers.
 - d. Air filters.
 - e. Air monitoring units.
 - f. Flexible ducts.
 - g. Ductwork accessories.
 - h. Access panels.
 - i. Filter gauges
2. Shop Drawings.

- a. Ductwork typical construction.
- b. Ductwork layouts.
- c. Tabulation of all air supply grilles, registers and diffusers listing location, size, air volume, flow and sound generated.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General.

- 1. Galvanized steel sheets shall be first quality cold rolled, galvanized, open hearth soft steel, capable of double seaming without fracture, meeting ASTM 526-64T.
- 2. Stainless steel sheets shall be type 316 18-8 stainless, No. 4 finish where exposed in regularly occupied areas.
- 3. Steel shapes shall be hot rolled, galvanized.
- 4. Screws and bolts shall be cadmium plated.
- 5. Materials and fabrication shall comply with Uniform Mechanical Code Standard 4-2 and Chapter 10, latest edition.

B. Materials, Application.

- 1. Low pressure ductwork except for special exhaust system shall be galvanized steel.
- 2. Medium pressure ductwork except for special exhaust system shall be galvanized steel.
- 3. Transverse joints in rectangular ducts may be manufactured type similar to Ductmate Industries, Inc.

C. Circular ducts.

- 1. Circular (across section) ducts shall be galvanized steel of spiral seam construction, fittings shall have continuous, welded, stamped construction both manufactured by United Sheet Metal, Omniduct, Spiromatic, Spiro-Duct or approved equal.
- 2. Make joints between two ducts with beaded sleeve joint, with duct sealer applied to make end, mechanically fastened with sheet metal screws or pop rivets. Sealing of ductwork shall be as specified hereinafter.
- 3. Radius of elbows shall be minimum of 1-1/2 times diameter or maximum width of duct. Gored ells are not acceptable.
- 4. Tee fittings shall be of conical type changing in shape from round to rectangular with transformation joint with minimum of 1 to 7 taper.
- 5. Corrugated or flexible metal duct, or shop fabricated circular ducts will not be acceptable.
- 6. Circular ducts with liner shall be United Sheet Metal, Spiromatic, Circliner or approved equal.
 - a. Duct shall be of double wall construction consisting of galvanized steel outer and inner wall with a layer of one inch thick fiberglass insulation between the walls. Inner face of the insulation shall be faced with mylar film to prevent erosion or

harbor bacteria.

- b. Insulation shall have the following Underwriter's rating:

Flame Spread	10-20
Fuel Contributed	10-15
Smoke Development	0-20

- c. Inner wall shall have perforations of approximately 2/32" diameter, and the percentage of open area shall be approximately 22%.
- d. Support the inner wall by metal spacer welded in position.

D. Access doors.

1. For square ducts.

- a. Access doors shall be of size to permit inspection and adjustment and replacement of fire damper links, fan bearings, etc. through access opening. The minimum size shall be 12" x 12" x 26 gauge in furred spaces and 18" x 22 gauge in equipment rooms and areas, wherever possible. Demonstrate adequacy of size as required by the Engineer.
- b. Door shall be double wall type with felt or foam rubber gasket seal and shall have butt hinges and sash locks on 2-opposite sides, at a maximum spacing of 9". Use sash locks on both sides where hinged door swings may be obstructed.
- c. Door in insulated ducts shall contain a full thickness of insulation between the door panels.

2. Access doors for circular ducts shall be United Sheet Metal Type AR-W, Omniduct, Spiromatic, Spiro-Duct, or approved equal.

2.02 INSULATED FLEXIBLE DUCTWORK

A. General.

1. Insulated flexible ductwork where shown on drawings, shall be factory pre insulated, spiral helix spring permanently bonded to an interior liner, and sheathed in an exterior foil scrim vapor barrier jacket.
2. Manufacturer: Glenflex SLS-DS, Casco Silent Flex II, Thermaflex or approved equal.
3. Insulated flexible ductwork shall be installed for low pressure duct application only.

B. Low pressure ductwork.

1. Low pressure ductwork shall have precut lengths with continuous inner liner, factory installed female collars and fastening devices at each end, a factory installed manual balancing damper assembly complete with a level position indicator and a positive locking device.
2. Provide all round duct takeoffs from low pressure ducts with aluminum draw band, or Spin-In Twist-Lok fittings, approved for installation in return air plenum.
3. Maximum length 7'-0".

D. UL requirements.

1. The entire flexible duct assembly shall be labeled in accordance with UL-181 Class I air duct requirements and not have a flame and smoke spread rating in excess of 25/50.
 2. Installation must conform with factory supplied and UL approved print installation instruction sheets.
 3. Submittals will be required to include product data sheets and installation instruction sheets in order to assure awareness of the proper installation technique.
- E. Thermal conductance.
1. Insulation must achieve a minimal thermal conductance (c) rating of 0.23 and must be completely shielded from the airstream at all times.

2.03 ACCESS PANELS

A. General.

1. These Specifications cover prefabricated wall and ceiling access panels normally required to provide access to equipment requiring servicing and adjustment.
2. The types of wall and ceiling access panels required are similar to Milcor Styles A, L, K and M, Potter-Roemer No. 265 and 275, Zurn Series Z-1376, Carey Styles HP, HM, HPE, and AT, or Karp #214, for the appropriate locations and with hinge, metal gauge, latch, and other modifications necessary to conform to requirements specified hereinafter. Panels shall be UL labeled to match wall or ceiling rating requirements.

B. Location.

1. Furnish for installation by the pertinent trade, access panels wherever fans, air handlers, air filters, valves, balance valves, damper operating mechanisms, fire damper access doors and similar items normally requiring adjustment or servicing are installed in concealed spaces.
2. Where furred ceilings are of the removable panel type of construction, the removable panels will be used for access to small equipment such as valves, dampers and controls.

C. Sizes.

1. Size access panels to permit removal of equipment for servicing, and in no case shall be less than 12" x 12" clear in usable openings.
2. Where proper servicing of the equipment required the entrance of a serviceman, size the access opening accordingly with minimum net clear opening not less than 18" x 24".
3. Where access panels are to be located in acoustic tile ceilings, increase size of access panel, when required, to next nearest full tile size so that access panel can be installed integral with tile pattern without cutting into tiles.

D. Construction.

1. Construct access panels neatly and substantially of steel, complete with frame and with necessary grounds for attaching to metal lath, tile walls or other construction, as required. Hinges shall be of concealed type. Minimum door and frame gauges shall be USS No. 16 and USS No. 18 respectively. Furnish panels and frames with a factory-applied prime coat, except panels in tile walls shall be chrome plated and polished or satin finish Type 304 stainless steel.
2. Panels to be installed in acoustical tile ceilings shall be as specified in paragraph (1)

above except that the door panels shall be recessed and faced with acoustical tile to match the ceiling tile so the frame will be concealed. The depth of the door recess shall be such that door facing tile are flushed with ceiling tile.

E. Exceptions.

Normally, access doors to large attic spaces will be furnished under another section, and when so furnished will be shown on the Architectural plans. Examine all plans carefully and furnish any access panels or doors to equipment in these spaces where they are not to be furnished under the other section.

2.04 CONTROL DAMPERS

A. Manual volume dampers.

1. Dampers installed in ductwork, in furred ceiling spaces or in roof spaces with less than 30" of clearance below beams, joints or other construction, and where access panels are not provided shall have damper rods extended below ceiling and terminated with a concealed damper regulator, Ventlok, Young, or approved equal.
2. Damper blades shall not exceed 10" in width and shall be a minimum of 16-gauge galvanized steel, or 14-gauge aluminum. All dampers shall be frame mounted. The damper frame shall be of minimum 13-gauge steel channel. Except that dampers less than 18" maximum size may have 16-gauge by 1-1/4" minimum flat bar stock frames. Multi blade dampers shall be arranged for opposed blade operation.
3. Steel parts shall be galvanized or factory-finished with a metal primer and enameled finish. All parts of dampers in outside air intakes shall be galvanized. Bearings shall be precision sleeve type of oil-impregnated bronze, Teflon or Nylon.
4. Dampers and hardware for stainless steel ducts used for corrosive air shall be stainless steel to match duct.
5. Provide locking and indicating quadrants, Ventlok or Duro-Dyne, installed in accessible locations. For wrapped ducts, quadrants shall be bracket mounted with a recessed flange.
6. Where dampers are inaccessible for adjustments, provide Ventfabrics No. 666, or equal by going Regulator Co.; with rod extension to damper.

- B. Gravity dampers or backdraft dampers. Gravity dampers shall have aluminum blades with felt seals mounted in a 16-gauge steel frame. Bearings shall be precision machined oil-impregnated bronze, Teflon or Nylon of the sleeve type. The steel frame shall be factory-finished with metal primer and enamel finish, American Venting, Inc. or approved equal.

2.05 FIRE AND SMOKE DAMPERS

A. General.

1. Fire and smoke dampers shall be designed and constructed in accordance with NFPA standard 90A and UL Standard 555 or the California State Fire Marshal, and shall be so labeled with permanent identification.
2. Ducts with a width or height dimension of 12-inches or less shall be of a type or so arranged that the damper's free area opening is the same as the connecting duct.
3. NFPA or UL approved installation instructions shall be shipped with each fire and smoke damper.

4. Provide access doors in ducts on the fusible link side of each fire and smoke damper.
- B. Automatic Fire dampers (AFD) - NOTUSE
- C. Automatic Smoke Dampers (ASD)
1. Damper shall be 1-1/2 hour rated and motor operated.
 2. Frame shall be minimum 16 gauge galvanized steel formed from a continuous channel section. Bearings shall be formed in the frame and shall match the contour of the blade. Blades shall be roll formed single-thickness galvanized steel and shall overlap both frame and adjacent blades a minimum of 3/4". Blade edge and jamb seals shall be low friction type non-degradable steel-to-steel and shall withstand 850° F with a minimum leakage of 15 cfm/ft at 1" w.g., stainless steel flexible metal compression type jamb seals will not be accepted. (For projects outside L.A. City jurisdiction)
 3. The torque required to maintain the rating in the closed position shall be 0 in.lbs. Blade linkage shall be interconnected to the damper jackshaft on both ends.
 4. Each damper shall be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL 555S. The leakage rating under UL 555S shall be no higher than leakage class II (10 cfm/ft. @ 1" w.g. and 20 cfm/ft @ 4" w.g.). (For projects outside L.A. City jurisdiction)
 5. Dampers shall be tested in HVAC systems to ensure operation with pressures of at least 4" w.g. in the closed position, and 4000 fpm in the open position.
 6. Actuators shall be fail closed upon lose of power and shall be rated to an elevated temperature of 250° F, depending upon the actuator.
 7. Actuators shall be factory installed, electric type and shall provide a minimum of 75 in-lbs of torque at the damper shaft. Actuator bracket shall be designed to allow for the installation of ductmate without realignment or alterations.
 8. Damper and actuator assembly shall be factory cycled to ensure proper operations. Dampers shall be installed in accordance with manufacturer's installation instructions.
 9. Damper assembly shall include dual position indicator switch package capable of positively indicating each dampers status as being full-open or full-closed at remote central control panel.
 10. Smoke detector shall be a duct mounted ionization type for vertical position dampers.
 11. The detector shall incorporate an airtight chamber and shall be UL listed per UL S911 and per CSFM listing 3240. The detector shall operate at air velocities of 300 to 4000 FPM and shall be capable of local testing via magnetic switch.
 12. An integral filter system shall be included to reduce dust and residue effects on detector and housing, thereby reducing maintenance and servicing.
 13. The detector and sampling tubes shall be factory mounted and pre-wired to provide a single-point power connection by the damper manufacturer.
 14. Damper/actuator/detector assembly shall be factory cycled to ensure proper operation. Dampers shall be Pottorff model 2151, or approved equal.
- D. Combination fire and smoke dampers (FSD)
1. Dampers actuator and smoke detector shall be as specified for automatic smoke

dampers, above.

2. Each damper assembly shall be equipped with a UL 33 listed thermal bi-metallic resettable "McCabe Link" that provides for fail closed fire and smoke operation independent of the actuator position, electric sensing stats (fire stat) will not be accepted. Thermal McCabe Link shall disengage damper linkage from actuator and mechanically lock damper in a closed position from either a smoke detector signal or when duct temperature exceeds 165° F.
3. The design shall only allow damper to be reopened when the smoke detector signal is clear and the duct temperature has returned to a safe level, as per NFPA 92A.
4. The FSD shall be Pottorff FSD-172-OP, or approved equal.

2.06 AIR DISTRIBUTION EQUIPMENT

A. General.

1. Refer to submittals, Paragraph 1.02.
2. Equipment shall provide required air flow, throw and spread without drafts or noise.
3. Size of supply, return, exhaust outlets and inlets as indicated on the drawings are approximate only. Sizes shall be as recommended by the manufacturer to meet the noise criteria requirements of the area served as recommended by the ASHRAE Guide as a minimum, with drafts (air velocities) at the occupancy level not in excess of 50 FPM.
4. Provide all accessories required to effect these conditions.
5. Replace all grilles, registers, dampers or diffusers causing excessive drafts or noise at no additional cost to the Owner.
6. Performance ratings shall be certified by the ADC.
7. Noise level ratings shall be in accordance with ADC Test Code No. 1062RI and ASHRAE Standards 36-62 and 36B-63.
8. Test room and test instruments shall be ADC approved.
9. Manufacturer: Air distribution equipment shall be of specified types manufactured by Anemostat, Price, Kruger, Titus or approved equal.

B. Air distribution equipment types.

1. Type 1: Ceiling diffusers shall be perforated face plate modular core diffuser with removable hinged perforated face plate with 24" x 24" nominal panel size, OBD and flexible duct adapter, applicable to the ceiling it is installed. Anemostat QCP-L or approved equal.

or

Type 1: Ceiling diffuser square or rectangular shall be Anemostat modular core type, model QC-L or QC-S, with OBD and flexible duct adapter, applicable to the ceiling it is installed.

2. Type 2: Return air registers and grilles shall be removable hinged perforated face plate with 24" x 24" nominal panel size, OBD and flexible duct adapter, applicable to the ceiling it is installed, Anemostat 3PD-L or approved equal.

or

Type 2: Return air and exhaust air register in rooms with lay-in T-bar ceiling shall be Anemostat S30HD-FP with OBD and flexible duct adaptor, horizontal face bars set at an angle of 45-degrees.

3. Type 3: Not Used
4. Type 4: Exhaust air and return air registers in rooms without lay-in T-Bar ceiling shall be Anemostat S30HD, horizontal face bars set at an angle of 45-degrees with OBD and flexible duct adaptor.
5. Type 5: Not Used
6. Type 6: Not Used
7. Type 7: Ceiling diffusers in rooms without lay-in T-Bar ceiling shall be Anemostat QC-S or approved equal. Modular ceiling diffuser with OBD.
8. Type 8: Sidewall supply registers shall be double deflection grille with opposed blade damper attached, two sets of individually adjustable louvers, Anemostat S20H.
9. All perforated diffusers and registers shall be steel construction, equipped with volume controls and adjustable baffles where required for pattern control and shall have factory applied off-white prime coat finish.
10. Ceiling diffusers with automatic fire dampers, where diffusers are installed in fire rated ceilings, shall be State Fire Marshal approved type. Rated enclosure between rated ceiling and fire dampers shall be provided by the Contractor under this Section.
11. Screened opening shall be No. 16 ga. wire 1/2" mesh galvanized mounted in a metal frame.

2.07 AIR FILTERS

A. General.

1. Furnish filters complete with media, retainer frames and housing certified to meet design requirements.
2. Filters shall be types specified by Farr, Eco-aire, American Air Filter, or approved equal.

B. Types.

1. MERV 8 Filters

C. Filter housing.

1. Filter housing shall be Farr Company Model 3P Universal Glide/Pack, and shall be factory fabricated and assembled.
2. The units shall be constructed of not less than 16-gauge galvanized steel and shall incorporate two (2) access doors, extruded aluminum tracks, and individual universal holding frames designed to accommodate a wider range of standard size filters in varying efficiency ranges. See Schedule on Drawings for sizes.

D. Certification.

1. Include an individual test report for each type of filter prepared by an independent testing laboratory with test equipment specified in ASHRAE Standard 52-81 using a 24-1/ x 24-

1/2" duct section for the filter under test.

2. Each test report shall include filter descriptive information and assurance that the construction and performance is in accordance with the Specifications.
3. All filters tested shall have been procured by the independent testing laboratory from the open market independent of the manufacturer of these filters, and a statement of this fact shall accompany the submittal along with the test report.

PART 3 - EXECUTION

3.01 SHEET METAL DUCTWORK AND PLENUMS

A. General.

1. Install ductwork of sizes, runs and connections as shown on the drawings.
2. All sheet metal construction not shown or specified shall be constructed to conform to SMACNA HVAC Duct Construction Standards latest edition."
3. Verify all dimensions at the site, making all field measurements and shop drawings necessary for fabrication and erection of sheet metal work. Make allowances for beams, pipes or other obstructions in building construction and for the work of other sections. Check plans showing work of other trades and consult with Engineer in the event of any potential interference.
4. Fabricate ductwork in workmanlike manner with airtight joints, presenting smooth surfaces on inside, neatly finished on outside, construct with curves, bends, turning vanes to aid the easy flow of air.
5. Install ductwork at maximum practical height above the work of other trades whenever possible so as to clear all obstructions, preserve headroom, and keep openings and passageways clear, whether shown on plans or not. The use of variation in duct sizes and additional duct fittings will be allowed, if required, to clear minor obstructions and maintain clearances. These shall be reviewed by the Engineer. Make such changes without additional cost to the Owner.
6. Increase ducts and plenums sizes lined with insulation to allow for insulation thickness so that dimensions shown on plans will be net inside dimension.
7. Pipes, conduits, tie or hanger rods or other work shall not pierce and/or pass through the air passageway of ducts or plenum except where shown.
8. Make internal ends of "S" slip joints in direction of airflow.
9. For pocket lock transverse joints, the pocket frame shall be made 1/8" smaller than the ducts in both dimensions (width and depth) for ease of field locking. All clips used in the flanges shall be of the same gauge as duct material.
10. Intermediate reinforcement shall be on all four sides of duct, bolted together and bolted or riveted to the duct.
11. Ductwork shall have rectangular or circular cross-section as shown on drawings.
12. Rectangular ducts shall be diagonally creased (crossbroken) in both directions or machine beaded on all four sides. Circular ducts shall be spirally seamed.
13. Longitudinal seams shall be hammered airtight.
14. Caulk automatic damper frames airtight.

15. Caulk ductwork connecting to fresh air intakes watertight for a minimum length equal to the height and shall be installed to pitch to intakes and drain to outside of building.
16. Clean all direct and foreign matter from ductwork, and clean diffusers, registers and grilles.
17. Round duct may be substituted for rectangular duct and vice versa, maintaining the same cross sectional area. Submit for approval.

B. Construct low pressure rectangular steel ductwork, for static pressures of 2" w.g. or less, positive or negative as follows:

1. Wall thickness shall be:

Maximum Duct Size In Inches	US. Standard Gauge
Up through 12	26
13 through 30	24

2. Construction shall be:

- a. Longitudinal seams shall be Pittsburgh Lock seams.
- b. Transverse or cross joints and duct reinforcing shall be in accordance with the following schedule:

CROSS JOINTS

MAX. DUCT DIM., INCHES	DUCTS IN SHOP, STORAGE & CONCEALED AREAS	DUCTS VISIBLE FROM REG- ULARLY OCCUPIED AREAS
18 & under	1" Pocket lock on 8' max centers	20-gauge drive slip & plain slip on 8' max. centers.
19 thru 30	1" Pocket lock on 5' max. centers	16-gauge drive slip & Hemmed "S" slip on 5' max. centers.

3. Sealing Joints.

- a. Make all cross joints and all transverse joints of all metal ducts airtight by covering with 6" wide strips of six (6) ounce canvas (2.85 sq.yds. per lb., 48 x 48 thread count) cemented on with an arabol type waterproof lagging adhesive. Dip canvas strips into lagging adhesive and smooth around and over all seams to work out all air bubbles or balloons.
- b. Seal punched holes and corner cracks with mastic.
- c. Manufactured seams shall be sealed as recommended by the Manufacturer except that leaks shall be sealed by same method as 3.a. above.

D. Construction of circular steel ductwork.

1. Wall thickness for circular ducts shall be as follows:

Spiral Lock	Round

Duct Diameter	Seal Duct	Duct Fittings	Girth Joints
Up to 8"	26 ga.	22 ga.	2" long beaded sleeve joint.
9" thru 22"	24 ga.	20 ga.	4" long beaded sleeve joint.
23" thru 36"	22 ga.	20 ga.	4" long beaded sleeve joint or draw band.
2.	Fittings and connections for circular ducts.		
a.	Duct and fitting shall be joint by slipping the projecting collar of the fittings into the pipe. Insertion length shall be a minimum of 2". Mechanically fasten and seal.		
b.	Make all cross joints of metal ducts, and all transverse joints airtight by covering with 6" wide strips of 6-ounce canvas (2.85 sq. yds. per lb., 48 x 48 thread count) cemented on with an arabol type waterproof lagging adhesive. Dip canvas strips into lagging adhesive and smooth around and over all seams to work out all air bubbles or balloons. This is in addition to required duct joint sealant.		
c.	Seal punched holes and corner cracks with mastic.		

E. Duct Hangers.

1. Duct supports for rectangular ducts shall be in accordance with Table No. 10-E and Section 1004 of the Uniform Mechanical Code, except hanger spacing shall be 5'-0" maximum.
 - a. Single horizontal ducts shall have hanger straps double bolted to transverse joints, to reinforcing angles, or extended continuously under the ducts and riveted or screwed to both sides. (For new overhead concrete construction, the hangers shall be double bolted to inserts which shall be fabricated of the same material as the hangers or secured to manufactured concrete inserts). (For existing concrete, hangers shall be bolted to 1-1/2" x 1/8" rolled steel angle iron clips which shall be secured to construction with 1/4" bolt size self-drilling expansion shields). (For concrete construction, over six months old, percussion driven 3/8" diameter flat head pins with minimum .150" diameter shank 1-1/2" long may be used if approved by Architect).
 - b. For metal deck construction, double bolt the hangers to inserts of the same material as the hanger inserted in slots in the decking prior to concrete deck pour.
 - c. Where ducts are run one above the other, they shall be individually supported on a trapeze of steel singles with threaded steel rods and full-size nuts securely fastened to the overhead construction with inserts, expansion shields, or bolted clip angles. Maintain a distance of 3" between ducts wherever possible, but in no event shall the distance be less than 2". The minimum sizes of the horizontal angles and the hanger rods shall be in accordance with Table 10-E, Part III, of the Uniform Mechanical Code.
 - d. Support vertical ducts with bolted angles located at each floor on each side of each duct. Angles shall be in accordance with Table 10-E, Part I, of the Uniform Mechanical Code.
2. Hangers for circular ducts shall conform to the following:

Duct Diameter	Strap Hangers	Maximum Spacing	No. Of Hangers
Up to 18"	1" x 22" ga.	6'-0"	1

3. Earthquake restraints shall be in accordance with SMACNA Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems, latest edition.

F. Plenum Construction.

1. Construct Plenums in accordance with SMACNA, HVAC Duct Construction Standard, latest edition. This section is general and does not show arrangement of a particular installation.
2. Add additional angles for reinforcing, bracing, or supporting when required by the Engineer to prevent bulging, sagging, breathing, or vibration in excess of 1% of span at the center of the span.
3. Make plenum doors of No. 18 USS gauge galvanized steel, 20" x 54" size minimum. Reinforce doors with steel angle stiffeners and close on an angle reinforced opening. Provide adequate hinges on each door for a tight rigid connection and provide cinch type latches that will draw door tightly closed and will be operable from both sides of door by means of lever handles. The handles and latches shall be "Ventlok" No. 260, or equivalent by Elgin or Duro-Dyne. Install felt or rubber gaskets completely around each door to provide an airtight fit. Doors shall be arranged to open against air pressure.
4. Seal seams around filter and coil housing and all plenums with caulking compound. Examine all plenum spaces carefully to assure that they will be airtight. Seal all openings airtight where ducts, pipes, and conduits pierce the plenum spaces.
5. Joint caulking or sealing compound shall be 3M Standard Grade Duct Sealer, Tuff-Bond No. 29, Permacel No. EZ-4719, United Duct Sealer, Benjamin Foster No. 30-02, or Chicago Mastic #10-108, as recommended and guaranteed by the Manufacturer for this specified application and shall be applied in accordance with the manufacturer's recommendations.

G. Transitions - all ductwork.

1. Taper sides of ducts in a diverging airflow maximum of 1 to 8 slope per side.
2. Taper sides of ducts in a converging airflow maximum of 1 to 4 taper.

H. Duct elbows - rectangular ducts.

1. All duct elbows, including supply, exhaust, and return shall be either square or made with the inside radius ells to accomplish this radius requirement.
2. Square elbows may be used instead of radius type and shall be fitted with turning vanes whether shown on the drawings or not. The turning vanes shall be as shown in SMACNA duct manual, except that the first vane shall be tightly fitted against the heel of the elbow. Shop fabricated duct turns may be used, provided that they are mounted in manufactured rails and are submitted and approved by the Engineer. Duct turning vanes shall be of the same metal as ductwork. Except where space will not otherwise permit, a duct size change in the elbow is not acceptable.
3. All duct offsets and branches to more than one outlet shall be made with elbows, except that each change in direction may be made with a single mitered joint in lieu of an elbow provided the change is not more than 1 to 5.
4. For all branch duct connections, a 90-degree, tap-in type connection may be used. Such connections will not require an outside radius on the branch ducts, and the inside radius may be a 45-degree angle of length equal to 20% of branch duct width. A branch duct is

any duct which does not rebranch.

- I. Flexible duct connection: Provide 16-ounce neoprene impregnated glass fabric at all connections to fans. Install with metal collar frames at each end of connections. Attach fabric tightly to ducts. Allow at least 1-inch slack in connections. Make fabric connections minimum 4-inches long. Ventfabrics, Duro-Dyne or approved equal.
- J. Flashing ducts through roof: Install flashing to cover top and sides of curb and fit closely around duct. Cover top edge of base flashing with collar soldered to duct and turned down over base flashing. Fabricate flashing from 24-gauge galvanizing steel.
- K. Support ducts above roof with 1-1/2" X 1-1/2" X 1/8" angles (minimum), fitted with 6" X 6" X 1/8" thick base plate all welded construction. See detail on drawings. Secure base plate to roof structure and set in pitch pocket.
- L. Test holes: Drill instrument test holes into ductwork for pitot tube tests where required by testing agency under equipment & Systems Tests Section 22 08 00. Install Ventlok No. 699 and/or 699-2 instrument plugs.
- M. Provide and install access doors in ducts where fire, smoke or automatic dampers, fan bearings, filters, humidifiers or other equipment is installed in ducts.
- N. Provide and deliver to the appropriate trade for installation where you direct, access doors or panels in building construction for access to duct doors or panels, damper quadrants, control devices, or other devices requiring access.
- O. Duct liner.
 - 1. Ducts and plenums shall be lined as specified in Section 22 07 00, "Insulation".

3.02 FLEXIBLE AIR DUCT

- A. Installation.
 - 1. Insulated flexible ducts shall be continuous, single pieces not over 3' in length for medium pressure and 7' in length for low pressure, and shall be adequately supported and shall have a minimum inside bending radius two-thirds the internal diameter, but ducts shall not be installed with a radius of bend less than two duct diameters.
 - 2. Install flexible ducts in as straight a manner as possible. Cut ducts to lengths required rather than create bends to take up excess lengths.
- B. Joining.
 - 1. Where flexible ducts join other ductwork and air terminals, use duct sealer and sheet metal or nylon cinch type bands to secure flexible duct and make the joint airtight.

3.03 ACCESS TO EQUIPMENT

- A. General.
 - 1. Install all ductwork, equipment and accessories to permit access for maintenance.
 - 2. Any relocation of conduit, piping, equipment and accessories required to provide maintenance access shall be accomplished by the Contractor at no additional cost.
- B. Access.
 - 1. Provide access doors where any dampers, instruments, controls, motors and other

equipment requiring access for servicing, repairs, or replacement are located behind walls, chases or above non-removable ceilings.

2. The location of access doors shall be coordinated with and installed by the applicable trade installing walls or ceilings.
3. The Contractor shall arrange for the necessary openings in the building to allow for admittance of all apparatus.

3.04 DIFFUSERS, REGISTERS AND GRILLES INSTALLATION

A. Coordination with ceiling features.

1. Install all inlets and outlets as close as possible to that shown on the plans but adjust to fit into the ceiling materials shown on the Architectural, Electrical and Fire Sprinkler plans.
2. In dry wall and plaster ceilings, diffuser, register or grilled trim shall overlap the plaster line with adequate trim.
3. In ceilings with acoustic tile adhesively applied to drywall or plaster ceilings, furnish diffusers, registers or grilles with overlapping margins.
4. In perforated metal plan systems: Square or rectangular diffuser and grille edge trim shall be flush with the finished ceiling.
5. Furnish and install plaster frames for diffusers, grilles and registers which are located on finish plaster surfaces. Plaster frames for grilles and registers shall be set flush with the finished surface and attached to ductwork by hickey punching, with rivets or sheet metal screws. Grilles and registers shall be fastened to the frames with sheet metal screws. All inlet and outlet devices shall be gasketed for air tight mounting.
6. Provide any intake duct not protected by a louver, grille or register with a 1/4" mesh galvanized screen over open end.
7. Paint all ductwork visible through grilles, registers, and other openings with one coat of flat black paint.

3.05 AIR FILTERS

- A. Provide clean filters as required by "Equipment and System Tests" Section 22 08 00.
- B. New filter media: After completion of the testing of the air handling equipment and systems and approval of same, but before final acceptance of the project, replace all type F-2 filters. The above is not required if new testing filters (if required) have been in service less than 60-days.

3.06 INSTALLATION OF DRAFT GAUGES

- A. Provide draft gauges to read the pressure differential across each filter bank.
- B. Install static pressure tip on the up-stream side in an unobstructed area and not obstructing the removal of filters. Sensor on down stream side shall be a perforated tube transversing the filter face.

END OF SECTION

SECTION 23 80 00

AIR CONDITIONING AND AIR HANDLING EQUIPMENT

PART 1 - GENERAL

Division 1 requirements apply to this Section.

1.01 SUMMARY

A. The work includes, but is not limited to the following:

1. Centrifugal fans.
2. Power roof exhausters.
3. Air Handling Units.
4. Split system heat pump units.

B. Related Sections:

1.	Section 22 08 00:	Equipment and Systems Tests
2.	Section 22 05 53:	Identification
3.	Section 23 05 48:	Vibration Isolation and Seismic Restraints
4.	Section 23 31 00:	Air Transmission and Distribution System
5.	Section 29 90 00:	Building Management System

1.02 SUBMITTALS

A. Requirements: In addition to the requirements of Section 23 00 00, GENERAL PROVISION, the submittal material shall include six (6) copies of descriptive data for all products and materials including, but not limited to the following:

1. Descriptive data.
 - a. Published fan performance curves.
 - b. Published sound power levels based on actual test data.
 - c. Finishes.
 - d. Certified dimension drawings.
2. Shop drawings.
 - a. Installation details.

1.03 STANDARDS

A. Tests.

1. Test all units and rate in accordance with the standard test code of the AMCA.
2. Centrifugal and propeller type fans shall bear the AMCA certified rating seal.

1.04 FACTORY FINISH

- A. All fans shall have factory prime coat and factory enamel coat finish unless otherwise noted or specified.
- B. Repair any finish damaged in shipment or in installation to equal factory finish.

PART 2 - PRODUCTS

2.01 Refer to equipment schedules on drawings. Acceptable manufacturers : Trane, Carrier and York.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in strict accordance with manufacturer's requirements, shop drawings, and Contract Documents.

3.02 START-UP

- A. Physical connections and start-up are provided by the installing contractor. Provide start-up for as long a period of time as necessary to ensure proper operation of the unit but in no case for less than 2 full working days. The start-up engineer shall conduct such operating tests as required to ensure that the unit is operating in accordance with design. Complete testing of all safety and emergency control devices shall be made. The start-up engineer shall submit a written report to the owner and manufacturer containing all test data recorded as required above and a letter certifying that the unit is operating properly.
- B. Operation and Maintenance Manuals: Provide complete with descriptive literature, model, and serial number of all equipment, performance data, manufacturer's instructions for operating and maintenance, lubrication recommendation and schedule, and winter shutdown procedure.

END OF SECTION

SECTION 23 90 00

BUILDING MANAGEMENT SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of Division 01 apply to this section
- B. Section Includes: Provide temperature controls for air conditioning, heating, and ventilating systems as indicated. Work includes, but is not be limited to, the following:
 - 1. Furnishing and installing automatic control valves and automatically operated dampers, except those furnished as part of a unit.
 - 2. Furnishing and installing electric relays (magnetic starters excepted), electric or mechanical linkages, duct sensors, thermostats, damper motors and motorized valves, and appurtenances and accessories required to make a complete and operable digital controls installation.
 - 3. Wiring outlet boxes and conduits, unless otherwise noted, for low voltage control systems, including control wiring required to connect magnetic starters, (specified in other sections) to control systems.
 - 4. Testing and adjusting temperature control system.
 - 5. Furnishing record drawings and operational data of systems as installed and finally adjusted.
 - 6. Formal instruction of Owner personnel in operation of equipment.
- C. Following items are specified in other sections:
 - 1. Magnetic starters, contacts, power relays and variable resistors or controllers for motors, and other electrical devices.
 - 2. Load carrying wiring and conduit for above listed devices and wiring for starting switches not interconnected with temperature control system. (Division16: Electrical).
 - 3. Electrical power to control panels and other equipment. (Division16: Electrical).
 - 4. Installing automatic valves in pipelines.
 - 5. Installing automatic dampers.
 - 6. Automatic controls and valves not connected with comfort heating, ventilating and air conditioning systems.
 - 7. Packaged self-contained equipment specified complete with temperature controls.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 220500: Basic Mechanical Requirements.
 - 1. Complete list of items proposed to be furnished and installed under this section.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements.
 - 3. Manufacturer's printed installation procedures.
- B. Shop Drawings: Provide Shop Drawings, in the same size as the Drawings, prepared, signed and sealed by a mechanical engineer licensed in the State of California. Shop Drawings shall indicate temperature control diagrams, complete with equipment appurtenances required for system. Include sequence of operation description for each system. Submit in accordance with of Division 01.

- C. Sequence of Operation: Provide complete, detailed, step-by-step sequence of operation for each item of equipment.
- D. Operating Instructions: Comply with provisions of Section 15010: Basic Mechanical Requirements. Explain and demonstrate operation of system to Owner representatives as required.
- E. Guarantee: Refer to Section 15010: Basic Mechanical Requirements.

1.03 QUALITY ASSURANCE

- A. Manufacturer and Installer Qualifications: Comply with provisions stated under Section 15010: Basic Mechanical Requirements.

1.04 PRODUCT HANDLING

- A. Production, Replacement, Delivery and Storage: Refer to Section 15010: Basic Mechanical Requirements and Section 15050: Basic Mechanical Materials and Methods.

1.05 SYSTEM PERFORMANCE

- A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
 - 1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
 - 2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
 - 3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
 - 4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
 - 5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 45 sec.
 - 6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
 - 7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
 - 8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 sec of other workstations.
 - 9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
 - 10. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table-1

Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	$\pm 0.5^{\circ}\text{C}$ ($\pm 1^{\circ}\text{F}$)
Ducted Air	$\pm 0.5^{\circ}\text{C}$ ($\pm 1^{\circ}\text{F}$)
Outside Air	$\pm 1.0^{\circ}\text{C}$ ($\pm 2^{\circ}\text{F}$)
Dew Point	$\pm 1.5^{\circ}\text{C}$ ($\pm 3^{\circ}\text{F}$)
Water Temperature	$\pm 0.5^{\circ}\text{C}$ ($\pm 1^{\circ}\text{F}$)
Delta-T	$\pm 0.15^{\circ}$ ($\pm 0.25^{\circ}\text{F}$)
Relative Humidity	$\pm 5\%$ RH
Water Flow	$\pm 2\%$ of full scale
Airflow (terminal)	$\pm 10\%$ of full scale (see Note 1)
Airflow (measuring stations)	$\pm 5\%$ of full scale
Airflow (pressurized spaces)	$\pm 3\%$ of full scale
Air Pressure (ducts)	± 25 Pa (± 0.1 in. w.g.)
Air Pressure (space)	± 3 Pa (± 0.01 in. w.g.)
Water Pressure	$\pm 2\%$ of full scale (see Note 2)
Electrical	$\pm 1\%$ of reading (see Note 3)
Carbon Monoxide (CO)	$\pm 5\%$ of reading
Carbon Dioxide (CO ₂)	± 50 ppm

Note 1: Accuracy applies to 10%–100% of scale

Note 2: For both absolute and differential pressure

Note 3: Not including utility-supplied meters

Table-2

Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	± 50 Pa (± 0.2 in. w.g.) ± 3 Pa (± 0.01 in. w.g.)	0–1.5 kPa (0–6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	$\pm 10\%$ of full scale	
Space Temperature	$\pm 1.0^{\circ}\text{C}$ ($\pm 2.0^{\circ}\text{F}$)	
Duct Temperature	$\pm 1.5^{\circ}\text{C}$ ($\pm 3^{\circ}\text{F}$)	
Humidity	$\pm 5\%$ RH	
Fluid Pressure	± 10 kPa (± 1.5 psi) ± 250 Pa (± 1.0 in. w.g.)	MPa (1–150 psi) 0–12.5 kPa (0–50 in. w.g.) differential

PART 2 - PRODUCTS

2.01 Refer to section 230923

2.04 OPERATOR INTERFACE

- A. The Operator Workstation or server shall conform to the BACnet Operator Workstation (B-OWS) or BACnet Advanced Workstation (B-AWS) device profile as specified in ASHRAE/ANSI 135 BACnet Annex L.
- B. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information.
- C. In addition to the primary operator interface, the system shall include a secondary interface compatible with a locally available commercial wireless network and viewable on a commercially available wireless device such as a Wireless Access Protocol (WAP) enabled cellular telephone. This secondary interface may be text-based and shall provide a summary of the most important data. As a minimum, the following capabilities shall be provided through this interface:
 - 1. An operator authentication system that requires an operator to log in before viewing or editing any data, and which can be configured to limit the privileges of an individual operator.
 - 2. The ability to view and acknowledge any alarm in the system. Alarms or links to alarms shall be provided on a contiguous list so the operator can quickly view all alarms.
 - 3. A summary page or pages for each piece of equipment in the system. This page shall include the current values of all critical I/O points and shall allow the operator to lock binary points on or off and to lock analog points to any value within their range.
 - 4. Navigation links that allow the operator to quickly navigate from the home screen to any piece of equipment in the system, and then return to the home screen. These links may be arranged in a hierarchical fashion, such as navigating from the home screen to a particular building, then to a specific floor in the building, and then to a specific room or piece of equipment.
- D. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135, BACnet Annex J.
- E. Hardware. Each workstation or web server shall consist of the following:
 - 1. Computer. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified elsewhere in this document. The following hardware requirements also apply:
 - a. The hard disk shall have sufficient memory to store:
 - i. All required operator workstation software.
 - ii. A DDC database at least twice the size of the delivered system database.
 - iii. One year of trend data based on the points specified to be trended at their specified trend intervals.
 - b. Provide additional hardware (communication ports, video drivers, network interface cards, cabling, etc.) to facilitate all control functions and software requirements specified for the DDC system.
 - c. Minimum hardware configuration shall include the following:
 - i. Dual or Quad Core Processor
 - ii. 6 GB RAM
 - iii. 500 GB hard disk providing data at 3.0 Gb/sec
 - iv. 16x DVD-RW drive

- v. Serial, parallel, and network communication ports and cables as required for proper DDC system operation

F. System Software.

1. Operating System. Web server or workstation shall have an industry-standard professional-grade operating system. Operating system shall meet or exceed the DDC System manufacturers minimum requirements for their software. Typically acceptable systems include Microsoft Windows7, Microsoft Vista, Microsoft Windows XP Pro, Windows Server 2003 or 2008, Red Hat Enterprise Linux, or Ubuntu Desktop 10.04.
2. System Graphics. The operator interface software shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
 - a. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
 - b. Animation. Graphics shall be able to animate by displaying different image files for changed object status.
 - c. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Adobe Flash).
3. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in the same formats as are used for system graphics.
4. Graphics Library. Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

G. System Applications. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.

1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
2. Manual Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
3. System Configuration. The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password protection. Operators shall be able to configure the system.

4. On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
5. Security. Each operator shall be required to log on to the system with user name and password in order to view, edit, add, or delete data.
 - a. Operator Access. The user name and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator. Users with system administrator rights shall be able to create new users and edit the privileges of all existing users. System Administrators shall also be able to vary and deny each operator's privileges based on the geographic location, such as the ability to edit operating parameters in Building A, to view but not edit parameters in Building B, and to not even see equipment in Building C.
 - b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. This auto logoff time shall be user adjustable.
 - c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
6. System Diagnostics. The system shall automatically monitor the operation of all building management panels and controllers. The failure of any device shall be annunciated to the operator.
7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 15900 Appendix A (Sequences of Operation). Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
8. Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying on acronyms.
9. Alarm Reactions. Operator shall be able to configure (by object) what, if any actions are to be taken during an alarm. As a minimum, the workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
10. Alarm and Event log. Operators shall be able to view all system alarms and changes of state from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and delete alarms, and archive closed alarms to the workstation or web server hard disk.
11. Trend Logs. The operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Section 15900 Appendix A (Sequences of Operation). Trends shall be BACnet trend objects.
12. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object or property in the system. The status shall be available by menu, on graphics, or through custom programs.
13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
14. Standard Reports. Furnish the following standard system reports:

- a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
 - b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
 - c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
 - i. Alarm History.
 - ii. Trend Data. Operator shall be able to select trends to be logged.
 - iii. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
15. Energy Reports. System shall include an easily configured energy reporting tool that provides the capabilities described in this section.
- a. The energy reporting tool shall be accessible through the same user interface (Web browser or operator workstation software) as is used to manage the BAS.
 - b. The energy reporting tool shall be preconfigured by the Contractor to gather and store energy demand and consumption data from each energy source that provides metered data to the BAS. Meter data shall be stored at 5 minute intervals unless otherwise specified in the Sequence of Operation provided in Appendix A. This data shall be maintained in an industry standard SQL database for a period of not less than five years.
 - c. The energy reporting tool shall allow the operator to select an energy source and a time period of interest (day, week, month, year, or date range) and shall provide options to view the data in a table, line graph, bar graph, or pie chart. The tool shall also allow the operator to select two or more data sources and display a comparison of the energy used over this period in any of the listed graph formats, or to total the energy used by the selected sources and display that data in the supported formats.
 - d. The energy reporting tool shall allow the operator to select an energy source and two time periods of interest (day, week, month, year, or date range) and display a graph that compares the energy use over the two time periods in any of the graph formats listed in the previous paragraph. The tool shall also allow the operator to select multiple energy sources and display a graph that compares the total energy used by these sources over the two time periods.
 - e. The energy reporting tool shall allow the operator to easily generate the previously described graphs "on the fly," and shall provide an option to store the report format so the operator can select that format to regenerate the graph at a future date. The tool shall also allow the user to schedule these reports to run on a recurring basis using relative time periods, such as automatically generating a consumption report on the first Monday of each month showing consumption over the previous month. Automatically generated reports shall be archived on the server in a common industry format such as Adobe PDF or Microsoft Excel with copies e-mailed to a user editable list of recipients.
 - f. The energy reporting tool shall be capable of collecting and displaying data from the following types of meters:
 - i. Electricity
 - ii. Gas
 - iii. Oil

- iv. Steam
 - v. Chilled Water
 - vi. Potable Water
 - vii. Heating and cooling degree days. (May be calculated from sensor data rather than metered.)
- g. The user shall have the option of using Kw (Kwh) or Btu/hr (Btu) as the units for demand and consumption reports. Multiples of these units (MWH, kBtu, etc.) shall be used as appropriate. All selected sources shall be automatically converted to the selected units. The user shall similarly have the option of entering facility area and occupancy hours and creating reports that are normalized on an area basis, an annual use basis, or an occupied hour basis.
 - h. The user shall have the option of entering benchmark data for an individual facility or a group of facilities.
 - i. The user shall have the option of displaying any or all of the following data on any chart, line, or bar graph generated by the energy reporting tool:
 - i. Low/High/Average value of the metered value being displayed.
 - ii. Heating and/or Cooling Degree Days for the time period(s) being displayed.
 - iii. The Environmental Index for the facilities and time periods being displayed.
16. Environmental Index. System shall monitor all occupied zones and compile an index that provides a numerical indication of the environmental comfort within the zone. As a minimum, this indication shall be based upon the deviation of the zone temperature from the heating or cooling setpoint. If humidity is being measured within the zone then the environmental index shall be adjusted to reflect a lower comfort level for high or low humidity levels. Similarly, if carbon dioxide levels are being measured as an indication of ventilation effectiveness then the environmental index shall be adjusted to indicate degraded comfort at high carbon dioxide levels. Other adjustments may be made to the environmental index based upon additional measurements. The system shall maintain a trend of the environmental index for each zone in the trend log. The system shall also compute an average comfort index for every building included in this contract and maintain trendlogs of these building environmental indices. Similarly, the system shall compute the percentage of occupied time that comfortable conditions were maintained within the zones. Through the UI the user shall be able to add a weighting factor to adjust the contribution of each zone to the average index based upon the floor area of the zone, importance of the zone, or other static criteria.
17. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
- H. Workstation Application Editors. Each PC or browser workstation shall support editing of all system applications. The applications shall be downloaded and executed at one or more of the controller panels.
- 1. Controller. Provide a full-screen editor for each type of application that shall allow the operator to view and change the configuration, name, control parameters, and set points for all controllers.
 - 2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a method of selecting the desired schedule and schedule type. Exception schedules and holidays shall be shown clearly on the calendar. The start and stop times for each object shall be adjustable from this interface.
 - 3. Custom Application Programming. Provide the tools to create, edit, debug, and download custom programs. System shall be fully operable while custom programs

are edited, compiled, and downloaded. Programming language shall have the following features:

- a. Language. Language shall be graphically based and shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks.
- b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
- c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
- d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
- e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
- f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
- g. Variables. Operator shall be able to use variable values in program conditional statements and mathematical functions.
 - i. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
 - ii. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.
- I. Portable Operator's Terminal. Provide all necessary software to configure an IBM-compatible laptop computer for use as a Portable Operator's Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.

2.05 CONTROLLER SOFTWARE

- A. Furnish the following applications for building and energy management. All software application shall reside and operate in the system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. System Security. See Paragraph 2.04.G.5 (Security) and Paragraph 2.04.G.14.c.iii (Operator Activity).

- C. Scheduling. Provide the capability to execute control functions according to a user created or edited schedule. Each schedule shall provide the following schedule options as a minimum:
1. Weekly Schedule. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
 2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule has executed, the system shall discard and replace the exception schedule with the standard schedule for that day of the week.
 3. Holiday Schedules. Provide the capability for the operator to define up to 24 special or holiday schedules. These schedules will be repeated each year. The operator shall be able to define the length of each holiday period.
- D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
- E. Binary Alarms. Each binary object shall have the capability to be configured to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.
- F. Analog Alarms. Each analog object shall have both high and low alarm limits. The operator shall be able to enable or disable these alarms.
- G. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display on graphics.
- H. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
- I. Demand Limiting.
1. The demand-limiting program shall monitor building power consumption from a building power meter (provided by others) which generates pulse signals or a BACnet communications interface. An acceptable alternative is for the system to monitor a watt transducer or current transformer attached to the building feeder lines.
 2. When power consumption exceeds adjustable levels, system shall automatically adjust setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified in Section 15900 Appendix A (Sequences of Operation). When demand drops below adjustable levels, system shall restore loads as specified.
- J. Maintenance Management. The system shall be capable of generating maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Section 15900 Appendix A (Sequences of Operation).
- K. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Section 15900 Appendix A (Sequences of Operation).
- L. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs. The calculation interval, PID gains, and other tuning parameters shall be adjustable by a user with the correct security level.
- M. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- N. Energy Calculations.

1. The system shall accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.
 2. The system shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.
- O. Anti-Short Cycling. All binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- P. On and Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and a setpoint. The algorithm shall be direct-acting or reverse-acting.
- Q. Runtime Totalization. Provide software to totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in Section 15900 Appendix A (Sequence of Operations).

2.06 CONTROLLERS

- A. General. Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 15900 Article 1.9 (System Performance). Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.
- B. BACnet.
1. Building Controllers (BCs). Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L, and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.
 2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
 3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
 4. Smart Sensors (SSs). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.
 5. BACnet Communication.
 - a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
 - b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
 - c. Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - d. Each ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.

- e. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - f. Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.
- C. Communication
 - 1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
 - 2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
 - 3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
 - 4. Stand-Alone Operation. Each piece of equipment specified in Section 15900 Appendix A shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network such as outdoor air conditions, supply air or water temperature coming from source equipment, etc.
- D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
 - 1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
 - 2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
- E. Keypad. Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.
- F. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
- G. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to a field-removable modular terminal strip or to a termination card connected by a ribbon cable. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- H. Memory.
 - 1. Controller memory shall support operating system, database, and programming requirements.
 - 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 - 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- I. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- J. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.07 INPUT AND OUTPUT INTERFACE

- A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- B. Protection. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground shall cause no damage to the controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no controller damage.
- C. Binary Inputs. Binary inputs shall allow the monitoring of ON/OFF signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.
- D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall also accumulate up to 10 pulses per second.
- E. Analog Inputs. Analog inputs shall monitor low-voltage (0–10 Vdc), current (4–20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary Outputs. Binary outputs shall provide for ON/OFF operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on Building Controllers shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- G. Analog Outputs. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0–10 Vdc or a 4–20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- I. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system

2.08 AUXILIARY CONTROL DEVICES

- A. Motorized Control Dampers, unless otherwise specified elsewhere, shall be as follows.
 - 1. Type. Control dampers shall be the parallel or opposed-blade type as specified below or as scheduled on drawings.
 - a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
 - b. Other modulating dampers shall be opposed-blade.
 - c. Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.
 - 2. Frame. Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or 3.175 mm (1/8 in.) extruded aluminum with reinforced corner bracing.

3. Blades. Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance. Blades shall be not less than 1.5875 mm (16 gauge).
4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 L/s·m²(10 cfm per ft²) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).
6. Sections. Individual damper sections shall not exceed 125 cm × 150 cm (48 in. × 60 in.). Each section shall have at least one damper actuator.
7. Modulating dampers shall provide a linear flow characteristic where possible.
8. Linkages. Dampers shall have exposed linkages.

B. Electric Damper and Valve Actuators.

1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
3. Signal and Range. Proportional actuators shall accept a 0–10 Vdc or a 0–20 mA control signal and shall have a 2–10 Vdc or 4–20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 2.6H.)
4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.

C. Control Valves.

1. Control valves shall be two-way or three-way type for two-position or modulating service as shown.
2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
 - a. Water Valves:
 - i. Two-way: 150% of total system (pump) head.
 - ii. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - b. Steam Valves: 150% of operating (inlet) pressure.
3. Water Valves.
 - a. Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
 - b. Sizing Criteria:
 - i. Two-position service: Line size.
 - ii. Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 5 psi, whichever is greater.

- iii. Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa (5 psi) maximum.
- iv. Valves ½ in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless steel ball.
- v. Valves 2½ in. and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.
- c. Water valves shall fail normally open or closed, as scheduled on plans, or as follows:
 - i. Water zone valves—normally open preferred.
 - ii. Heating coils in air handlers—normally open.
 - iii. Chilled water control valves—normally closed.
 - iv. Other applications—as scheduled or as required by sequences of operation.

D. Binary Temperature Devices.

- 1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C–30°C (55°F–85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
- 2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C–30°C (55°F–85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
- 3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

E. Temperature Sensors.

- 1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
- 2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m² (10 ft²) of duct cross-section.
- 3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
- 4. Space Sensors. Space sensors shall have setpoint adjustment, override switch, display, and communication port as shown.
- 5. Differential Sensors. Provide matched sensors for differential temperature measurement.

F. Humidity Sensors.

- 1. Duct and room sensors shall have a sensing range of 20%–80%.
- 2. Duct sensors shall have a sampling chamber.
- 3. Outdoor air humidity sensors shall have a sensing range of 20%–95% RH and shall be suitable for ambient conditions of -40°C–75°C (-40°F–170°F).
- 4. Humidity sensors shall not drift more than 1% of full scale annually.

- G. Flow Switches. Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).
1. Paddle switches shall have adjustable sensitivity and NEMA 1 enclosure unless otherwise specified.
 2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- H. Relays.
1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
 2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.
- I. Override Timers.
1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0–6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.
- J. Current Transmitters.
1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4–20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
 2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
 3. Unit shall be split-core type for clamp-on installation on existing wiring.
- K. Current Transformers.
1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
 2. Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.
 3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.
- L. Voltage Transmitters.
1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4–20 mA output with zero and span adjustment.
 2. Adjustable full-scale unit ranges shall be 100–130 Vac, 200–250 Vac, 250–330 Vac, and 400–600 Vac. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
 3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.
- M. Voltage Transformers.
1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
 2. Transformers shall be suitable for ambient temperatures of 4°C–55°C (40°F–130°F) and shall provide $\pm 0.5\%$ accuracy at 24 Vac and 5 VA load.

3. Windings (except for terminals) shall be completely enclosed with metal or plastic.
- N. Power Monitors.
1. Selectable rate pulse output for kWh reading, 4–20 mA output for kW reading, N.O. alarm contact, and ability to operate with 5.0 amp current inputs or 0–0.33 volt inputs.
 2. 1.0% full-scale true RMS power accuracy, +0.5 Hz, voltage input range 120–600 V, and auto range select.
 3. Under voltage/phase monitor circuitry.
 4. NEMA 1 enclosure.
 5. Current transformers having a 0.5% FS accuracy, 600 VAC isolation voltage with 0–0.33 V output. If 0–5 A current transformers are provided, a three-phase disconnect/shorting switch assembly is required.
- O. Hydronic Flowmeters
1. Insertion-Type Turbine Meter
 - a. Dual counter-rotating axial turbine elements, each with its own rotational sensing system, and an averaging circuit to reduce measurement errors due to swirl and flow profile distortion. Single turbine for piping 2 inches and smaller. Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag.
 - b. Insertion type complete with 'hot-tap' isolation valves to enable sensor removal without water supply system shutdown.
 - c. Sensing method shall be impedance sensing (non magnetic and non photoelectric)
 - d. Volumetric accuracy
 - i. $\pm 0.5\%$ of reading at calibrated velocity
 - ii. $\pm 1\%$ of reading from 3 to 30 ft/s (10:1 range)
 - iii. $\pm 2\%$ of reading from 0.4 to 20 ft/s (50:1 range)
 - e. Each sensor shall be individually calibrated and tagged accordingly against the manufacturer's primary standards which must be accurate to within 0.1% of flow rate and traceable to the National Institute of Standards and Technology (NIST).
 - f. Maximum operating pressure of 400 psi and maximum operating temperature of 200°F continuous (220°F peak).
 - g. All wetted metal parts shall be constructed of 316 stainless steel.
 - h. Analog outputs shall consist of non interactive zero and span adjustments, a DC linearly of 0.1% of span, voltage output of 0-10 Vdc, and current output of 4-20 mA.
 2. Magnetic Flow-Tube Type Flowmeter
 - a. Sensor shall be a magnetic flowmeter, which utilizes Faraday's Law to measure volumetric fluid flow through a pipe. The flowmeter shall consist of two elements, the sensor and the electronics. The sensor shall generate a measuring signal proportional to the flow velocity in the pipe. The electronics shall convert this EMF into a standard current output.
 - b. Electronic replacement shall not affect meter accuracy (electronic units are not matched with specific sensors).
 - c. Four-wire, externally powered, magnetic type flow transmitter with adjustable span and zero, integrally mounted to flow tube. Output signal shall be a digital pulse proportional to the flow rate (to provide maximum accuracy and to handle abrupt changes in flow). Standard 4-20 mA or 0-10 Vdc outputs may be used provided accuracy is as specified.

- d. Flow Tube:
 - i. ANSI class 150 psig steel
 - ii. ANSI flanges
 - iii. Protected with PTFE, PFA, or ETFE liner rated for 245°F minimum fluid temperature
 - e. Electrode and grounding material
 - i. 316L Stainless steel or Hastelloy C
 - ii. Electrodes shall be fused to ceramic liner and not require o-rings.
 - f. Electrical Enclosure: NEMA 4, 7
 - g. Approvals:
 - i. UL or CSA
 - ii. NSF Drinking Water approval for domestic water applications
 - h. Performance
 - i. Accuracy shall be $\pm 0.5\%$ of actual reading from 3 to 30 ft/s flow velocities, and 0.015 ft/s from 0.04 to 3 ft/s.
 - ii. Stability: 0.1% of rate over six months.
 - iii. Meter repeatability shall be $\pm 0.1\%$ of rate at velocities > 3 ft/s.
3. Magnetic Insertion-Type Flowmeter
- a. Magnetic Faraday point velocity measuring device.
 - b. Insertion type complete with hot-tap isolation valves to enable sensor removal without water supply system shutdown.
 - c. 4-20 mA transmitter proportional to flow or velocity.
 - d. Accuracy: larger of 1% of reading and 0.2 ft/s.
 - e. Flow range: 0.2 to 20 ft/s, bidirectional.
 - f. Each sensor shall be individually calibrated and tagged accordingly against the manufacturer's primary standards which must be accurate to within 0.1% of flow rate and traceable to the National Institute of Standards and Technology (NIST).
4. Vortex Shedding Flowmeter
- a. Output: 4-20 mA, 0-10 Vdc, 0-5 Vdc.
 - b. Maximum Fluid Temperature: 800°F (427 °C).
 - c. Wetted Parts: Stainless Steel.
 - d. Housing: NEMA 4X.
 - e. Turndown: 25:1 minimum.
 - f. Accuracy: 0.5% of calibrated span for liquids, 1% of calibrated span for steam and gases.
 - g. Body: Wafer style or ANSI flanged to match piping specification.
5. Transit-Time Ultrasonic Flowmeter
- a. Clamp-On transit-time ultrasonic flowmeter
 - b. Wide-Beam transducer technology
 - c. 4-20 mA transmitter proportional to flow or velocity.
 - d. Accuracy: 0.5% of reading in range 1 to 30 ft/s, 0.001 ft/s sensitivity.

P. Current Switches.

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.
- Q. Pressure Transducers.
1. Transducers shall have linear output signal and field-adjustable zero and span.
 2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
 3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4–20 mA output, suitable mounting provisions, and block and bleed valves.
 4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4–20 mA output, suitable mounting provisions, and 5-valve manifold.
- R. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- S. Pressure-Electric (PE) Switches.
1. Shall be metal or neoprene diaphragm actuated, operating pressure rated for 0–175 kPa (0–25 psig), with calibrated scale minimum setpoint range of 14–125 kPa (2–18 psig) minimum, UL listed.
 2. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application Electrically rated for pilot duty service (125 VA minimum) and/or for motor control.
 3. Switches shall be open type (panel-mounted) or enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
 4. Each pneumatic signal line to PE switches shall have permanent indicating gauge.
- T. Occupancy Sensors. Occupancy sensors shall utilize Passive Infrared (PIR) and/or Microphonic Passive technology to detect the presence of people within a room. Sensors shall be mounted as indicated on the approved drawings. The sensor output shall be accessible by any lighting and/or HVAC controller in the system. Occupancy sensors shall be capable of being powered from the lighting or HVAC control panel, as shown on the drawings. Occupancy sensor delay shall be software adjustable through the user interface and shall not require manual adjustment at the sensor.
- U. Local Control Panels.
1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels.
 2. Interconnections between internal and face-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
 3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

2.09 WIRING AND RACEWAYS

- A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 16.

- B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

PART 3 - EXECUTION

3.01 TEMPERATURE CONTROL SYSTEM INSTALLATION

- A. Control system shall be installed in accordance with control manufacturer's instructions and reviewed Shop Drawings.

3.02 EXAMINATION

- A. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.
- B. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor's work and the plans and the work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the contractor to report such discrepancies shall be made by—and at the expense of—this contractor.

3.03 COORDINATION

- A. Site
 - 1. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition without extra charge.
 - 2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
- B. Submittals. See Section 15900 Article 1.10 (Submittals).
- C. Life Safety.
 - 1. Duct smoke detectors required for air handler shutdown are provided under Division 16. Interlocks of smoke detectors to air handlers for shutdown is performed by Division 16 Electrical or F/A Contractor.
 - 2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 15. . Interlocks of smoke detectors to air handlers for shutdown is performed by Division 16 Electrical or F/A Contractor.
 - 3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 15. Fire and smoke damper control is provided under Division 16.
- D. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:
 - 1. All communication media and equipment shall be provided as specified in Section 15900 Article 2.2 (Communication).

2. Each supplier of a controls product is responsible for the configuration, programming, start up, and testing of that product to meet the sequences of operation described in Section 15900 Appendix A.
3. The contractor shall coordinate and resolve any incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
4. The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.
5. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

3.04 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install equipment in readily accessible locations as defined by Chapter 1 Article 100 Part A of the National Electrical Code (NEC).
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.05 FIELD QUALITY CONTROL

- A. All work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 15900 Article 1.8 (Codes and Standards).
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.
- C. Contractor shall have work inspection by local and/or state authorities having jurisdiction over the work.

3.06 WIRING

- A. All control and interlock wiring shall comply with national and local electrical codes, and Division 16 of this specification, Where the requirements of this section differ from Division 16, the requirements of this section shall take precedence.
- B. All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 16 requirements.
- C. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be subfused when required to meet Class 2 current limit.
- D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for the intended application.
- E. All wiring in mechanical, electrical, or service rooms – or where subject to mechanical damage – shall be installed in raceway at levels below 3 m (10ft).

- F. Do not install Class 2 wiring in raceways containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).
- G. Do not install wiring in raceway containing tubing.
- H. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 3 m (10 ft) intervals.
- I. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- J. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
- K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- L. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers.
- M. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- N. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
- O. Size of raceway and size and type of wire type shall be the responsibility of the contractor in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.
- P. Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- Q. Use color-coded conductors throughout with conductors of different colors.
- R. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
- S. Conceal all raceways except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g. steam pipes or flues).
- T. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- U. Adhere to this specification's Division 16 requirements where raceway crosses building expansion joints.
- V. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of vertical raceways.
- W. The contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- X. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.
- Y. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.07 COMMUNICATION WIRING

- A. The contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification.
- B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling
- C. Do not install communication wiring in raceways and enclosures containing Class 1 or other Class 2 wiring.
- D. Maximum pulling, tension, and bend radius for the cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- E. Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.
- F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to manufacturer's instructions.
- G. All runs of communication wiring shall be unspliced length when that length is commercially available.
- H. All communication wiring shall be labeled to indicate origination and destination data.
- I. All communication wiring shall be labeled to indicate origination and destination data.
- J. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."
- K. BACnet MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135. This includes but is not limited to:
 - 1. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot.)
 - 2. The maximum length of an MS/TP segment is 1200 meters (4000 ft) with AWG 18 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.
 - 3. The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.
 - 4. An MS/TP EIA-485 network shall have no T connections.

3.08 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by wall framing.
- D. All wires attached to sensors shall be sealed in their raceways or in the wall to stop air transmitted from other areas from affecting sensor readings.
- E. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
- F. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m (1 ft) of sensing element for each 1 m²(1 ft²) of coil area.

- G. Do not install temperature sensors within the vapor plume of a humidifier. If installing a sensor downstream of a humidifier, install it at least 3 m (10 ft) downstream.
- H. All pipe-mounted temperature sensors shall be installed in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- I. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.
- J. Differential Air Static Pressure.
 - 1. Supply Duct Static Pressure. Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
 - 2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.
 - 3. Building Static Pressure. Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover.
 - 4. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
 - 5. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
 - 6. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shut-off valves installed before the tee.
- K. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.
- L. Install humidity sensors for duct mounted humidifiers at least 3 m (10 ft) downstream of the humidifier. Do not install filters between the humidifier and the sensor.

3.09 ACTUATORS

- A. General. Mount and link control damper actuators according to manufacturer's instructions.
 - 1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
 - 2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - 3. Provide all mounting hardware and linkages for actuator installation.
- B. Electric/Electronic
 - 1. Dampers: Actuators shall be direct mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° travel available for tightening the damper seal. Actuators shall be mounted following manufacturer's recommendations.
 - 2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.10 WARNING LABELS

- A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the control system.
 - 1. Labels shall use white lettering (12-point type or larger) on a red background.
 - 2. Warning labels shall read as follows.

CAUTION

This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.

- B. Permanent warning labels shall be affixed to all motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
 - 1. Labels shall use white lettering (12-point type or larger) on a red background.
 - 2. Warning labels shall read as follows.

CAUTION

This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

3.11 PROGRAMMING

- A. Provide sufficient internal memory for the specified sequences of operation and trend logging.
- B. Point Naming. Name points as shown on the equipment points list provided with each sequence of operation. See Section 15900 Appendix A (Sequences of Operation). If character limitations or space restrictions make it advisable to shorten the name, the abbreviations given in Appendix B to Section 15900 may be used. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.
- C. Software Programming.
 - 1. Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the contractor. Embed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
 - a. Text-based:
 - i. Must provide actions for all possible situations
 - ii. Must be modular and structured
 - iii. Must be commented
 - b. Graphic-based:
 - i. Must provide actions for all possible situations
 - ii. Must be documented
 - c. Parameter-based:
 - i. Must provide actions for all possible situations
 - ii. Must be documented.
- D. Operator Interface.

1. Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as setpoints. As a minimum, show on each equipment graphic the input and output points and relevant calculated points as indicated on the applicable Points List in Section 15900 Appendix A.
2. The contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.12 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing. All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.
 1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
 2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
 3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturers' recommendations.
 4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
 5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.
 6. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops.
 7. Alarms and Interlocks:
 - a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 - b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
 - c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action

3.13 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Demonstration.
 1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.

2. The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the "Control System Checkout and Testing" article in Part 3 of this specification. The engineer will be present to observe and review these tests. The engineer shall be notified at least 10 days in advance of the start of the testing procedures.
3. The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
4. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
5. Demonstrate compliance with Part 1, "System Performance."
6. Demonstrate compliance with sequences of operation through all modes of operation.
7. Demonstrate complete operation of operator interface.
8. Additionally, the following items shall be demonstrated:
 - a. DDC loop response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
 - b. Demand limiting. The contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
 - c. Optimum start/stop. The contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
 - d. Interface to the building fire alarm system.
 - e. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the architect/engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.
9. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance.

1. All tests described in this specification shall have been performed to the satisfaction of both the engineer and owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.
2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals."

3.14 CLEANING

- A. The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.
- C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.15 TRAINING

- A. Provide training for a designated staff of Owner's representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, or a combination of training methods.
- B. Training shall enable students to accomplish the following objectives.
 - 1. Day-to-day Operators:
 - a. Proficiently operate the system
 - b. Understand control system architecture and configuration
 - c. Understand DDC system components
 - d. Understand system operation, including DDC system control and optimizing routines (algorithms)
 - e. Operate the workstation and peripherals
 - f. Log on and off the system
 - g. Access graphics, point reports, and logs
 - h. Adjust and change system set points, time schedules, and holiday schedules
 - i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
 - j. Understand system drawings and Operation and Maintenance manual
 - k. Understand the job layout and location of control components
 - l. Access data from DDC controllers and ASCs
 - m. Operate portable operator's terminals
 - 2. Advanced Operators:
 - a. Make and change graphics on the workstation
 - b. Create, delete, and modify alarms, including annunciation and routing of these
 - c. Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user-definable time intervals
 - d. Create, delete, and modify reports
 - e. Add, remove, and modify system's physical points
 - f. Create, modify, and delete programming
 - g. Add panels when required

- h. Add operator interface stations
 - i. Create, delete, and modify system displays, both graphical and others
 - j. Perform DDC system field checkout procedures
 - k. Perform DDC controller unit operation and maintenance procedures
 - l. Perform workstation and peripheral operation and maintenance procedures
 - m. Perform DDC system diagnostic procedures
 - n. Configure hardware including PC boards, switches, communication, and I/O points
 - o. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
 - p. Adjust, calibrate, and replace system components
3. System Managers/Administrators:
- a. Maintain software and prepare backups
 - b. Interface with job-specific, third-party operator software
 - c. Add new users and understand password security procedures
- C. Organize the training into sessions or modules for the three levels of operators listed above. (Day-to-Day Operators, Advanced Operators, System Managers and Administrators). Students will receive one or more of the training packages, depending on knowledge level required.
- D. Provide course outline and materials according to the "Submittals" article in Part 1 of this specification. Provide one copy of training material per student.
- E. The instructor(s) shall be factory-trained and experienced in presenting this material.
- F. Classroom training shall be done using a network of working controllers representative of installed hardware.
- G. All classroom training must be conducted at an ALC factory authorized and certified training center. Contractor must provide proof of factory certification of training facility upon request

3.16 SEQUENCE OF OPERATIONS AND SYSTEM POINTS

Refer to contract set of mechanical plans for all Sequences of Operation and EMS Points Lists.

HVAC SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. General requirements for Commissioning (Cx) of HVAC systems and equipment including installation, start-up, testing, documentation, and training according to the Construction Documents.
- B. Standard procedures for the execution of commissioning work shall be in conformance with Division 1, Coordinate all work with the Commissioning Agent (CxA).

1.02 REFERENCES

- A. Applicable codes, standards, and references: all inspections and tests shall be in accordance with the following applicable codes and standards, except as provided otherwise herein:
 - 1. National Electrical Testing Association – NETA.

2. National Electrical manufacturer's Association – NEMA.
3. American Society for Testing and Materials – ASTM.
4. Institute of Electrical and Electronic Engineers – IEEE.
5. American National Standards Institute – ANSI.
6. National Electrical Safety Code – NESC.
7. California Building Code – CBC.
8. California Electrical Code – CEC.
9. California Mechanical Code – CMC.
10. Insulated Power Cables Engineers Association – IPCEA.
11. Occupational Safety and Health Administration – OSHA.
12. National Institute of Standards and Technology – NIST.
13. National Fire Protection Association – NFPA.
14. American Society of Heating and Air Conditioning Engineers – ASHRAE
(The HVAC Commissioning Process, ASHRAE Guideline).
15. Associated Air Balance Council – AABC
(National Standards for Total System Balance).
16. Uniform Mechanical Code – UMC.
17. Uniform Plumbing Code – UPC.

1.03 SUBMITTALS

- A. Submittals package(s) shall include the following:
1. Commissioning required submittals in accordance with Division 01 Specification Sections.
 2. Copy of the Architect's reviewed and accepted submittals to the CxA via the Project Manager.
 3. List of team members who will represent the Contractor in the Pre-functional Equipment Checks (PEC) and Functional Performance Tests (FPT), at least six (6) weeks prior to the start of Pre-functional Equipment Checks.
 4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, a copy of full details of Owner-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of Owner to keep Warranty in force clearly defined.
 5. Installation and checklist documentation shipped with equipment and field checklist forms to be used by factory or field technicians.
 6. Detailed manufacturer's recommended procedures and schedules for PECs, supplemented by Contractor's specific procedures, and FPTs, at least four (4) weeks prior to the start of PEC.

1.04 MEETINGS, SEQUENCING AND SCHEDULING

- A. Meetings: Attend the Cx meetings as required under Division 1 and Cx Plan.
- B. Sequencing and Scheduling: The work described in this Section shall begin only after all work required in related Divisions 22 and 26 Sections has been successfully completed and all tests, inspection reports, and Operation & Maintenance manuals required have been submitted and accepted. The start-up and PEC shall be completed and submitted to the Owner at least two weeks prior to beginning FPT.
 - 1. Coordinate all HVAC work with the work of other trades prior to scheduling of any Cx procedures.
 - 2. Coordinate the completion of all HVAC testing, inspection, and calibration prior to start of Cx activities.

1.05 QUALITY CONTROL

- A. Comply with the Owner's Quality Control Specifications,
- B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this section.

1.07 EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

- A. Split Systems
- B. 100% Make Up Air Units with gas fired heating and dx cooling
- C. Fan Coil Units
- D. Single Package Rooftop Gas Heating/Electric Cooling Units
- E. Single Package Rooftop Heatpump Units
- F. Exhaust Fans
- G. Ventilators
- H. Pumps
- I. Hot Water Boiler, Gas

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

- A. Equipment to be utilized in the commissioning process shall meet the following requirements:
 - 1. Provide test equipment as necessary for the testing of the equipment and systems to be commissioned.
 - 2. Provide testing equipment and accessories that are free of defects and certified for use.
 - 3. Provide testing equipment with current calibration labels as per NIST Standards.
 - 4. Equipment shall be calibrated on the manufacturer's recommended intervals with

calibration tags affixed to the instrument. In the absence of calibration tags, calibration documentation shall be submitted to the CxA at least thirty (30) days prior to use; this documentation shall include description and serial number of instrument and calibration data and date.

5. All testing equipment shall be maintained in good operating condition for the duration of the project.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

- A. Work to be performed prior to commissioning:
 1. Complete all phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.
 2. If modifications or corrections to the installed system(s) are required to bring the system(s) to acceptance levels due to Contractor's incorrect installation or defective materials, such modifications shall be made at no additional cost to the Owner.
 3. Normal start-up services required to bring each system into full operational state:
 - a. Testing, motor rotation check, control sequences of operation, full and part load performance.
 - b. Commissioning shall not start until each system is complete and start-up has been performed.
- B. Pre-Commissioning responsibilities:
 1. Inspection, calibration and testing of the equipment required to commission the following systems:
 - a. HVAC System(s).
- C. Commissioning Process Requirements:
 1. Refer to Section Division 1 Requirements and related sections for information on meetings, start-up plans, Pre-Functional and FPT, operations & maintenance data, training requirements, and other Cx activities.

3.02 PREPARATION

- A. Provide certified HVAC technicians as required, with tools and equipment necessary to perform all Cx activities specified.
- B. Provide certified testing agency personnel and equipment factory representatives as require in the Cx plan and other related sections.
- C. Verify that all work required in this section and in Section 01810 is complete prior to starting of FPT.
- D. Verify that complete operational manuals have been reviewed and accepted by the CxA as specified before starting FPT.

3.03 TESTING

- A. Testing procedures shall include the following minimum information:

1. Test number.
 2. Equipment used for the test, with manufacturer and model number and date of last calibration.
 3. Date and time of the test.
 4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
 5. Identification of the system, subsystem, assembly, or equipment.
 6. Conditions under which the test was conducted, including (as applicable); ambient conditions, set points, override conditions, status, and operating conditions that impact the results of the test.
 7. Systems and assemblies test results and performance and compliance with contract requirements.
 8. Issue number, if any, generated as the result of the test.
 9. Name(s) and signature(s) of witnesses and the person(s) performing the test.
- B. Contractor shall participate and perform all Cx related testing requirements as specified.
- C. General Requirements for Mechanical, Controls, and Testing and Balance:
1. Construction and Acceptance Phases:
 - a. Provide assistance to CxA in preparing FPT procedures specified. Sample test forms are include in the project Cx Plan.
 - b. Develop full startup and initial checkout plan using manufacturer's start-up procedures and all Cx checklists for all commissioned equipment. Submit to CxA for review and approval prior to startup.
 - c. During startup and initial checkout process, execute mechanical-related portions of PEC for the equipment and systems to be commissioned.
 - d. Perform and clearly document completed startup and system operational checkout procedure. Providing (4) four copies of the results to the Owner.
 - e. Resolve any open punch list items before FPT. Air testing and balance shall be completed with discrepancies and problems remedied before FPT of respective air -related systems.
 - f. Provide skilled technicians to execute starting of equipment and to execute PFT. Ensure that technicians are available and present during agreed upon schedules and for sufficient duration to complete necessary tests, adjustments, and solutions to identified problems.
 - g. Maintain a log of events and issues of tests and all related Cx activities. Submit handwritten reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests, and lists of completed tests as specified.
 - h. Correct open issues and re-test as needed to prove compliance with system operational standards.

- i. Prepare Operation & Maintenance Manuals and provide training for the District maintenance personnel and end-users per Section 01730.
- j. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of Warranty and notify the Owner.
- k. Execute simulated seasonal FPT, witnessed by the Owner and the CxA, as specified. Document all results and perform corrections as needed for system acceptance and make necessary adjustments to Maintenance & Operations Manuals and Record Drawings.

3.04 SENSOR CALIBRATION

- A. Field-installed temperature, relative humidity, CO₂, pressure sensors, pressure gages, and actuators (dampers and valves) shall be calibrated using the methods described below. Calibration procedures shall be documented during execution of the Start-up and the PEC. Alternate methods may be used, if approved by the CxA.
- B. Test instruments shall have had a NIST certified calibration within the last 12 months. Sensors installed in the unit at the factory with provided calibration certification need not be field calibrated.
- C. Sensors:
 - 1. Verify that sensor locations are appropriate and away from causes of erratic operation.
 - 2. Verify that sensors with shielded cable are grounded only at one end.
 - 3. For sensor pairs that determine a temperature difference, make sure they are reading within 0.2°F of each other.
 - 4. For sensor pairs that determine a pressure difference, make sure they are reading within 2% of each other.
 - 5. Calibration: Put the equipment in operation. Make a reading with a calibrated test instrument within six inches of the site sensor. Verify that the sensor reading (via the permanent thermostat or gage) is within the tolerance listed in the table below of the instrument-measured value. If not, calibrate or replace sensor.
 - 6. Tolerances:

Sensor	Required Tolerance (+/-)
AHU wet bulb or dew point	2.0°F
Outside air, space air, duct air temps	0.4°F
Watt-hour, voltage & amperage	1% of design
Pressures, air, water and gas	3% of sensor range (inc. design value)
Flow rates, air	10% of sensor range (inc. design value)
Flow rates, natural gas	5% of sensor range (inc. design value)

Relative humidity	4%
CO ₂ monitor	100 ppm
Sound level	5 db - Type 1 meter (Per Calibrator Mfg.)
Domestic Hot Water Temperature	1.5 °F
Domestic Hot Water Pressures Water & Gas	3% of sensor range (inc. design value)
Flow Rates, Domestic Water	4% of sensor range (inc. design value)
Flow Rates	5% of sensor range (inc. design value)

3.05 ADJUSTING

- A. Systems improperly adjusted; incorrectly installed equipment and/or deficient Contractor's performance may result in additional work being required for commissioning acceptance.
 - 1. Contractor shall perform all work required to correct installations not meeting contract requirements at no additional cost to the Owner.
- B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.
- C. If systems' Cx deadline, as defined in the Project Schedule, goes beyond the scheduled completion without resolution of the problem(s), the Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem.

3.06 TRAINING

- A. Provide training as required in applicable Division 15 specification sections and section 01820.
- B. All off site training must be conducted in a classroom environment at an ALC factory authorized and certified training center. Contractor must provide proof of factory certification of training facility upon request.

END OF SECTION

APPENDIX A

SCHEDULE OF RESPONSIBILITIES

	ITEM	FURNISH BY	INSTALL BY	POWER BY	CONTROL WIRING BY
1	Magnetic Motor Starters:				
	a. Automatic controlled, with or without HOA switches.	E	E	E	DDC
	b. Manually controlled	E	E	E	N/A
	c. Manually controlled furnished as factory wired unit equipment	M	M	E	E
	d. Special duty type (part winding, multi-speed, etc.)	M	See Note 1	E	N/A
	e. Adjustable frequency drives with or without manual bypass.	DDC	E	E	DDC See Note 2
	f. Domestic booster pump. Motor Controls	M	M	E	E
2	Line voltage contactors.	E	E	E	E
3	Control relay transformers (other than starters).	DDC	DDC	E	DDC
4	Control and Instrumentation panels	DDC	DDC	E	DDC
5	Automatic control valves, automatic dampers and damper operators, solenoid valves, insertion temperature and pressure sensors including wells	DDC	M	E	DDC
6	Control interlock wiring between chillers, pumps, cooling towers, fans and air handling units and other miscellaneous mechanical equipment.	DDC	DDC	E	DDC
7	Duct Smoke Detectors	E	M	E	E
8	Dampers				
	a. Control Dampers	M	M	N/A	DDC
	b. Smoke Dampers and Combination Fire/Smoke Dampers	M	M	E	E
9	Airflow Stations with transmitter.	M	M	E	DDC
10	Air terminal devices (I.e., VAV and fan powered boxes).	M	M	E	DDC
11	Intelligent Devices and Control Units provided with packaged mechanical equipment such as: Large VAV and constant volume package units Boilers and Chillers.	M	M	E	E
12	Intelligent Devices and Control Units not provided by equipment manufacturer such as: Air handling units, Heat pumps, AC units (small < 20 tons), Air terminal units (VAV boxes), door and window contact switches	DDC	DDC	E	DDC
13	Intelligent Devices and Control Units provided with electrical systems such as: Occupancy / motion sensors, Lighting Control Panels, Switches and dimmers, Switch Multiplexing Control Units, Door Entry Control Units.	E	E	E	E
14	Gateways for proprietary non-BACnet equipment	M	M	E	DDC
15	Communications network devices such as Routers, Bridges and Repeaters.	DDC	DDC	E	DDC

Abbreviations	
DD	DDC Contractor (Sunbelt Controls)
C	
M	Mechanical Contractor
E	Electrical Contractor
N/A	Not Applicable

Notes:

1. Magnetic motor starters (special duty type) shall be set in place under electrical division except when part of factory wired equipment, in which case they shall be set in place under mechanical division.
2. Where a remote motor disconnect is required in addition to the one provided integral to a Variable Frequency Drive (VFD), controls contractor shall provide the necessary control interlock between the disconnects.

END OF APPENDIX A

DIVISION 26

ELECTRICAL

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in sections of Division 01.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 03 3000 - Cast-in-Place Concrete.
 - 3. Section 09 9000 - Painting and Coating.
 - 4. Division 23 - HVAC.
 - 5. Division 27 – Communications.
 - 6. Division 28 - Electronic Safety and Security.
 - 7. Division 31 - Excavation and Fill for Utilities.
- C. Applicable Standards
 - 1. ANSI/NEMA FB-1 (2010) – Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
 - 2. ANSI/NEMA 250 (2008) – Enclosure for Electrical Equipment (1000 Volts Maximum).
 - 3. California Electrical Code (CEC).
 - 4. IEEE C57.12.28 (2005) – Standard for Pad-Mounted equipment (Enclosure Integrity).
 - 5. UL 1 (2005) – Standard for Flexible Metal Conduit.
 - 6. UL 1242 (2007) – Standard for Electrical Intermediate Metal Conduit.
 - 7. UL 506 (2008) – Specialty Transformers.
 - 8. UL 6 (2010) – Electrical Rigid Metal Conduit-Steel.
 - 9. UL 797 (2007) – Electrical Metallic Tubing-Steel.
 - 10. UL 870 (2008) – Standard for Wireways, Auxiliary Gutters, and Associated Fittings

A. Quality Assurance:

1. Workers possessing the skills and experience obtained in performing work of similar scope and complexity shall perform the Work of this Division.
2. Refer to other sections of the Specifications for other qualification requirements.

B. Drawings and Specifications Coordination:

1. For purposes of clearness and legibility, Drawings are essentially diagrammatic and the size and location of equipment is indicated to scale whenever possible. Verify conditions, dimensions, indicated equipment sizes, and manufacturer's data and information as necessary to install the Work of this Division. Coordinate location and layout with other Work.
2. Verify final locations for rough-ins with field measurements and with the requirements of the equipment to be connected.
3. Drawings indicate required size and points of termination of conduits, number and size of conductors, and diagrammatic routing of conduit. Install conduits with minimum number of bends to conform to structure, avoid obstructions, preserve headroom, keep openings and passageways clear, and comply with applicable code requirements.
4. Routing of conduits may be changed provided that the length of any conduit run is not increased more than 10 percent of length indicated on the Drawings.
5. Outlet locations shall be coordinated with architectural elements prior to start of construction. Locations indicated on the Drawings may be distorted for clarity.
6. Coordinate electrical equipment and materials installation with building components and the Work of other trades
7. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
8. Coordinate connection of electrical systems with existing underground utilities and services.

C. Terminology:

1. Signal Systems: Applies to clock, bell, fire alarm, annunciator, sound, public address, buzzer, telephone, television, inter-communication, lighting control systems and security systems.
2. Low Voltage: Applies to signal systems operating at 120 volts and less, and power systems operating at less than 600 volts. Medium voltage: Applies to power systems operating at more than 600 volts.
3. UL: Underwriter's Laboratories Inc, Nationally Recognized Testing Laboratory (NRTL), or equal.

D. Regulations: Work shall comply with the requirements of authorities having jurisdiction and the California Electrical and Building Codes. Material shall conform to regulations of the National Board of Fire Underwriters for electrical wiring and apparatus. Materials shall be new and listed by UL, or another NRTL.

E. Structural Considerations for Conduit Routing:

1. Where conduits pass through or interfere with any structural member, or where notching, boring or cutting of the structure is necessary, or where special openings are required through walls, floors, footings, or other buildings elements, conform to CBC, Part 2, Title 24, Section 1906.3 for conduits and pipes embedded in concrete and Sections 2308.9.10 and 2308.9.11 for notches and bored holes in wood; for steel, as detailed on the structural steel Shop Drawings.
2. Where a concrete encasement for underground conduit abuts a foundation wall or underground structure which the conduits enter, encasement shall rest on a haunch integral with wall or structure, or shall extend down to footing projection, if any, or shall be doweled into structure unless otherwise indicated. Underground structures shall include maintenance holes; pull boxes, vaults, and buildings.
3. Holes required for conduit entrances into speaker poles, floodlight poles or other poles, shall be drilled with the conduit nipple or coupling welded to poles. Welds shall be provided by the electric arc process and shall be continuous around nipple or coupling.

F. Electrically Operated Equipment and Appliances:

1. Furnished Equipment and Appliances:

- a. Work shall include furnishing and installing wiring enclosures for, and the complete connection of electrically operated equipment and appliances and electrical control devices which are specified to be furnished and installed in this or other sections of the Specifications, wiring enclosures shall be concealed except where exposed Work is indicated on the Drawings.
- b. Connections shall be provided as necessary to install equipment ready for use. Equipment shall be tested for proper operation and, if motorized, for proper rotation. If outlets are of incorrect electrical characteristics or any specified equipment fails to operate properly, repair and/or replace the outlet and/or equipment.

2. Equipment and Appliances Furnished by Others:

- a. Equipment and appliances indicated on Drawings as "not in contract" (NIC), "furnished by others," or "furnished by the Owner," will be delivered to the Project site. Required electrical connections shall be performed for such equipment and appliances. Motorized equipment will be furnished factory-wired to a control panel or junction box unless otherwise indicated. Appliances will be furnished equipped with portable cord and cap. Provide disconnect switches where required.
- b. Connections to equipment furnished under this Division shall be part of the Work of this section. Work shall include internal wiring, installation, connection and adjustment of bolted drive motors in which the motor is supplied as a separate unit, and connections only for equipment furnished with factory installed internal wiring, except as further limited by Drawings and this Specification. Work shall include furnishing and installing suitable outlets, disconnecting devices, starters, push-button stations, selector switches, conduit, junction boxes, and wiring necessary for a complete electrical installation. Work shall also include furnishing and installing conduit and boxes for HVAC control systems, furnished under Division 23. Devices and equipment furnished shall be of same type used elsewhere on the Work or as specified.

- c. Electrical equipment furnished under other sections, for installation and connection under Work of this section, will be delivered to the Project site ready for installation.
 - d. Mechanical equipment furnished under other sections, and requiring electrical connection under this section, will be set in place as part of the Work of the section furnishing such equipment unless noted otherwise.
 - e. Suitability and condition of equipment furnished under other sections shall be determined in advance of installation. Immediate notice of damage, unsuitability, or lack of parts shall be given to the entity providing such equipment.
- G. Protection of Materials:
 - 1. Protect materials and equipment from damage and provide adequate and proper storage facilities during progress of the Work. Damaged materials and/or equipment shall be replaced.
- H. Cleaning:
 - 1. Exposed parts of Work shall be left in a neat, clean, usable condition. Finished painted surfaces shall be unblemished and metal surfaces shall be polished.
 - 2. Thoroughly clean parts of apparatus and equipment. Exposed parts to be painted shall be thoroughly cleaned of cement, plaster, and other materials. Remove grease and oil spots with solvent. Such surfaces shall be wiped and corners and cracks scraped out. Exposed rough metal shall be smooth, free of sharp edges, carefully steel brushed to remove rust and other spots, and left in proper condition to receive finish painting.
 - 3. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.
- I. WARRANTIES
 - 1. Provide one-year warranty on all material and labor performed, unless noted otherwise in specific sections.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Advise the Inspector before starting the Work of this Division.
- B. Exposed conduits shall be painted to match the surfaces adjacent to installation.
- C. Trenches outside of barricade limits shall be backfilled and paved within 24 hours after being inspected by the Inspector. Provide traffic plates during the time that trenches are open in traffic areas and in areas accessible to students and staff.
- D. Where existing structural walls are cored for new conduit runs, separation between cored holes shall be three inches edge to edge from new or existing holes, unless otherwise required by the Architect. All coring to be laid out and reviewed by Architect prior to drilling. Contractor to verify location of structural steel, rebar, stress cabling or similar prior to lay out.
- E. Electrical equipment shall be braced and anchored for CBC Seismic Design requirements, or as otherwise indicated on the Drawings.

3.02 DELIVERY STORAGE AND HANDLING

- A. Deliver products to project site with proper identification, which shall include names, model numbers, types, grades, compliance labels, and similar information needed for District identification; all products and materials shall be adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion.

3.03 CUTTING AND PATCHING

- A. Cutting and patching of electrical equipment, components, and materials shall include the removal and legal disposal of selected materials, components, and equipment.
- B. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- C. Repair or restore other work or surfaces damaged as a result of the work performed under this contract.

3.04 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose off the Project site.
- B. Remove equipment and implements of service, and leave entire work area neat and clean, to the satisfaction of the Owner Authorized Representative.

3.05 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 26 05 13

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Boxes, enclosures, keys and locks.
2. Receptacles and switches.
3. Identifications and signs.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Division 26 – Electrical.
3. Division 27 – Communications.
4. Division 28 - Electronic Safety and Security.

PART 2 - PRODUCTS

2.01 BOXES, ENCLOSURES, KEYS AND LOCKS

A. Outlet Boxes and Fittings:

1. Outlet boxes installed in concealed Work shall be galvanized steel, pressed, or welded type, with knockouts.
2. In exposed Work, where conduit runs change direction or size, outlet boxes and conduit fittings shall be cast metal with threaded hubs cast integral with box or fitting.
3. Fittings shall be cast metal and non-corrosive. Ferrous metal fittings shall be cadmium-plated, or zinc galvanized. Castings shall be true to pattern, smooth, straight, with even edges and corners, of uniform thickness of metal, and shall be free of cracks, gas holes, flaws, excessive shrinkage, and burnt-out sand.
4. Covers for fittings shall be galvanized steel or non-corrosive aluminum and shall be designed for particular fitting installed.
5. Light fixture outlets shall be 4-inch octagon, 4-inch square, 2 1/8-inch deep or larger, depending upon number of conductors or conduits therein. Plaster rings shall be furnished with round opening with two ears drilled 2 23/32 inches center to center.

6. For local device outlets provide 4-inch square 2 1/8-inch deep, boxes for single gang, 5-inch square boxes for two-gang, and special solid gang boxes with gang plaster ring for more than two switches.
7. For TV outlets, and horns and strobes provide manufacturer's supplied back box as needed. For television outlets, provide 4-gang deep boxes and 4-gang plaster rings.
8. Plaster rings shall be provided on flush-mounted outlet boxes except where otherwise indicated or specified. Plaster rings shall be same depth as finished surface. Install approved ring extension to obtain depth to finish surface.
9. In existing plywood wall or drywall construction, and where flexible steel conduit is fished into walls, single-gang and 2-gang outlets for wiring devices may be sectional steel boxes with plaster ears. Boxes shall be fastened to plywood with flat-head screws in each plaster ear screw hole. Boxes fastened to gypsum board shall be Racor, Appleton, Cooper, Bowers, or equal.
10. Factory made knockout seals shall be installed to seal box knockouts, which are not intact.
11. Where flexible conduit is extended from flush outlet boxes, provide and install weatherproof universal box extension adapters.

B. Junction and Pull boxes:

1. Junction and pull boxes, in addition to those indicated, shall only be used in compliance with codes, recognized standards, and Contract Documents.
2. Interior and non-weatherproof boxes shall be constructed of blue or galvanized steel with ample laps, spot welded, and shall be rigid under torsion and deflecting forces. Boxes shall be furnished with auxiliary angle iron framing where necessary to ensure rigidity.
3. Covers shall be fastened to box with enough machine screws to ensure continuous contact all around. Flush type boxes shall be drilled and tapped for cover screws if boxes are not installed plumb. Surfaces of pull and junction boxes and covers shall be labeled in black marker ink designating system, panelboard and circuit designation contained in box. In exposed Work, designation shall be installed on inside of pullbox or junction box cover.
4. Weatherproof NEMA 3R pull and junction boxes shall conform to foregoing for interior boxes with following modifications:
 - a. Cover of flush mounting boxes shall be furnished with a weather-tight gasket cemented to, and trimmed even with, cover all around.
 - b. Surface or semi-flush mounting pull, and junction boxes shall be UL, or another Nationally Recognized Testing Laboratory (NRTL) listed as rain-tight and shall be furnished complete with threaded conduit hubs.
 - c. Exposed portions of boxes shall be galvanized and finished with one prime coat and one coat of baked-on gray enamel, unless already furnished with factory baked-on finish.

5. Junction and pull boxes shall be rigidly fastened to structure and shall not depend on conduits for support.
6. Underground Concrete Pull Boxes:
 - a. Pre-cast concrete pull boxes. Concrete pull boxes shall be traffic type, reinforced for H-20 wheel loading, pre-cast concrete. Pull boxes with inside dimensions of 2 feet by 3 feet by 3 feet deep shall consist of a base section, top ring, and cover. Base section shall be furnished with 2 knockouts measuring 10 inches by 10 inches in each 3 feet side, and one 20 inches by 20 inches knockout in each 2-foot side. Pull boxes with inside dimension 4 feet by 4 feet by 4 feet deep shall consist of a base section, midsection, topping, and cover. Base section shall be furnished with 2 knockouts measuring 8-inch by 16-inch on each of two opposite sides, and one 20-inch by 20-inch knockout on each of other two opposite sides. Pull boxes shall be furnished with a minimum of 6-inch diameter sump knockout and one-inch diameter ground rod knockout. In pull boxes, furnish and install cable racks on walls. Racks shall be furnished with 3 porcelain cable holders on vertical steel mounting bars. Pull boxes shall be furnished with 3/4-inch diameter pull irons. Covers shall be traffic-type consisting of steel safety plate bolted to frame. Covers shall be marked as electrical, power, or signal as required.
 - b. Provide end bells in duct entrances. Terminate each metal conduit with insulated bushing provided with a grounding terminal.
 - c. Install pulling irons on opposite walls and below horizontal centerlines of ducts and bricked-up openings, and in bottom. Install pulling irons with each end hooked around a reinforcing bar.
 - d. Remove floor drain knockout and provide a depth of 24 inches of crushed rock below box extending a minimum of 12 inches beyond on all sides.
 - e. Permanently and effectively ground metal equipment cases, cable racks, and similar items in pull boxes to site grounding electrode system. Provide grounding conductor in compliance with CEC Article 250.
 - f. Provide 6-inch deep sand base under pull boxes.
 - g. Identify power and signal cables by tagging in manholes and pull boxes. Tie securely to cables with nylon cord.
 - h. Top of steel plate shall provide a minimum coefficient of static friction of 0.5 for either wet or dry locations, when tested for any shoe sole material. Test shall comply with ASTM D 1047 or F 489 or F 609 standards. Submit manufacturer's test results for Architect's review as part of materials and equipment submittals.
 - i. The use of underground extension boxes shall be limited to not more than 1 times the original depth of pull box.
 - j. Approved Products: Oldcastle Precast, Jensen Precast, Western Precast, or OWNER approved equal.
7. Underground utility boxes shall be reinforced concrete with non-setting shoulders to prevent settlement following installation. Boxes shall be furnished with cast iron cover with

finger hole, size as indicated on Drawings. Utility boxes shall be as manufactured by Oldcastle, Jensen, Western Precast, or equal.

8. Manholes, vaults, and pull boxes required by a utility company, and installed as part of this Contract, shall meet requirements of servicing utility company.

C. Keys and Locks:

1. Provide two keys with furnished door locks, including cabinet door locks and switchboard locks, two keys for lock switches on switchboards or control panels, and two keys with interlocks or other furnished lock switches. Deliver keys to OAR.
2. Special keys and locks shall only be provided where specified. Locks shall be keyed to Corbin No. 60 or 70 as follows:
 - a. Access to operate equipment shall be keyed to Corbin 60.
 - b. Access to service areas shall be keyed to Corbin 70.

2.02 RECEPTACLES AND SWITCHES

A. Receptacles:

1. Duplex receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be wired on the side and back with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be PVC. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
(20 amps) NEMA 5-20	PS5362-I	HBL5362-I	5362-I
(15 amps) NEMA 5-15	PS5262-I	HBL5262-I	5262-I

Equal products approved by OWNER may be acceptable.

2. Single receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be back and side wire with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be thermoplastic. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts. For circuits consisting of one single receptacle only, ampere rating of receptacle shall be same as circuit breaker or fuse.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
(20 amps) NEMA 5-20R	5361-I	HBL5361-I	5361-I
(15 amps) NEMA 5-15R	5261-I	HBL5261-I	5261-I

Equal products approved by OWNER may be acceptable.

3. Provide specification grade ground-fault circuit interrupter (GFCI) type receptacles in accordance with 2010 UL standards. GFCI receptacles shall have a trip indication light. Receptacle terminal screws shall be back and side wire with internal screw pressure plates. Test and reset buttons shall match device body and shall be ivory. GFCI receptacles shall be manufactured in standard configuration for installation with stainless

steel smooth plates. Exterior mounted receptacles shall be mounted inside weatherproof enclosure.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 5-20R	2095-I	GFR5352-IA	7899-I
NEMA 5-15R	1595-I	GFR5252-IA	8598-I

Equal products approved by OWNER may be acceptable.

4. Provide weatherproof receptacles, except where otherwise indicated or specified, consisting of GFCI receptacles, as specified herein, and metal plates with die-cast lockable hinged lids and weatherproof mats;

Tamper-resistant receptacles with thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects. Receptacles shall have extra heavy-duty brass, one-piece mounting strap with integral ground. Receptacles shall be ivory color, impact resistant nylon face and back body.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Arrow Hart</u>	<u>Leviton</u>
NEMA 5-20R	TR63-I	TR8300V	8300SGI
NEMA 5-15R	TR62-I	TR8200V	8200SGI

Equal products approved by OWNER may be acceptable.

B. Switches

1. Local Switches:

- a. Local switches shall be high strength thermoplastic toggle, industrial grade, rated 20 amps at 120-277 volts AC only, with plaster ears, external screw pressure plate back and side wired, and standard size composition cups which fully enclose mechanism. Switches shall be approved for installation at currents up to full rating on resistive, inductive, tungsten filament lamp and fluorescent lamp loads, and for up to 80 percent of rating for motor loads. Switches shall have oversized silver alloy contacts for long life and better heat dissipation. Provide switches as single pole, double pole, 3-way, 4-way, non-lock type. Provide non-lock type switches with ivory handles;

	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
Single pole	PS20AC1I	HBL1221I	1221-2I
Double pole	PS20AC2I	HBL1222I	1222-2I
Three-way	PS20AC3I	HBL1223I	1223-2I
Four-way	PS20AC4I	HBL1224I	1224-2I

Equal products approved by OWNER may be acceptable.

- b. Lock type switches shall be specification industrial grade, 20 amp, 120-277 volts with metal or nylon key guides with on/off indication, and operable by same key. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16-inch long forks, 5/32-inch spacing between forks and 5/16-inch width overall.

1) Approved products:

<u>Pass & Seymour</u>	<u>Arrow Hart</u>

Single pole	PS20AC1L w/#500 Key-2L	1221L w/1201LK Key
Double pole	PS20AC2Lw/#500 Key	1222L w/1201LK Key
Three-way	PS20AC3L w/#500 Key	1223L w/1201LK Key
Four Way	PS20AC4L w/#500 Key	1224L w/1201LK Key

Equal products approved by OWNER may be acceptable.

- c. Rotary lock switches shall incorporate a tumbler type lock to prevent unauthorized operation. Lock shall be tumbler type by Corbin, keyed to a HH41 key. Lock switch to be installed with pin tumblers facing downward. Key shall be removable in all positions. Each device shall be complete with 2 keys. Keys shall be delivered only to the OAR. Switches shall be rated at 20 amps, 120-volt or 277-volt AC. Switch plates shall be of stainless steel, engraved with on and off positions indicated.

- 1) Approved products:

	<u>Arrow Hart</u>
Single pole	AH1191N
Double pole	AH1192N
Three-way	AH1193N

Equal products approved by OWNER may be acceptable.

- d. Pilot light switches shall be rated 20 amps and shall conform to specifications for local switches. Switches shall be furnished with red, Lexan handles that are lighted by LED lamps. Pilot light shall light when load is on. Pilot light 120-volt switches

- 1) Approved products:

	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
Single pole	PS20AC1-RPL	HBL1221-PL	1221-PLR
Double pole	PS20AC2-RPL	HBL1222-PL	1222-PLR
Three-way	PS20AC3-RPL	HBL1223-PL	1223-PLR

Equal products approved by OWNER may be acceptable.

- 2) 20 amps, 277 volts rated pilot light switches shall be single pole and shall conform to specifications for local switches, and the requirements of paragraph d above.

- a) Approved Products:

<u>Pass & Seymour</u>	<u>Leviton</u>	<u>Hubbell</u>
PS20AC1-RPL	1221-7PR	HBL1221-PL7

- e. Provide remote control switches for mechanically held contactors arranged for 3-wire control, toggle type, momentary contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclose mechanism, and ivory handles.

- 1) Approved products:

<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
1251-I	HBL1557-I	1285-I

Equal products approved by OWNER may be acceptable.

- f. Provide remote control switches for magnetically held contactors arranged for 3-wire control, toggle type, maintained contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclosed mechanism, and ivory handles.

- 1) Approved products:

<u>Pass and Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
1225-I	HBL 1385	1285-I

Equal products approved by OWNER may be acceptable.

- g. Momentary Contact locking key type switch. 20A 120/277V center off. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/32" spacing between forks and 5/16" width overall.

- 1) Approved products:

Arrow Hart AH1995L w/ AH2000 key
Equal products approved by OWNER may be acceptable.

- h. Momentary Contact switch low voltage 1 pole 3A 24VAC 3 position center off. Key for locking switch shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/31" spacing between forks and 5/16" width overall.

- 1) Approved products:

Pass and Seymour Toggle 1081I, Locking 1081KGRY w/500 Key
Equal products approved by OWNER may be acceptable.

2. Time Switches and Photoelectric Controls.

- a. Provide time switches with a 7-day, solid-state, electronic type capable of fully automatic or manual operation and housed in a sheet steel enclosure unless built into a panel or switchboard. Resistive or inductive contacts rated for 25-amps, each pole 240-VAC; 5-amps tungsten or 277-VAC pilot duty, each pole 240-VAC. Time switches to contain a non-volatile clock and non-volatile memory with a built-in rechargeable super capacitor power carry-over system. Battery carryover is not acceptable. Provide a minimum of 15 on/off set points per week. Timing to be in one-minute increments with a minimum on or off time of one minute. Time switch digital displays to indicate days of week, hours, and minutes. Display to contain a load status light to indicate when equipment is in operation.

- b. Required :

- 1) Liquid crystal display panel.
- 2) Holiday scheduling: Up to 40 dates may be assigned special holiday schedules, up to one year in advance.
- 3) Automatically adjusts to and from daylight savings time and for leap year.
- 4) Contact ratings: 10 amp at 240 VAC.
- 5) Safety override switch for each circuit to either provide shut down of circuit or to override on.

- 6) Selective review: All or part of schedule shall be displayed at touch of a key.
- 7) Super Capacitor for power carry-over system.
- 8) Supply voltage: 120/277-Volt.
- 9) 365-day advance scheduling.
- c. Approved products: Tork Model EW 101B series, Intermatic ET90000 series, or OWNER approved equal.
- d. Photoelectric control: Shall be rated 2,000 watts, 120V with single pole, single throw, normally closed contact, enclosed in a die-cast aluminum gasketed enclosure with 1/2-inch conduit fitting,
 - 1) Approved products: Tork series 2100, or OWNER approved equal.

2.03 IDENTIFICATION AND SIGNS

A. Identification Plates:

- 1. Provide identification plates for the following unless otherwise specified, for switchboards, unit substations, motor control centers, control panels, push-button stations, time switches, contactors, motor starters, motor switches, panelboards, and terminal cabinets.
- 2. Identification plates shall be of plastic stock and shall adequately describe function, voltage and phase of identified equipment. Where identification plates are detailed or described on Drawings, inscription and size of letters shall be as indicated. For lighting and power panels, identification plates shall indicate panel designation, voltage, and phase of panel. For terminal cabinets, identification plates shall indicate system contained in terminal cabinet.
- 3. Identification plates shall be black-and-white nameplate stock of bakelite with characters cut through black exposing white. Plates shall be furnished with beveled edges and shall be securely fastened in place with No. 4 Phillips-head, cadmium-plated steel, self-tapping screws. Characters shall be 3/16 inch high, unless otherwise indicated.

B. Markings:

- 1. Install identification markings to surface-mounted starters, switches, disconnect switches, contactors, and other devices controlling motors and appliances. Provide abbreviations required along with an identifying number. Markings to be provided with locking type stencils using paint of a contrasting color. Figures shall be 3/8 inch high unless otherwise indicated. Dymo Industries Inc., self-sticking plastic labels, with embossed characters made with a typewriter may be installed instead of stencils and paint; p-touch self adhesive plastic, or Brother P-Touch self sticking laminated plastic labels may be installed.
- 2. High Voltage: High voltage switchboards, cabinets, boxes, and conduits exposed in accessible locations, including under buildings and in attics, are required to be marked "WARNING-HIGH VOLTAGE – ABOVE 600 VOLTS". Markings for switchboards shall consist of 18 gage steel, porcelain enamel sign of standard manufacture. Markings for boxes, cabinets, and conduits shall be by means of stenciling or printed self-adhesive

markers, Westline Tel-A-Pipe, or equal. Provide letters of black on orange background and not less than 1-7/8 inches high. On conduit runs, install markings at intervals not exceeding 10 feet in any individual area. Markings shall be installed after other painting Work is complete.

C. Warning Signs:

1. Provide a warning sign on outside of each door or gate to rooms or enclosures containing high voltage equipment. Signs required reading, "WARNING - HIGH VOLTAGE - KEEP OUT". Provide 2-inch high lettering.
2. Provide a warning sign on each high-voltage non-load break disconnect and fused cutout (not oil filled). Signs required reading, "DO NOT OPEN UNDER LOAD". Provide 2-inch-high lettering.
3. Provide signs of standard manufacture, 18 gage steel, with porcelain enamel finish. Provide red lettering on a white background.

PART 3 - EXECUTION

3.01 INSTALLATION AND SUPPORT OF BOXES

- A. Install outlet boxes flush with finished surface of wall or ceiling. Install plumb and securely fastened to structure, independent of conduit. Except where otherwise indicated, provide factory-fabricated adjustable attachment bar hangers between studs to support outlet boxes. When installation is performed in fire rated walls, maintain the wall's rating integrity by means of approved fire stop methods.
- B. Outlet boxes installed in suspended or furred ceilings with steel runner or furring channels shall be supported, except where otherwise indicated, by a Unistrut P-4000 Tessco A1200HS-10, Cooper B-Line B22s-HG, or OWNER approved equal channel spanning main ceiling runner channels. Each box shall be supported from its channel by a 3/8-inch 16 threaded steel rod with a Unistrut P-4008, Fastenal #48604, Copper B-Line 78101140346 or OWNER approved equal; nut and a Tomic No. 711-B Adapta-Stud, or OWNER approved equal. Rod shall be tightened to a jamb fit with channel and its nut. Box shall be locked to rod by means of a 1/2-inch locknut on stud and a 3/8-inch 16 hex nut locking stud to rod.
- C. Heights of outlets and equipment indicated on Drawings shall govern. In absence of such indications, following heights shall be maintained with heights measured to centerline unless otherwise noted:
1. Install wall-mounted switches as indicated on Detail "F" on sheet E3.01..
 2. Outlet boxes for fire alarm pull stations shall be mounted as indicated on Detail "A" on sheet E4.01
 3. Wall mounted fire alarm strobe or horn/strobe devices shall be as indicated on Detail "A" on sheet E4.01
 4. Install outdoor fire alarm audible devices or fire alarm sprinkler flow bells at least 10 feet but not more than 12 feet above finished floor to center. Provide STI or other OWNER approved protective covers as required in plans.

5. Voice evacuation speakers mounted indoors shall be mounted as indicated on Detail "A" on sheet E4.01..
6. Install clocks and speakers, in classrooms and offices, 8 feet above finished floor. Unless otherwise indicated.
7. In rooms other than places of assembly such as, but not limited to, multipurpose rooms, auditoriums, and libraries, clock outlets and speakers in classrooms and offices shall be mounted 8 feet above finished floors. Other assembly areas such as gymnasiums shall be mounted 10 to 12 feet above finished floor. Provide STI, or equal protective covers for clocks when required.
8. Install fire alarm strobe lights as indicated on Detail "A" on sheet E4.01.
9. Install outside bells and yard light outlets 4 feet above second floor level for 2 or more story buildings, 12 inches below top plate level for one story buildings without covered porch or arcade, and 12 inches below covered porch and arcade ceilings.
10. Install desk telephones, power receptacle outlets, and data outlets as indicated on Detail "F" on sheet E3.01
11. Install panelboards and terminal cabinets 6 feet 6 inches from finish floor to top of cabinet.
12. Install television outlets at a height corresponding to location of television monitor, or as indicated on plans.
13. The use of extension boxes shall be limited to not more than 1 times the original depth of junction box.

3.02 COVER PLATES

- A. Provide a plate on each switch, plug, pilot light, data, interphone, public telephone, and television outlet, and on existing and reset outlets where so indicated or required. Plates shall be of stainless steel unless otherwise specified.
- B. Flush wiring device and signal system outlets indicated to be blank covered, shall be covered with blank stainless-steel plates. Flush lighting outlets to be blanked shall be covered with Wiremold 5736 steel covers, or equal, painted to match surrounding finish. Provide stainless steel covers to blank indicated or required surface-mounted outlets.
- C. In the following cases, and at required locations. Switch and receptacle plates shall be engraved with the device(s), or fixtures being controlled, or as indicated:
 1. Three-gang and larger gang switches in locations other than classrooms.
 2. Lock switches.
 3. Pilot switches.
 4. Switches so located that operator cannot see fixtures, or items of equipment controlled while his hand is on the switch.
 5. Switches not in same room with fixtures or items of unit heaters, air curtains, fly fans, etcetera.

- 6. Receptacles operating at other than 120 V shall be identified with the operating voltage.
 - 7. Switches operating on 277 V shall be identified with the operating voltage.
 - 8. Where indicated on Drawings.
- D. Designations shall be as indicated on Drawings or as specified by Architect.
 - E. Standard GFI cover plates shall be Pass & Seymour 4600, Racor 5028-0, or equal. GFI cover plates shall be provided with a CAM lock mechanism with two keys or a padlock hasp that does not protrude through the face of the cover and will allow the shank of locks keyed Corbin No. 60 keys.

3.03 IDENTIFICATION OF CIRCUITS AND EQUIPMENT

- A. Provide descriptive nameplates or tags permanently attached to switchboards, motor control centers, transformers, panelboards, circuit breakers, disconnect switches, starters, pushbutton control stations and other apparatus installed for operation or control of circuits, appliances, fire alarm control panel(s), fire alarm annunciator(s), power supplies, terminal cabinets, energy management control units, and Information technology system backbone and distribution equipment points.
- B. Provide nameplates of engraved laminated plastic, or etched metal. Submit Shop Drawings denoting dimensions and format to Architect before installation. Fasten to equipment with escutcheon pins, rivets, self-tapping screws, or machine screws. Self-adhering or adhesive backed nameplates are not permitted.
- C. Fasten tags to feeder wiring in conduits at every point where runs are broken or terminated, including pull wires in empty conduits. Indicate circuit, phase, and function. Tag branch circuits in panel boards and motor control centers. Tags may be manufactured of pressure-sensitive plastic or embossed self-attached stainless steel or brass ribbon.
- D. Provide circuit identification cards and cardholders in all panel boards. Cardholders shall consist of metal frame retaining a clear plastic cover permanently attached to inside of panel door. List of circuits shall be typewritten on a card. Circuit description shall include name or number of circuit's area and connected load.
- E. Junction and pull boxes shall have covers stenciled with box number when indicated on Drawings, or circuit numbers according to panel schedules. Data shall be lettered in a conspicuous manner with a color contrasting with finish.
- F. Name shall be correctly engraved, with a legend indicating function or areas, when required by codes or indicated on Drawings.

3.04 PROTECTION

- A. Protect Work of this section until Substantial Completion.

3.05 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE CONDUCTORS (600 VOLT AC)

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes: Low-voltage conductors, splices, terminations and installation.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. List of Materials: Submit a complete list of proposed materials.
- C. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, insulation type, resistivity, conductivity, impedance, and conductance. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
- D. Prior to start of construction; provide letter from wiring and electrical cables manufacturer certifying that the products are qualified/ listed as low electromagnetic field products.

1.03 SUBSTITUTIONS

- A. Deviations/Substitutions from these requirements shall not be accepted without written approval from OWNER'S Design Standards Section and Maintenance and Operations Technical Unit. When deviations are proposed, the following information shall be submitted:
 - 1. Substitution request form stating reasons and benefits to OWNER.
 - 2. OWNER'S approval shall be obtained for any equipment or materials substitutions.
 - 3. Proposed substitutions requests shall provide proof of compliance with OWNER'S requirements and applicable standards.
- B. Submittals must comply with contract general provisions.

1.04 QUALITY ASSURANCE

- A. Components and materials shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes.
- B. Wiring installation shall be performed under the supervision of state certified electricians. Contractor or Installer's electricians shall be certified in accordance with Labor Code sections 3099, and 3099.2 and section 209.0 of the California Code of Regulations.

- C. Contractor shall have adequate experience installing systems of similar size and complexity.
 - 1. Qualifications of Installer: Minimum five years of experience installing products and systems of similar scope and complexity.
 - 2. Installer shall have completed at least five projects of equivalent scope and complexity.
 - 3. Contractor shall have completed and commissioned a minimum of five service agreements that provide similar support services to those needed for this project.
 - 4. System startup and testing shall be performed under direct observation of the Project Inspector and OAR.
- D. The Project Inspector will observe installation of feeder cables. Notify the Project Inspector not less than two working days in advance of the proposed time of feeder installation.

1.05 WARRANTY

- A. Provide a one-year labor warranty.
- B. Provide material warranty of no less than 10 years.
- C. Warranty period begins at substantial completion or project acceptance for beneficial occupancy.
- D. CONTRACTOR shall warranty all products and materials. Multiple warranty sources is not acceptable.

PART 2 - PRODUCTS

2.01 WIRES / CONDUCTORS

- A. Pressure cable connectors shall be pre-insulated 3M Scotchlok, Ideal Wing Nut, O-Z/Gedney or equal.
- B. Wires shall be single conductor type THHN or THWN insulated with polyvinyl chloride and covered with a protective sheath of nylon, rated at 600 volts. Wires may be operated at a maximum continuous conductor temperature in dry locations of 90 degrees C. and 75 degrees C. in wet locations. Wires and cables shall be listed by Underwriter's Laboratories (UL) Standard 83 for thermoplastic insulated wires, and listed for installation in accordance with Article 310 of the California Electrical Code (CEC).
- C. Conductors shall be solid copper for 12 AWG and smaller conductors, and stranded copper for 10 AWG and larger conductors.
- D. Conductors shall be insulated with PVC and sheathed with nylon.
- E. Wires shall be identified by surface markings indicating manufacturer's identification, conductor size and metal, voltage rating, UL symbol, type designations and optional rating. Indentations for lettering are not permitted.

- F. Wires shall be tested in accordance with the requirements of UL standard for types THWN and THHN.
- G. Conductors shall be solid Class B or stranded Class C annealed uncoated copper in accordance with UL standards, or another Nationally Recognized Testing Laboratory (NRTL).

2.02 STANDARDS

- A. THWN/THHN wires shall comply with the following standards:
 - 1. UL 83 for thermoplastic insulated wires.
 - 2. UL 1063 for machine tool wires and cables.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Wires shall not be installed until debris and moisture is removed from conduits, boxes, and cabinets. Wires stored at site shall be protected from physical damage until they are installed and walls are completed.
- B. Wire-pulling compounds furnished as lubricants for installation of conductors in raceways shall be compounds approved and listed by UL, NRTL, or equal. Oil, grease, graphite, or similar substances are not permitted. Pulling of 2 AWG or larger conductors shall be performed with a cable pull machine. Any runs shorter than 50 feet are exempt. When pulling conductors, do not exceed manufacturer's recommended values
- C. At outlets for light, power, and signal equipment, pigtail splices with 8-inch circuit conductor leads for connection to fixtures, equipment, and devices.
- D. Pressure cable connectors, Yellow, Red, or Blue spring-loaded twist-on type, may be furnished in splicing number 8 AWG or smaller wires for wiring systems. Listed Push-in spring clamp wire connectors, Ideal In-Sure, or equal may be used in luminaires for fixture wiring.
- E. Joints, splices, taps, and connections to switchboard neutral, bonding or grounding conductors, conductors to ground busses, and transformer connections for wires 6 gage and larger shall be performed with high-pressure cable connectors approved for installation with copper conductors. Connectors shall be insulated with heavy wall heat shrink WCSM, or cold-applied roll-on sleeve RVS. Insulation level shall be a minimum of 600V and joints, splices, and taps shall be qualified to ANSI C 119.1, UL, NRTL, or equal listed mechanical pressure connections.
- F. Connections to any bussing and high-pressure cable connectors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- G. Connection of any bonding or grounding conductors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- H. Wire switchboards, panel cabinets, pull boxes, and other cabinets except public address, shall be neatly grouped and tied in bundles with nylon ties at 10-inch intervals. In switchboards,

panels and terminal blocks, wires shall be fanned out to terminals. If bundles are longer than 24 inches, a maximum of nine current carrying conductors may be bundled together.

- I. Install conductor lengths with a minimum length within the wiring space. Conductors must be long enough to reach the terminal location in a manner that avoids strain on the connecting lug.
- J. Maintain the conductor required bending radius.
- K. Neutral conductors larger than 6 gage, which are not color identified throughout their entire length, shall be taped, painted white or natural gray, or taped white where they appear in switchboards, cabinet, gutters or pull boxes. Neutral conductors 6 gage and smaller shall be white color identified throughout their entire length.
- L. Fire alarm and clock wiring shall be continuous from terminal cabinets or from equipment to each device. Splices are not permitted between devices and/or terminal cabinets at junction and pull boxes. Wiring shall be terminated at terminal blocks or devices only.
- M. Wiring systems shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of feeder and branch circuit conductor's insulation resistance. The insulation of the conductors shall be tested prior to connections to any panelboards, switchboards, variable frequency drives, lighting control systems, ballasts, and wiring devices such as but not limited to GFI receptacles, TVSS receptacles, or equipment. Insulation testing of panelboards and switchboards shall be independently performed from the insulation testing of any conductors as specified in other sections of this specification.
 - 1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of feeder conductors. Tests must be conducted with wires disconnected at both ends.
 - a. Provide calibration program records to assure the testing instrument to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).
 - b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
 - c. Test reports shall include the following:
 - 1) Identification of the testing organization.
 - 2) Equipment identification.
 - 3) Ambient conditions.
 - 4) Identification of the testing technician.
 - 5) Summary of project.
 - 6) Description of equipment being tested.
 - 7) Description of tests.
 - 8) Test results.
 - 9) Analysis, interpretation and recommendations.

2. Utilize the services of an approved independent testing laboratory or a qualified contractor's employee (Technician certified in accordance with ANSI/NETA ETT-2000 Standard for Certification of Electrical Testing Personnel) to perform megger time-resistance insulation testing of branch circuit conductors. Tests must be conducted with wires disconnected at both ends.
 - a. Test equipment and report requirements stipulated under paragraph 3.01.N.1 apply to branch circuit testing.
3. Tests shall be performed in the presence of the Project Inspector.
4. Insulation resistance shall not be less than 100 mega-ohms.

3.02 COLOR CODES

A. General Wiring:

1. For phase and neutral conductors 6 gage or larger, permanent plastic-colored tape may be furnished to mark conductor end instead of coded insulation. Tape shall cover not less than 2 inches of conductor insulation within enclosure.
2. Color code conductor insulation as follows:

SYSTEM VOLTAGE		
Conductor	208Y/120	480Y/277
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Natural Gray

Neutrals shall be colored-distinguished if circuits of two voltage systems are used in the same raceway.

3. Where two voltage systems are combined in an enclosure; CONTRACTOR shall apply a permanent color code label where the circuits originate.

- B. Signal Systems: Wires for signal systems shall be color-coded and installed under observation of the Project Inspector. Except where otherwise specified, color-coding shall match existing color-code established for the campus.

3.03 FEEDER IDENTIFICATION

- A. Feeder wires and cables shall be identified at each point the conduit run is broken by a cabinet, box, gutter, etc. Where terminal ends are available, identification shall be by means of heat shrink wire markers, which provide terminal strain relief. Markers shall be by Tyco Electronics, Panduit, Brady Perma-Sleeve, or equal. Identification in other areas shall be by means of wrap-around tape markers from Tyco Electronics, Panduit, Brady Perma-Code or equal. Markers shall include feeder designation, size, and description.

3.04 TAPE AND SPLICE KITS

- A. Splices, joints, and connectors joining conductors in dry and wet locations shall be covered with insulation equivalent to that provided on conductors. Free ends of conductors connected to energized sources shall be taped. Voids in irregular connectors shall be filled with insulating

compound before taping. Thermoplastic insulating tape approved by UL, NRTL, or equal for installation as sole insulation of splices shall be furnished and shall be installed according to manufacturer's printed specifications.

3.05 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.06 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Provide and install grounding system as indicated or required.
- B. Related Requirements:
 - 1. Refer to related sections for their system grounding requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Division 27: Communications.

1.02 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. IEEE 142 Green Book.
 - 2. Underwriter's Laboratories (UL).
 - 3. California Electrical Code.
 - 4. Building Industry Consultant Services International (BICSI) (Signal).
 - 5. EIA/TIA (Signal and power).
 - 6. Nationally Recognized Testing Laboratory (NRTL) or equal.

1.03 SYSTEM DESCRIPTION

- A. Metallic objects on the Project site that enclose electrical conductors, or that are likely to be energized by electrical currents, shall be effectively grounded.
- B. Metal equipment parts, such as enclosures, raceways, and equipment grounding conductors, and earth grounding electrodes shall be solidly joined together into a continuous electrically conductive system.
- C. Metallic systems shall be effectively bonded to the main grounding electrode system.
- D. A separately derived AC source shall be grounded to the equipment grounding conductor, and to separate "made" electrode of building grounding electrode system.
- E. Electrical continuity to ground metal raceways and enclosures, isolated from equipment ground by installation of non-metallic conduit or fittings, shall be provided by a green insulated grounding conductor of required size within each raceway connected to isolated metallic raceways, or enclosures at each end. Each flexible conduit over six feet in length shall be provided with a green insulated grounding conductor of required size.

- F. Cold water, or other utility piping systems, shall not be utilized as grounding electrodes due to the installation of insulating couplings and non-metallic pipe in such installations. In addition to bonding to cold water pipe provide at least one of the following made grounding electrodes:
1. A dedicated "made" electrode, fabricated of at least 20 feet of galvanized 1/2 inch diameter rebar encased by at least two inches of concrete, and placed next to the bottom of a concrete foundation, or footing in direct contact with earth. A welded extended portion shall surface at the location of the common grounding electrode bus bar and be extended by a 3/0 CAD welded bare copper cable, or be CAD welded directly to the bus. The CAD weld shall be at least four inches above finished floor in a dry location. The main grounding electrode and associated grounding conductors shall be in an enclosure and in conduit.
 2. Grounding electrodes as specified hereafter in this section.
 3. Concrete enclosed electrode, fabricated of at least 20 feet of No. 2 AWG, minimum size, bare copper conductor, encased by at least two inches of concrete, located within or near bottom of a concrete foundation, or footing, which is in direct contact with earth. Footing rebar shall be connected to copper wire with approved connectors. An external electrode, as specified hereafter or as required by the CEC, shall be installed and connected to foundation or footing rebar.
- G. Non-current carrying metal parts of high-voltage equipment enclosures, signal and power conduits, switchboard and panelboard enclosures, motor frames, equipment cabinets, and metal frames of buildings shall be permanently and effectively grounded. Provide a CEC sized grounding conductor in every raceway.
- H. Metallic or semi-conducting shields and lead sheaths of cables operating at high voltage, shall be permanently and effectively grounded at each splice and termination.
- I. Neutral of service conductors shall be grounded as follows:
1. Neutral shall be grounded at only one point within the Project site for that particular service. Preferable location of grounding point shall be at the service switchboard, or main switch.
 2. Equipment and conduit grounding conductors shall be bonded to that grounding point.
 3. If other buildings or structures on the Project site are served from a switchboard or panelboard in another building, power supply is classified as a feeder and not as a service.
 4. Equipment grounding conductor is installed from switchboard to each individual building. At building, grounding conductor is bonded with power equipment enclosures, metal frames of building, etc., to "made" electrode for that building.
 5. Feeder neutrals shall be bonded at service entrance point only, neutrals of separately derived systems shall be bonded at the source only.
- J. If there is a distribution transformer at a building the secondary neutral conductor shall be grounded to "made" electrode serving the building.
- K. Within every building, the main switchboard or panelboard, shall be bonded to the cold water line. Metallic piping systems such as gas, fire sprinkler, or other systems shall be bonded to the cold water line.

1.04 SUBMITTALS

- A. Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Furnished yard boxes shall be precast concrete and shall be approximately 14 inches wide by 19 inches long by 12 inches deep or larger, if necessary to obtain required clearances. Boxes shall be furnished with bolt-down, checkered, cast iron covers and cast iron frames cast into boxes. Yard boxes shall be Jensen Precast, Oldcastle Precast, Western Precast, Kistner , or equal.
- B. "Made" electrodes shall be copper-clad steel ground rods, minimum 3/4 inch diameter by ten feet long.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Grounding electrodes shall be installed in the nearest suitable planting area, where not otherwise indicated on Drawings, and each electrode shall terminate within a concrete yard box installed flush with finish grade. In planting areas, finish elevation of concrete yard boxes shall be two inches above planting surfaces.
- B. If concrete enclosed electrode is provided, grounding wire shall be terminated to a suitable copper plate with grounding lugs and must be enclosed in a raceway or box..
- C. Grounding rods shall be driven to a depth of not less than eight feet. Permanent ground enhancement material, (GEM) as manufactured by Erico Electrical Products, Loresco Powerset, Tessco Ultrafil or equal, shall be installed at each ground rod to improve grounding effectiveness. Install in accordance with manufacture's installation instructions.
- D. Grounding electrodes shall provide a resistance to ground of not more than 25 ohms.
- E. When installing grounding rods, if resistance to ground exceeds 25 ohms, two or more rods connected in parallel, or coupled together shall be provided to meet grounding resistance requirements.
- F. Ground rods shall be separated from one another by not less than ten feet.
- G. Parallel grounding rods shall be connected together with recognized fittings and grounding conductors in galvanized rigid steel conduit, buried not less than 12 inches below finish grade.

3.02 TESTING

- A. Provide the services of an approved independent testing laboratory to test grounding resistance of "made" electrodes, ground rods, bonding of building steel, water pipes, gas pipes and other utility piping. Tests shall be performed as follows:
 - 1. Visually and mechanically examine ground system connections for completeness and adequacy.
 - 2. Perform fall of potential tests on each ground rod or ground electrode where suitable locations are available per IEEE Standard No. 81, Section 8.2.1.2. Where suitable locations are not available, measurements will be referenced to a known dead earth or reference ground.

3. Perform the two point method test per IEEE No. 81, Section 8.2.1.1 to determine ground resistance between ground rod and building steel, and utility piping - such as water, gas and panelboard grounds. Metal railings at building entrances and at handicapped ramps shall also be tested.
 4. Test shall be performed in the presence of the Inspector.
- B. Submit 3 copies of test results to the Architect. Test results shall be submitted on an official form from the independent testing laboratory recording Project location, test engineer, test conditions, test equipment data, ground system layout or diagram, and final test results.

3.03 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.04 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 05 33

RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Raceways and wire ways.
2. Conduit installation.
3. Underground requirements.

B. Related Requirements:

1. Section 26 05 00: Common Work Results for Electrical.
2. Section 26 05 13: Basic Electrical Materials and Methods.
3. Division 27 - Communications.
4. Division 28 - Electronic Safety and Security.

C. Applicable Standards and Codes.

1. EIA/TIA 569 Standards.
2. National American Standards Institute (ANSI).
3. National Electrical Manufacturer's Association (NEMA).
4. Nationally Recognized Testing Laboratory (NRTL).
5. California Electrical Code (CEC).
6. Uniform Building Code (UBC).
7. Underwriters Laboratory (UL).

1.02 SUBMITTALS

A. Materials List: Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 RACEWAYS

A. Conduit Materials:

1. Metallic conduit, and tubing shall be manufactured under the supervision of an UL, or another NRTL factory inspection and label service program. Each ten-foot length of conduit and tubing shall bear the UL or another NRTL label and manufacturer's name.
2. Rigid metallic conduit shall be rigid steel, heavy wall, mild steel, zinc-coated, with an inside and outside protective coating manufactured in accordance with ANSI C 80.1. Couplings, elbows, bends, conduits, bushings and other fittings shall be the same materials and finish as the rigid metallic conduit. Fittings, connectors, and couplings shall be threaded type, manufactured in accordance with ANSI C 80.1 and UL 6.

3. Electrical metallic tubing shall be steel tubing, zinc-coated with a protective enamel coating inside, manufactured in accordance with NEMA C 80.3. Fittings, couplings, and connectors shall be gland compression type, set screw couplings and connectors not permitted. All parts shall be manufactured in accordance with NEMA C80.3 and UL 6A Electrical metallic tubing is designated hereinafter as EMT. Steel and rain tight fittings shall be approved and listed for the intended application.
 4. Flexible steel conduit shall be of flexible interlocking strip construction with continuous zinc coating on strips, manufactured in accordance with UL 1.
 - a. Connectors and couplings shall be required fittings of the type, which threads into convolutions of flexible conduit.
 5. Liquid-tight flexible metal conduit shall be galvanized heavy wall, flexible locked steel strip construction, UV rated, with smooth moisture and oil-proof, abrasion-resistant, extruded plastic jacket. Connectors shall be as required for installation with liquid-tight flexible conduit and shall be installed to provide a liquid-tight connection.
 6. Non-metallic conduit shall be rigid PVC electrical conduit extruded to schedule 40 dimensions of Type II. Grade 1 high impact, polyvinyl chloride, sweeps, couplings, reducers and terminating fittings shall be listed under the UL, or another NRTL, and shall bear the manufacturer's listed marking.
 7. Multi-cell raceway shall be four inch PVC, Type 40, UL or another NRTL listed for underground use with optical fiber and signal system cables. Raceway shall be furnished with 3-1/2 inch factory installed inner ducts with required internal spacers, and required couplers, sweeps, and end bells. Multicell raceway shall be Carlon Multigard, or District approved equal.
 8. Metal Clad (MC) cable system is not allowed.
- B. Sleeves for Conduits: Sleeves shall be adjustable type by Carlon, U.S. Plastic, PEP Plastic or equal.
- C. Where conduit enters a building through a concrete foundation below grade, or ground water level, or where it is necessary to seal around a conduit where it passes through a concrete floor or wall, provide O-Z/Gedney Type FSK Thru Wall and Floor Seal, equivalent Cooper Crouse Hinds Thru-Wall, Legrand Thru-Wall, or equal.
- D. Expansion Joints-Seismic Separations between building(s) and other locations as indicated on drawings:
1. Provide Thomas & Betts XJG-TB, O-Z/Gedney. type AX with bonding strap and clamps, Cooper XJGD or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z/Gedney type EX, Cooper XJGD, or equal. Provide O-Z/Gedney type AXDX, or equal combination deflection/expansion fittings at all seismic separations. Provide manufacture's internal and external bonding jumpers at all locations. Liquid-tight metal conduit or flexible metal conduit shall not be approved at expansion joints, separations between buildings or seismic separations.
 2. Provide expansion fittings at intervals not exceeding 100 feet in conduits exposed to direct sunlight. Fittings may be installed in the conduit run or where conduit attaches to junction or pull boxes. OZ/Gedney type AX, TX or EXE series, or equivalent by Thomas and Betts, Crouse-Hinds or approved equal.
- E. Conduit Seal Fittings:
1. Provide conduit seal fittings where indicated on the Drawings. Conduit seals shall be of rigid galvanized steel. Seals in horizontal conduit installations shall be Thomas & Betts

EYS, Appleton Type ESU, Crouse Hinds Type EYS, or equal. Seals in vertical conduit installations shall be Thomas & Betts EYD, Appleton Type SF, Crouse Hinds Type EYD, or equal, with continuous drain. When installing conduit seals make provision for percent fill space reduction in accordance with CEC.

2. Install sealing compound after wire has been installed. Ensure drain is not blocked in vertical seals when installing compound. Where conduit seals are installed in hazardous area applications, there shall be no conduit coupling, fitting, etc., between seal and boundary of hazardous area.

F. Surface Steel Raceway:

1. The surface steel raceway system for branch circuit wiring, data network, voice, video, and other low voltage wiring shall be as manufactured by the Wiremold Company, Hubbell, or Mono-Systems, Inc. or equal. The raceway system may be supplied pre-wired in accordance with all sections of these specifications and requirements herein and shall be UL or another NRTL listed. Computer data installation shall be as required by other sections of this Division.
 - a. If furnished pre-wired, the system must be listed in accordance with UL or another NRTL for "Multiple Outlet Assemblies" and so labeled on interior of the assembly. The pre-wired installation must contain no extra wire splices in the raceway as compared to a contractor assembled installation assembled from components. The pre-wired steel raceway shall be Hi-Pot tested at the factory to prevent any potential bare wire or shot circuit defects.
2. The raceway base, cover, and device bracket shall be manufactured of steel and finished in ivory, gray enamel or custom colors suitable for field painting to match adjacent finishes.
3. The raceway shall be a two-piece design with a metal base and snap-on metal cover, except for the Wiremold V700 system, Hubbell HBL750 series and Mono-Systems Inc. S145-700 series that shall be a one-piece design. The base and cover sections shall be a minimum of 0.040-inch wall thickness. The base section shall be available in ten-foot lengths. A hand-operated cutting tool shall be available for the base and cover to ensure clean, square cuts. Wiremold V500, Hubbell V500, and Mono Systems inc. SM500 series are not permitted.
4. A full complement of fittings shall be furnished, including but not limited to, flat internal and external elbows, tees, entrance fittings, wire clips, cover clips, couplings, support clips, C-hangers and end caps. The fitting color shall match the raceway color. Fittings shall be supplied with a base where indicated and/or required. A take-off fitting shall be furnished as required to adapt to existing flush wall boxes.
5. Device brackets shall be furnished for mounting single or two-gang devices within the raceway. Devices shall be provided with the ability of mounting flush or in conjunction with standard steel, stainless steel, or manufacturer's metal faceplates.
6. The raceway shall be furnished with a complete line of connectivity outlets and modular inserts for unshielded twisted pair including category 5, fiber-optic, coaxial, and other cabling types with face plates and bezels to facilitate installation. Computer data installation shall be as required by other sections of this Division, and Division 27.
7. Raceway shall be furnished with corner elbows and tee fittings to maintain a cable bend radius which meets the requirements of fiber-optic and copper cables under EIA/TIA 569 for communications pathways.

G. Factory Pre-Wired Surface Metal Raceway:

1. Furnish and install pre-wired surface metal raceways as indicated on Drawings and as specified.
2. Metal Raceway shall be galvanized steel Wiremold V4000, Hubbell 4000 series, or Mono-Systems Inc. SMS-4000 series complete with raceway base, cover, fittings, receptacles and mounting plates required for a complete assembly. Raceway shall have two wiring compartments with integral dividing barrier for isolating the wiring compartments.
3. Pre-wired assembly shall be UL, or another NRTL listed as a multi-outlet assembly and surface raceway as labeled on interior of assembly.
4. Wiring devices and other components shall be factory installed, electrically wired and covers labeled as indicated on drawings. Each receptacle shall be identified with panelboard and circuit number from which it was fed. Grounding shall be maintained by means of factory installed grounding conductors.
5. Where shown on Drawings, Raceway covers shall have provisions for mounting computer data outlets.
6. Complete assembly is to consist of required fittings such as elbows, slide couplings for joining raceway sections, blank end caps and flat tees.
7. Prewired assembly must contain no wire splices.
8. Receptacles and wiring shall be as indicated on drawings and as specified.
9. Where raceway is used for power and computer data outlets, installation of data outlets shall be as required by other sections of this specification.
10. Prior and during installation, verify and comply with manufacturer's installation instructions.
11. Entire assembly shall be tested for shorts, opens, ground faults, and wire insulation at factory and certified. Raceways shall be electrically continuous and bonded in accordance with California Electrical Code.
12. Submit shop drawings for approval showing the complete layout of all components of each raceway, raceway lengths, each component description, location and circuit identification.
13. All wiring devices shall be removable without requiring disassembly of wireway.
14. Standard non OEM wiring devices shall be used as specified in District's specifications.

H. Wireways shall be 16 gage galvanized steel enclosed hinge/screw wiring troughs, surface metal raceway, wireway, and auxiliary gutter designed to enclose electrical wiring. Wireway fittings shall be furnished with removable covers and sides to permit complete installation of conductors throughout the entire wireway run. Cover shall be furnished with keyhole slots to accept captive screws locking the cover securely closed. Wireways shall be UL or another NRTL listed, and shall be Square D Type LDB NEMA-1 enclosure for interior applications, or Type RDB NEMA-3R enclosure for exterior applications, or equal by Cooper B-line, Hoffman, Wire Guard, or Circle AW.

I. Penetration in Fire-Rated Structures: Provide 3M, or equal, sealant and fire barriers for installing fire-rated seals around penetrations through floors, walls, and elevator hoistways. Fire stop system must be UL, or another NRTL listed, and classified for through-penetration applications of metallic conduits and busways.

J. Pull Wires: Install 1/8 inch polypropylene cords in empty or spare conduits.

PART 3 - EXECUTION

3.01 CONDUIT INSTALLATION

A. General Requirements:

1. Provide complete and continuous systems of rigid metallic conduit, outlet boxes, junction boxes, fittings and cabinets for systems of electrical wiring including lighting, power, and signal systems, except as otherwise specified.
2. EMT may be installed in interior concealed applications and in areas approved by owner. EMT shall not be installed in concrete, directly buried underground, outdoors, in boiler rooms, elevator pits, or where subject to damage.
3. Within buildings, flexible steel conduit may be installed instead of rigid steel conduit where permitted by code. Flexible steel conduit shall be installed:
 - a. For continuous lengths not exceeding more than 50 feet between pull points (pull boxes, outlet boxes, etcetera).
 - b. With no maximum total raceway length located within a building interior when the flex is located in concealed locations.
4. Flexible Steel conduit shall not exceed 1-1/2 inches in size.
5. Liquid-tight flexible steel conduit shall only be installed, except where otherwise specified, for final connection of motor terminal boxes, shop equipment, cafeteria equipment, HVAC equipment and other equipment, or for frequent interchange, and shall be of sufficient length, not exceeding 36 inches, to permit full travel or adjustment of motor on its base. Liquid-tight flexible conduit shall not be used for equipment not requiring adjustment or frequent interchange.
6. Connectors for flexible metal conduit shall be made of steel, and of the types which threads into convolutions of conduit. Connectors for watertight flexible metal conduit shall be as required for installation and shall be installed to provide a watertight connection.
7. Exposed conduit shall be installed vertically and horizontally following the general configuration of the equipment, using cast threaded hub conduit fittings where required and shall be clamped to equipment with suitable iron brackets and one hole pipe strap.
8. If connection is from a flush wall-mounted junction box, install an approved extension box.
9. Underground feeder distribution conduits for systems may be non-metallic conduit instead of rigid conduit except where otherwise specified or indicated.
10. Conduit shall be concealed unless otherwise indicated. Conduits exposed to view, except those in attic spaces and under buildings, shall be installed parallel or at right angles to structural members, walls, or lines of building. Conduits shall be installed to clear access openings.
11. Bends or offsets will not be permitted unless absolutely necessary. Radius of each conduit bend or offset shall be as required by ordinance. Bends and offsets shall be performed with standard industry tools and equipment or may be factory fabricated bends or elbows complying with requirements for radius of bend specified. Heating of metallic conduit to facilitate bending is not permitted. Public telephone conduit bends and offsets shall be provided with a radius which is not less than ten times trade size of conduit unless otherwise permitted. Refer to underground installation, specified in this section, for radius of bends and offsets required for underground installations.

12. Running threads are not permitted. Provide conduit unions where union joints are necessary. Conduit shall be maintained at least six inches from covering of hot water and steam pipes and 18 inches from flues and breechings. Open ends of conduits shall be sealed with permitted conduit seals during construction of buildings and during installation of underground systems.
13. Expansion Joints/Seismic Separations/Separations between buildings/Locations Indicated: Provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type AX with bonding strap and clamps. Crouse Hinds XJGD, or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type EX, Crouse Hinds XJGD, or equal. Provide Crouse Hinds, Thomas & Betts, or O-Z Electrical Mfg. Co. Type AXDX, or equal Combination Deflection/Expansion Fittings at all seismic separations. Provide manufactures internal and external Bonding Jumpers at all locations. Liquid-tight flexible conduit shall not be approved at expansion joints or seismic separations.
14. Where conduits are terminated in groups at panelboards, switchboards, and signal cabinets, etc., provide templates or spacers to fasten conduits in proper position and to preserve alignment. Conduits terminating at signal cabinets shall only enter cabinets in the following locations:
 - a. Conduits entering top, side, and bottom of cabinets shall be aligned in a single row, centered two inches from rear of cabinet.
 - b. Conduits entering back of cabinet shall be aligned in a single row centered two inches from top of cabinet.
 - c. Conduits shall not be spaced closer than three inches on centers.
15. Conduits above metal lath ceilings shall be rigidly suspended with pipe hangers or pipe racks or shall be secured to superstructure with factory fabricated pipe straps. Conduits in metal lath or steel stud partitions shall be tied to furring channels or studs. In ceiling spaces and in partitions, tie wires shall be spaced not more than 5 feet apart, shall fasten conduit tight against channels and studs at point of tie and shall not support any of conduit weight. Tie wire shall be 16 gage galvanized double annealed steel.
16. Where auxiliary supports, saddles, brackets, etc., are required to meet special conditions, they shall be fastened rigid and secure before conduit is attached.
17. Conduit in ceiling spaces, stud walls, and under floors, shall be supported with factory fabricated pipe straps or shall be suspended with pipe hangers or pipe racks. Pipe straps shall be attached to and shall fasten conduit tight at point of support against ceiling and floor joists, rafters, and wall studs, or two-inch x four-inch headers fitted between joists or wall studs.
18. Conduits installed on exposed steel trusses and rafters shall be fastened with factory fabricated conduit straps or clamps, which shall fasten conduit tight against supporting member at point of support.
19. Conduits installed under buildings shall be strapped with factory fabricated conduit straps to underside of concrete floor or joists, or wood floor joists, or shall be suspended with pipe hangers or pipe racks. Conduits under building are not permitted to be placed directly on grade; they shall be suspended from building or shall be buried below surface or ground. 1-1/4 inch and larger conduits under buildings shall be installed with conduit hangers or racks.
20. Pipe hangers for individual conduits shall be factory fabricated. Steel rods shall be 3/8 inch for two-inch conduit hangers and smaller and shall be 1/2 inch for 2 1/2-inch conduit hangers and larger.

21. Pipe racks for groups of parallel conduits and for supporting total weights not exceeding 500 pounds shall be trapeze type and shall consist of a cross channel, Steel City Kindorf B-900, Unistrut P-1000, equivalent Cooper B-Line or equal, suspended with a 3/8 inch minimum diameter steel rod at each end. Rods shall be fastened with nuts, top and bottom to cross-channel and with square washers on top of channel. Conduits shall be clamped to top for cross-channel with conduit clamps, Steel City Kindorf C-105 or Unistrut P-1111 through P-1124, equivalent Cooper B-Line, or equal. Conduits shall not be stacked one on top of another, but a maximum of two tiers may be on same rack providing an additional cross-channel is installed. Where a pipe rack is to be longer than 24 inches, or if the supported weight exceeds 500 pounds, submit Shop Drawings of installation to the Architect for review.
22. Conduits suspended on rods more than two feet long shall be rigidly braced to prevent horizontal motion or swaying. Installation shall meet zone 4 seismic requirements.
23. Factory fabricated pipe straps shall be one or two-hole formed galvanized clamps, heavy-duty type, except where otherwise specified.
24. Hangers, straps, rods, or pipe supports under concrete shall be attached to inserts set at time concrete is placed, or with approved concrete anchors. Under wood, install bolts, lag bolts, or lag screws; under steel joists or trusses, install beam clamps. Contractor shall submit size of anchors, bolts, screws, and installation method to Architect for approval prior to start of any work.
25. Conduits shall be supported at intervals required by code, but not to exceed ten feet. One inch and smaller exposed conduits shall be fastened with one-hole malleable iron straps. Perforated straps and plumber's tape is not permitted for the support of conduits.
26. Conduits stubbed up through a roof or an arcade shall be flashed with a waterproof flashing. Refer to Division 07 for additional requirements.
27. Bushings and locknuts for rigid steel conduit shall be steel threaded insulating type. Setscrew bushings are not permitted.
28. Flex conduits shall be cut square and not at an angle.
29. Routing of conduits may be changed providing length of any conduit run is not increased more than ten percent of the length indicated on Drawings.

B. Underground Requirements:

1. Conduits and multicell raceways installed underground shall be entirely encased in three inch thick concrete on all sides , except where otherwise specified. Provide required spacers to prevent any deflection when concrete is placed and to preserve position and alignment. Conduits and raceways shall be tied to spacers. Anchors shall be installed to prevent floating of conduits and raceways during placing of concrete. Provide red colored concrete to encase conduits of systems operating above 600 volts.
2. Underground conduits and raceways shall be buried to a depth of not less than 24 inches below finished grade to top of the concrete envelope, unless otherwise specified.
3. Assemble sections of conduit with required fittings. Cut ends of conduit shall be reamed to remove rough edges. Joints in conduits shall be provided liquid-tight. Bends at risers shall be completely below surface where possible.
4. Conduits and raceways in a common trench shall be separated by at least three inches of concrete. Electrical power and/or lighting conduit runs installed in a common trench with conduits containing signal system wiring such as public address, telephone, intrusion detection, fire alarm, television, computer networking, and clock systems shall maintain a separation of a minimum of six inches from these types of signal system conduits and raceways. Electrical power, lighting and signal conduits and raceways

installed in a common trench with other utility lines such as gas, water, sewer and storm lines shall maintain 12 inches separation from these types of utility lines.

5. The Inspector will observe underground installations before and during concrete placement. A mandrel shall be drawn through each run of conduit in presence of the Inspector before and after placing concrete. Mandrel shall be six inches in length minimum, and have a diameter that is within 1/4 inches of diameter of conduit to be tested.
 6. Non-metallic conduit installations shall comply with following additional requirements. Joints in PVC conduit shall be sealed by means of required solvent-weld cement supplied by conduit manufacturer. Non-metallic conduit bends and deflections shall comply with requirements of applicable electrical code, except that minimum radius of any bend or offset for conduits sized from 1/2 inch to 1 1/2-inch inclusive shall not be less than 24 inches. Bends at risers and risers shall be PVC-coated rigid steel conduit. Radius of curve of bends or offsets in non-metallic conduit for public telephone system shall be not less than ten times trade size of conduit, unless otherwise specifically permitted.
 7. Furnish and install a six-inch wide, polyethylene, red underground barrier type 12 inches above full length of concrete reading, "CAUTION ELECTRIC LINE BURIED BELOW".
 8. Underground conduit systems provided for utility companies shall be furnished to meet the requirements of the utility companies requiring service.
 9. Protect inside of conduit and raceway from dirt and rubbish during construction by capping openings.
 10. Add bell-end bushings for conduit stub-up including underground entries to pull boxes, and manholes. Under floor standing switchboards and motor control centers provide a four-inch galvanized nipple with ground bushing.
 11. Underground conduit for systems operating above 600 volts shall be a minimum size of four inches.
 12. At portable classroom all stub ups shall be installed with a coupling flush to finish grade.
 13. Underground conduits and raceways shall be swabbed prior to wire pull.
- C. Rooftop conduit shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Blok, or equal. Roller type supports shall be provided below and above conduit to prevent its dislodgement. Bottom of conduits shall clear the roof surface by 10 inches.
1. At PVC roofing provide walk tread, polyester reinforced, UV resistant, with surface embossment at rooftop supports. Heat welding of walk pads shall only be done by manufacturer certified installers.
 - a. Sika-Sarnafil and Carlisle: Walk tread shall be no more than one inch larger than the plan area of the pipe support blocks and adhered to the roof membrane with Sika 1A or Carlisle Universal Single-Ply sealant, as applicable.
 - b. Johns Manville: Walk tread shall be installed under the pipe support blocks and adhered to the blocks, if possible, and left loose laid on top of the PVC roof system. Walk-pad shall have a minimum of 4 inches of material past perimeter on all 4 sides of block.
 2. Built-up roofing: Provide APP granulated modified torch-down at each pipe support block. Torch-down shall extend 2 to 4 inches beyond the edges of the block and

adhered by torch application over existing cap sheet membrane. This work shall be performed by a certified roofer.

D. General Installation Requirements for Computer Network System Conduits:

1. Location of outlet boxes and equipment on Drawings is approximate, unless dimensions are indicated. Drawings shall not be scaled to determine position and routing of wireways, drops, and outlet boxes. Location of outlet boxes and equipment shall conform to architectural features of the building and other Work already in place and must be ascertained in the field before start of Work.
2. The maximum pulling tensions of the specified cables shall not be exceeded and proper radius of cable bends shall be maintained.
3. For computer network wiring, conduit types shall be limited to rigid metal conduit, electrical metallic tubing, schedule 40 PVC, multi-cell raceways, and flexible metallic conduit for lengths less than six feet.
4. Interior section of conduit run shall be not longer than 100 feet and shall not contain more than two bends of 90 degrees between pull points or pull boxes.
5. The inside radius of a conduit bend shall be at least six times the internal diameter of the conduit. When the conduit size is greater than two inches, the inside radius shall be at least ten times the internal diameter of the conduit. For fiber-optic cable, the inside radius of a conduit bend shall be at least ten times the internal diameter of the conduit.
6. Conduit shall be sized in accordance with Table 4.4-1 of EIA/ TIA 569 standard.
7. Splicing or terminating cables in pull boxes is not permitted.
8. For indoor application, a pull box shall be provided in conduit run where:
 - a. The length is over 100 feet.
 - b. There are more than two bends of 90 degrees.
 - c. There is a reverse bend in the run.
9. Boxes shall be provided in a straight section of conduit and shall not be installed in lieu of a bend. The corresponding conduit ends are to be aligned with each other. Conduit fittings shall not be installed in place of pull boxes.
10. Where a pull box is provided with raceways, pull box shall comply with the following:
 - a. For straight pull-through, provide a length of at least eight times the trade-size diameter of the largest raceway.
 - b. For angle and U-pulls:
 - 1) Provide a distance between each raceway entry inside the box and the opposite wall of the box of at least six times the trade-size diameter of the largest raceway, this distance being increased by the sum of the trade-size diameters of the other raceways on the same wall of the box.
 - 2) Provide a distance between the nearest edges of each raceway entry enclosing the same conductor of at least:
 - a) Six times the trade-size diameter of the raceway; or
 - b) Six times the trade-size diameter of the larger raceway if they are of different size.
 - c) For a raceway entering the wall of a pull box opposite to a removable cover, provide a distance from the wall to the cover

of not less than the trade-size diameter of the largest raceway plus six times the diameter of the largest conductor.

11. Drawings generally indicate Work to be installed, but do not indicate all bends, transitions of special fittings required to clear beams, girders or other Work already in place. Investigate conditions where conduits and wireways are to be installed, and furnish and install required fittings.

- F. Concrete Walls, Beams, and Floors: Provide sleeves where conduits pierce concrete walls, beams, and floors, except floor slabs on grade. Sleeves shall provide 1/2 inch clearance around conduits. Sleeves shall not extend beyond exposed surfaces of concrete and shall be securely fastened to forms. Where conduits pass through walls below grade, seal with required sealant and backer materials between conduit and sleeve to provide a watertight joint. Sealant shall be as indicated in Section 07 9200: Joint Sealants.

3.02 STUBS

- A. Panelboard: Install two one inch conduits from each flush mounted panelboard to access under floor space and to access above ceiling space where these conditions occur. Cap conduits with standard galvanized pipe caps.
- B. Floor: At points where floor stubs are indicated in open floor areas, for connections to machines and equipment, conduits shall be terminated with couplings, tops flush with finished floor. Stubs shall extend above couplings the indicated distance. Where capped stubs are designated, couplings shall be closed with cast iron plugs with screw drive slots.
- C. Underground:
 1. Underground conduit stubs shall be terminated at locations indicated, and shall extend five feet beyond building foundations, steps, arcades, concrete walks and paving. Rigid metallic conduit stubs and non-metallic conduit stubs shall be capped by installing a coupling flush in end wall of concrete encasement and plugging with a permitted plug. Project record drawings shall indicate location of ends of underground conduit stubs fully dimensioned and triangulated with reference to buildings or permanent landmarks. These dimensions, including depth below finished grade, shall be marked on project record drawings in presence of the Inspector before backfilling trench. Where extending existing concrete encased stubs, clean, chip and wire brush end of existing concrete and brush on a heavy coat of neat cement paste or epoxy bonding agent.
 2. Over ends of individual underground conduit stubs or groups of conduit stubs, install four-inch by 18-inch deep PVC filled with concrete, flush with finished grade in asphaltic concrete or lawns, and two inches above finished grade in planting areas. Cast a three-inch by three-inch brass plate engraved "ELECT" flush in top of concrete. Secure plate to concrete with brass dowels or as indicated on drawings.

3.03 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.04 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: This specification covers single-phase and three-phase general purpose individually mounted dry-type transformers, 600 V maximum, for power and lighting applications. It includes transformers as specified and as indicated on Drawings.
- B. Work, material or equipment shall comply with the codes, ordinances and regulations of the local government having jurisdiction, including the regulations of serving utilities and any participating government agencies having jurisdiction.
- C. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 05 00: Common Work Results for Electrical.
 - 3. Section 26 05 13: Basic Electrical Materials and Methods.
 - 4. Section 26 05 26: Grounding and Bonding.
 - 5. Section 26 05 19: Low-Voltage Wires (600 Volts AC)
 - 6. Section 26 05 33: Raceways and Boxes, Fittings and Supports.
 - 7. Division 27: Communications.
- D. Codes and Applicable standards: Products and installation shall meet or exceed the latest edition of the following standards.
 - 1. ANSI/IEEE C57.96, Distribution and Power Transformers, Guide for Loading Dry-Type Transformers; Appendix to ANSI C57.12 Standards.
 - 2. Department of Energy, Energy Act of 2005.
 - 3. International Electrical Code adopted by the State of California.
 - 4. ANSI/NEMA 250 Enclosure for Electrical Equipment (1000 Volts Maximum)
 - 5. IEEE C57.12.91, Test Code for Dry-Type Distribution and Power Transformers.
 - 6. IEEE C57.110 – IEEE Recommended Practice for establishing liquid-filled and dry-type power and distribution transformer capability when supplying nonsinusoidal load currents.
 - 7. 1100-IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
 - 8. NEMA standard 20, Dry-Type Transformers for General applications.
 - 9. UL 506, Specialty Transformers.

10. UL 1561, Dry-Type General Purpose and Power Transformers.
 11. NEMA TP-1, Guide for Determining Energy Efficiency for Distribution Transformers.
 12. NEMA TP-2, Standard Test Method for Measuring the Energy Consumption of Distribution Transformers.
 13. NEMA TP-3, Standard for the Labeling of Distribution Transformer Efficiency.
 14. CSA 802.2-00 Minimum Efficiency Values for Dry Type Transformers
 15. California Building Code (CBC)
 16. Tri-axial shake test results conducted in accordance with AC156 test protocol.
 17. NFPA 70 National Electric Code
- E. No requirement of these drawings and specifications shall be construed to void any of the provisions of the above standards. Any conflicts or changes required to the contract documents in order to obtain compliance with applicable codes shall be brought to the immediate attention of the Owner Authorized Representative by the CONTRACTOR.
- F. ACRONYMS
- | | |
|------|---|
| ANSI | American National Standards Institute |
| AOR | Architect of Record |
| CEC | California Electrical Code |
| EOR | Engineer of Record |
| IBC | International Building Code |
| IEEE | Institute of Electrical and Electronics Engineers |
| NEC | National Electrical Code |
| NEMA | National Electrical manufacturers Association |

1.02 DESIGN REQUIREMENTS

- A. Premium Efficiency transformers with internal losses at 35 percent loading reduced by 30 percent when using temperature and material correction factor to 75 degrees C per NEMA Standard TP1
- B. Load Mix: Transformer shall be UL 1561 listed to feed a mix of equipment load profiles such as computer without detracting or significant degradation of efficiency.
- C. Construction: Windings shall be continuous wound copper with brazed or welded terminations.
 1. Insulation and Varnish Systems: Epoxy Polyester impregnation
 2. Terminals, including those for changing taps must be readily accessible by removing a front cover plate.

- D. Performance of transformers shall meet or exceed the requirements of applicable codes and standards, the DOE Energy Policy Act of 2005 - Public Law 109-58 and the latest requirements of the California Energy Commission Appliance Efficiency Regulations. In addition; transformers shall be designed to an efficiency standard higher than the lowest legal standard for the purpose of contributing to LEED Energy and Atmosphere (Optimized Energy Performance) and Utility Rebates.
- E. Transformers shall be self-cooled type with 220 degrees C. insulation and a maximum temperature rise of 130 degrees C. under continuous full load conditions with an ambient of 40 degrees C.
- F. Transformers shall be furnished with four 2.50 percent (two above and two below normal voltage) taps. Windings shall be of fire-resistant type, designed for natural convection cooling through normal air circulation.
- G. Core mounting frames and enclosures shall be of welded and bolted construction with sufficient mechanical strength and rigidity to withstand shipping, installation, and short circuit stresses.
- H. Enclosure cover plates shall be sheet steel, captive bolted to enclosure framework. Enclosure shall provide suitable ventilating openings with rodent-proof screens, NEMA 1 enclosure. Enclosure shall be provided with lifting lugs and jacking plates as required. Transformers installed outdoors shall be provided with weatherproof NEMA 3R enclosure and weather proof kit.
1. Submit rodent-proof screen sample for OWNER's approval.
- I. Transformers shall be furnished complete with mounting channels and mounting bolts. Metal parts, excepting cores and core mounting frames shall be furnished clean, rust-proofed, and provided with a coat of an inert primer.
- J. Transformers up to 35 KVA shall not exceed 40 decibels. Transformers 36 KVA or more shall be a minimum of 5 decibels below NEMA standards per unit. Transformers shall be provided with vibration dampers consisting of California Dynamic, Mason Industries, Korfund or equal neoprene mounting pad and Elastorib sheeting. Size and number of shock mounts shall be in accordance with manufacturer's recommendations.
- K. Transformers shall be UL listed.
- L. Each transformer to be installed under this section shall be sound tested at the factory. CONTRACTOR shall provide two copies of transformers tests reports for EOR's review.
- M. Equipment shown on drawings to scale is approximate only and based upon a general class of equipment specified. The CONTRACTOR shall verify dimensions and clearances prior to commencement of work.
- N. Verify points of connection with the manufacturer's requirements, instructions, or recommendations prior to installation. Actual dimensions, weights, clearances and installation requirements shall be verified and coordinated by the CONTRACTOR.
- O. Provide transformers with a K rating as indicated on drawings. K-rated transformers shall be type NL-UL or NLP-UL as indicated on drawings and be equipped with the following features:
1. Electrostatic shield.
 2. NLP series shall have a maximum sound level of 3 dB below NEMA standards.
 3. Double-size neutral terminal.

4. Additional coil capacity to compensate for higher non-linear load loss.
5. Heavy-gage ventilated indoor enclosures (provide weather shields where installed indoors).
6. K-rated transformers shall meet other requirements of this section.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Shop Drawings: Include make, catalog number, dimensions, weight, KVA Rating, Percent Impedance, finish, type, insulation class, design temperature, sound levels, efficiency and taps provided. Include regulation at 80 percent and 100 percent of full load, no-load loss, full-load loss, percent efficiency, percent impedance, noise level and continuous capacity rating.
- C. Provide manufacturers data and inspection report that confirms transformers to be UL 1561 listed with K rating equal to that indicated on drawings.
- D. Provide a connection schematic diagram.
- E. Provide the following tests reports: Project Inspector will review the reports for conformance with specified criteria, and compliance with the applicable standards. Submit one copy for each set of shop drawings being submitted.
 1. Load Losses: Measurements shall be taken at multiple load levels and plotted to show compliance with specifications and correlated to efficiency curve for the transformer size and type.
 2. Provide No-Load and Total Losses report.
 3. Applied Voltage.
 4. Temperature Rise.
 5. Induced Voltage.
 6. Sound Level.
 7. Impulse Test.
 8. Manufacturer's nonlinear load test representing real world load mix. Transformers not meeting this requirement shall not be installed.
- F. Submit harmonics test plan as follows:
 1. NEMA ST-20.
 - a. Open Circuit Test (no load losses):
 - 1) Use for both Linear and non-Linear.
 - 2) Measure Power.
 - b. Short Circuit Test (load losses):
 - 1) Short Primary Winding.
 - a) Linear Test – complete with linear profile through secondary winding.
 - c. Non-Linear Test.

- 1) Complete with non-linear profile through secondary windings.
 - 2) Measure Power.
2. Take data and graph efficiency per NEMA ST-20.
 - a. Graph-1 – Linear Loads 0 to 100 Percent Loads.
 - b. Graph 2 – Non-Linear Profile K-9 0 to 100 Percent loads.
 3. Test Plans measuring Power IN and Power Out will not be accepted since procedures are not covered by any standard.

1.04 WARRANTY

- A. Transformers shall be warranted to be free from defects in materials, fabrication and execution for a period of three years from the date of substantial completion.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Transformers manufactured by Siemens, Square D, General Electric, PowerSmiths, MGM, and Eaton or equal.
- B. There shall be no openings through which foreign objects such as sticks, rods, wires, or the like might enter and contact live parts. Provide means for padlocking compartment doors.
 - a. Connection terminal points shall be bottom fed and located as far as possible below vent openings, or below top connections.
 - b. Terminals shall be protected from external/foreign objects contact.

PART 3 - EXECUTION

3.01 DELIVERY AND STORAGE

- A. Deliver, storage, protect and handle products in accordance with the manufacturer's recommendations.

3.02 INSTALLATION

- A. Transformer core frame shall be installed level on shock absorbing pads within enclosure. Comply with seismic requirements of CBC.
- B. Mounting bolts on floor mounted transformers shall be extended into pads only and shall not be in direct contact with building structural members.
- C. Flexible jumpers shall be installed for grounding continuity from enclosure to conduits or bus ducts where required.
- D. Transformers installed outdoors or below grade shall be mounted on concrete pads as specified in Section 03 3000: Cast-In-Place Concrete.
- E. Install transformer ventilation openings not closer than 6 inches from wall surfaces.
- F. Do not install transformers in corrosive environments such as swimming pool pump and boiler rooms, or similar areas.

3.03 VOLTAGE CHECK

- A. Set taps on transformers to provide satisfactory operating voltages with present loads energized, including new loads and existing loads. A check shall be performed in the presence of the Project Inspector at a panel fed from each transformer, which is farthest from transformer. Voltages at transformers ranging from 118 to 122 volts inclusive, for 120 volt systems and proportionately equivalent for higher voltage systems are permitted.
- B. Provide instruments and accessories required to perform checks. Voltmeters shall be accurate within .075 percent or one percent and shall have scales permitting voltage readings to be performed on upper half of scale. Calibration of the meters shall be observed by the Project Inspector.
- C. Adjust transformer taps under full load operating conditions, to provide normal operating voltages at the loads.

3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.05 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off Project site.
- B. Repair scratched or marred surfaces affected during the execution of work. Repair surfaces shall match original finish.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Distribution switchboards.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 30 00: Cast-In-Place Concrete.
3. Section 26 05 00: Common Work Results for Electrical.
4. Section 26 05 13: Basic Electrical Materials and Methods.
5. Section 26 05 26: Grounding and Bonding.
6. Section 26 05 19: Low-Voltage Wires (600 Volt AC).
7. Division 27: Communications.
8. Division 28: Electronic Safety and Security.

1.02 SUBMITTALS

A. Provide in accordance with Division 01.

B. Shop Drawings:

1. Include a front elevation indicating dimensions and locations of equipment on switchboard, make, kind and size or capacity of equipment and bussing, location of each service conduit entering switchboard, barriers, nameplate inscriptions, finish, total weight and size of switchboard and locations and sizes of anchor bolts.
2. Submit short-circuit and coordination studies signed and stamped by a registered electrical engineer. Studies shall be in accordance with IEEE guidelines. Submit two copies of each study for review prior to ordering and installing equipment.
3. Provide coordination study for main and branch circuit protective devices including secondary protective devices for transformers. The circuit protective devices shall be set based on the coordination study. A final written record of protective device settings shall be submitted.
4. Provide installation detail and seismic anchorage notes for switchboards.

PART 2 - PRODUCTS

2.01 SWITCHBOARDS

- A. General Description: Switchboards shall be product of Square D or approved equal by Siemens, Eaton, or General Electric; and shall conform to the following requirements:
1. Complete assembly, including steel framing and covers, bus system, and breaker mounting, shall satisfy applicable provisions of UL 891 and NEMA PB-2 and the California Electrical Code for low-voltage distribution switchboards. Switchboards shall be furnished with UL labels.
 2. Switchboards shall be floor standing, dead front, dead rear, line bussed, front operated and connected, circuit-breaker type, unless otherwise indicated and shall contain equipment indicated and specified. Switchboard shall be complete with pull, service, and distribution sections as required.
 3. Required equipment shall be enclosed in fully interchangeable die formed steel sectional cabinets with top and bottom plates and required braces and gussets so that cabinets will be absolutely rigid, plumb and uniform in size. Each cabinet shall be a separate and independent unit with assembly holes die-stamped or jig drilled; openings for interconnections shall be so placed that cabinet can be located in any position in assembly without drilling or cutting holes on job. Deliver switchboard to Project site in completely assembled sections and provide required assembly bolts and blanking plates. Front plates and doors shall be of not less than 12 gage furniture steel, completely removable, secured to cabinet with machine screws, with cup washers uniformly and symmetrically spaced. Provide hinged wire gutter covers for distribution sections. Equipment shall meet NEMA and UL standards.
 4. Main circuit breaker or main fusible switch shall be as follows:
 - a. Main circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic with solid state trips, bolted to bus with frame size and trip ratings as indicated on drawings. Voltage, amperage ratings and number of poles shall be as indicated on breakers. Main breaker shall provide a minimum short-circuit interrupting capacity as indicated on the Drawings. Provide shunt-trip and integral ground fault devices, as indicated on drawings. All breakers shall be furnished with lockout provisions.
 - b. Main fusible switch 800 amps or larger ampacity shall be high pressure contact, stored energy, quick-make/quick-break operation, with current limiting fuses, as indicated on Drawings. Provide shunt-trip, and integral ground fault devices, as indicated on Drawings. Where required, switches shall be motor operated and be furnished with an electrical trip mechanism piloted by output of ground fault sensing circuitry. Switch shall be furnished with lockout provisions.
 5. Feeder circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic or solid state type bolted to bus, with handles clearly indicating tripped position. Breakers shall be furnished with a single handle with no tie-bar. Voltage, amperage, and number of poles shall be as indicated on Drawings. Breaker ratings shall be on handle or label. Breakers shall be furnished with lockout provisions approved by the State of California for padlocking and shall provide a minimum symmetrical short-circuit interrupting rating, as indicated on Drawings. Series rated circuit breaker combinations are not acceptable.

6. Fusible feeder switches shall be quick-make, quick-break, voltage rating and number of poles as indicated on Drawings, with visible blades and dual horsepower ratings. Switch handles shall physically indicate on and off positions. Switches shall be lockable only in off position and accept three industrial type heavy-duty padlocks. Switch covers and handles shall be interlocked to prevent opening in on position. Provide means to permit authorized personnel to release interlock for inspection purposes. Switches shall be equipped with Class R current limiting fuses or dual element fuse of size and capacity indicated on Drawings.
7. Provide switchboard with silver-plated copper bus bars of same capacity as main breaker, or as indicated on Drawings, between current transformer and main section and distribution sections; also, full height of breaker space in distribution portions. Copper bus shall have current density of 1000A per square inch of cross section. Bus structure shall be free-fitted and shall have sufficient strength to withstand short-circuit as indicated on drawings. Connections shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices. Bus bar bracing shall be designed to withstand maximum available short-circuit current. Connections for cables to circuit breakers, switches and motor control devices shall be heavy-duty mechanical pressure type terminal lugs. Provide service cable lugs as required for incoming feeder from Main Switchboard. Cables and internal wiring shall be supported with suitable cleats.
8. Switchboard distribution sections shall be furnished with full height bussing. Unused spaces shall be provided with blank covers. Switchboards, as complete units, shall be given single short-circuit current ratings by manufacturer. Such ratings shall be established by actual tests by manufacturer, in accordance with UL specifications, on equipment constructed similarly to the furnished switchboard.
9. Provide a large nameplate identifying switchboard, indicating service voltage, originating power source, function and current rating. Nameplate shall be furnished with 3/16-inch engraved black letters on white background. Nameplate shall be mechanically fastened to switchboard.
10. Provide labels for circuit breakers, disconnect switches, and or other disconnecting means in switchboards. Labels shall be a P-Touch type or equal, with a minimum width of 3/8 inch with black letters on white background. Label shall indicate name of load served, name or room number and if in different building, name of building. If equipment is installed in same room as source, label should indicate source name and "in this room".
11. Paint cabinets, framework and plates inside and out with one coat of rust-resistant metal primer and one coat of gray enamel, baked on, or lacquer sprayed on.
12. Manufacture boards according to reviewed Shop Drawings. Switchboard shall meet requirements of legally constituted authorities having jurisdiction, and respective serving utility.
13. Switchboards installed outdoors shall be weatherproof NEMA Type 3R enclosure. Enclosure construction shall be formed of code gage galvanized steel with ANSI No. 61 gray enamel finish. Heavy-duty, three-point latching, vault type door handles with padlocking provisions shall be furnished on doors. Padlocks shall be furnished keyed to Corbin No. 60 keys. Switchboards installed outdoors shall be specifically required to maintain service during extreme outdoor ambient temperatures of a minimum of 150 degrees Fahrenheit in NEMA Type 3R enclosures.

14. For grounded wye electrical service switchboards rated more than 150 volts, to ground and 1,000 amperes or more, provide ground fault protection for main protective device. Ground fault protection shall be UL listed, with ground sensor encircling phase conductors and neutral conductors integral with the main protective device. Provide testing of ground fault protection system by an independent recognized testing laboratory. Testing lab shall provide necessary testing equipment at the Project site and perform a certified test on ground protection system in presence of the Project Inspector. The ground fault setting shall be selected to coordinate with downstream circuit protective devices. Verify that the system neutral is grounded at the service entrance switchboard only, except neutrals of step-down distribution transformers. For branch circuit protective devices, rated 800 amps or more, provide ground fault protection where shown on the drawings, or as described above, for main protective device. Coordinate settings with main protective device ground fault protection.
15. In main and distribution switchboards provide a multifunctional digital meter with true RMS measured Amperes (each phase and neutral) Volts (line-to-line and line-to-neutral), Power Factor, Frequency, VA, VAR, Watts, KWH, KVARH, KVAH, voltage/current unbalance, and demand metering: W, VAR, Amperes, VA. Meter to have a front mounted RS232 port to allow programming and meter values via laptop computer and supplied software. The meter shall be GE Multiline PQM with BACnet translator capabilities; equal or better meters will be acceptable with District's approval only. Contractor shall supply the metering software and electronic key to owner.
 - a. The equipment meters shall be capable of communicating via the protocol used by the EMS system on the site.
16. Connections to bussing shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Switchboard locations shall provide sufficient working space around the switchboard to comply with the California Electrical Code.
- B. Switchboards shall be securely fastened to the mounting surface.
- C. Switchboard cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
- D. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
- E. Lugs shall be suitable and as required for installation with the conductor being connected.
- F. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- G. Maintain the required bending radius of conductors inside the cabinet.
- H. Distribute and arrange conductors neatly in the wiring gutters.

- I. Tightening the wire lugs or conductor connections shall be performed in the presence of the Project Inspector. Torque values shall be those recommended by manufacturer.
- J. Remove shipping blocks from component devices.
- K. Manually exercise circuit breakers to verify they operate freely.
- L. Remove debris from switchboard interior.
- M. Follow manufacturer's instructions for installation.
- N. Furnish one spare fuse for each fusible switch installed. Spare fuses shall be of the same type and rated as those installed.
- O. Do not install in highly corrosive environments such as pool equipment, boiler, chemical and corrosive materials storage rooms, and similar areas. When equipment is installed in such areas, it shall be labeled and listed for the application.
- P. Switchboard equipment and system components shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of bolted electrical connections, and perform insulation resistance tests on each bus section, phase-to-phase and phase-to-ground for one minute in accordance with requirements stated in NETA-ATS 2007 table 100.1. Test shall be performed in the following manner:
 - 1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of bussing, circuit breakers and/or fused switches. The fused switches shall be equipped with fuses or temporary jumpers in place of fuses. Breaker and fused switches shall be tested in the closed position. No wiring shall be connected to the line or load side of the switchgear during testing.
 - a. Provide calibration program records to assure the testing instruments to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).
 - b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
 - c. Test reports shall include the following:
 - 1) Identification of the testing organization.
 - 2) Equipment identification.
 - 3) Ambient conditions.
 - 4) Identification of the testing technician.
 - 5) Summary of project.
 - 6) Description of equipment being tested.
 - 7) Description of tests.

- 8) Test results.
- 9) Analysis, interpretation and recommendations.

1. Perform tests in the presence of the Project Inspector.
2. During testing, provisions shall be made to prevent damage to solid state components, or electronic equipment such as TVSS equipment that may be tied onto switchboard bussing.
3. Test results shall meet manufacturer's recommendations or NETA ATS- 2007 recommendations, whichever is more stringent.

3.02 PADS AND ANCHORING

- A. Where free-standing equipment is installed at exterior locations or in locations below grade, concrete pads shall be provided as specified in Section 03 3000: Cast-In-Place Concrete. Interior locations at or above grade do not require a housekeeping pad.
- B. Concrete pad shall extend 42" from face of switchboard door or board, whichever is greater.
- C. Anchor bolts for freestanding equipment shall meet CBC Seismic design requirements, and manufacturer's installation recommendations. The more stringent requirements will be enforced.

3.03 PROJECT RECORD DOCUMENTS

- A. Provide project record drawings of switchboards as installed, indicating main and branch circuit ratings, circuit numbers and part numbers.
- B. For ground fault relays and sensors, the following information shall be provided:
 1. Certified Calibration and Acceptance Test.
 2. Installation Instructions.
 3. Operating Instructions.
 4. Maintenance Instructions.
 5. Replacement Parts List.
 6. Final Test Report.
- C. Test information shall be submitted to the Architect.

3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.05 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION

SECTION 26 24 16

PANELBOARDS AND SIGNAL TERMINAL CABINETS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Lighting and power distribution facilities, including panelboards.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 5. Section 26 5000: Lighting.
 - 6. Division 27: Communications.
 - 7. Division 28: Electronic Safety and Security.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Shop Drawings: Include a front elevation indicating cabinet dimensions, make, location and capacity of equipment, size of gutters, type of mounting, finish, and catalog number of locks. General layout of internal devices, wiring drawings with wire numbers and device connections, vendor cut sheets of devices in enclosure and bill of materials listing description, manufacturer, part number, and quantity of items shall be included.
- C. Installation Instructions: Submit manufacturer's written installation instructions.

1.03 DESIGN REQUIREMENTS

- A. Panelboards:
 - 1. Panelboards shall be wall-mounted, enclosed safety type with 120/240-volt, three-wire, solid neutral; 277/480-volt, four-wire, solid neutral; or 120/208-volt, four-wire solid neutral, with mains as indicated on Drawings or specified. First panelboard of each building shall be provided with main or sub-feeder circuit breakers where so indicated.
 - 2. Single pole branches shall be molded case, thermal magnetic circuit breakers with inverse time delay, trip free, quick-make, quick-break mechanism and silver alloy contacts. Circuit breakers shall be fully rated, with ampere rating marked on handle and shall indicate on/off and tripped positions. Ground fault interrupters shall be incorporated into circuit breakers where indicated. They shall be listed by UL, or other NRTL as ground fault devices. Provide appropriate lug kit of sufficient size to accommodate the feeders.

3. Two- and three-pole branches shall be enclosed and shall be thermal magnetic circuit breakers with inverse time delay, tamper-proof, ambient compensated, single handle, internal common trip, and quick-make, quick-break mechanism with silver alloy contacts. Circuit breakers shall be fully rated or as otherwise indicated on the Drawings.
4. Main and subfeeder circuit breakers shall be enclosed, thermal magnetic type with inverse time delay, single handle common trip, quick-make, quick-break mechanism, corrosion-resistant bearings and silver alloy contacts. Ampere frame size and trip rating shall be as indicated on Drawings. Breakers over 225-amperes shall be furnished with interchangeable trip units. Handles of main and subfeeder circuit breakers shall be provided cabinet door. Voltage rating shall be as indicated on Drawings.
5. Circuit breakers shall be fully rated and of one-piece, bolt-on type and shall meet short-circuit interrupting capacity requirements indicated on Drawings. Series rated circuit breaker combinations are not acceptable.
6. Internal connections shall be fabricated with plated copper bus bars and the busses shall extend for full length of space available for branch circuit breakers. Feeder cable connectors shall be installed at point of feeder entrance. Terminals shall be furnished with copper conductors. Panelboards fed by conductors having over-current protection greater than 200 amperes shall be protected on supply side by over-current devices having a rating not greater than that of panelboards. Copper bussing shall be fully rated. Heat rated bussing is not acceptable.
7. Except where otherwise indicated, circuit breakers shall be in two vertical rows connected to bus bars in a distributed phase arrangement. Two-pole branches shall be balanced on busses. Single pole branches shall be numbered adjacent to its circuit breaker, with odd numbers on left and even numbers on right.
8. Specified circuit breaker spaces shall be furnished with hardware required for future installation of circuit breakers.
9. Provide locking devices for individual circuit breakers. Padlocking devices shall be secured to circuit breakers and by panel dead front plates.
10. Panelboards shall be complete with 200 percent rated copper neutral bus, ground bus and isolated ground bus in addition to requirements of this section.

C. Panelboard Cabinets:

1. Panelboard cabinets shall be code gage galvanized steel or blue steel; fronts, doors, and trims shall be code gage furniture steel. Cabinets shall be furnished with at least six-inch high gutters at top and bottom where feeder cable size exceeds four gage or where feeder cable passes through cabinet vertically. Cabinets shall be furnished with top and bottom gutters sized as required by inspection department having jurisdiction, but never less than six inches where more than one feeder enters top or bottom of cabinets. Side gutters shall not be less than four inches wide. Width of cabinets shall be 20 inches, unless otherwise indicated on Drawings.
2. Doors shall be cut true, shall accurately fit opening and finish smooth across joints. Rabbets shall be inside. Hinges shall be entirely concealed except for barrels and pins. Hinge flanges shall be welded to door and trim. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors, keyed to NLMUSD Standards.

3. Where contactors, time switches, and control devices are specified or indicated to be installed within panelboard cabinets, a separate compartment and door shall be provided at top of cabinet for such devices. Door shall be sized as required to permit removal of contactor and other devices intact. Gutters shall be provided at sides and top of compartment. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors keyed to NLMUSD Standards.
 4. Provide and install panelboard manufacturer's permanent circuit number kit option.
 5. Panelboards with control devices in compartment shall arrive at the Project site completely assembled with control devices installed and wired.
 6. Outdoor cabinets shall be NEMA Type 3R. Construction shall be formed from code gage galvanized steel with ANSI No. 61 gray enamel finish. Provide heavy-duty, three-point latching, vault type door handles with padlocking provisions. Provide stainless steel or galvanized butt hinges on doors. Padlocks shall be furnished, keyed to NLMUSD Standards.
 7. Self-tapping screws and bolts not permitted.
- D. Panelboard Schedule: Provide a neatly typewritten schedule with number or name of room or area, or load served by each panelboard circuit. Room numbers or names shall be determined at the Project site and shall not necessarily be those indicated on the Drawings. Schedule shall also indicate panel designation, voltage and phase, building and distribution panel or switchboard from which it is fed. Schedule shall be installed in a frame under transparent plastic 1/32-inch-thick on inside of each panelboard cabinet door.
- E. Panelboard nameplate: Provide a nameplate identifying panelboard. Plates shall be black and white plastic nameplate stock, with character cut through black exposing white and shall bare designation of service. Name plate shall be mechanically fastened to switchboard.
- F. Provide additional labeling on dead-front of panelboard. Label shall be a P-Touch or equal with a minimum width of 3/8 inch with black letters on white background. Label shall re-identify panelboard and also identify name and location of power source feeding this panel. Location information shall include building name if located in different building and name or room location. If power source is installed in same room, label should indicate source name and "In this Room"
- G. Panelboard Standards: Panelboards shall be UL, or other NRTL listed and labeled. Panelboards shall meet latest revisions of following standards:
1. California Electric Code, Article 384.
 2. UL 67, Panelboards.
 3. UL 50, Cabinets and Boxes.
 4. UL 943, GFCI.
 5. UL 489, Molded Case Circuit Breakers.
 6. NEMA PB1.
 7. Federal Specifications W-P- 115C and WC-375B.

H. Signal Terminal Cabinets:

1. Signal terminal cabinets shall conform to the Specifications for panelboard cabinets, except as modified herein.
2. Terminal cabinets shall be flush type, with two-inch trim or surface mounted type, as indicated on Drawings. Terminal cabinets shall be furnished with sections and barriers to separate each system. Sections over 24 inches in width shall be provided with double doors and locks. Terminal cabinets, or sections of terminals housing separate systems, shall measure 12 inches long by 18 inches high by 5 ¾-inch deep, unless otherwise indicated on Drawings. Trims for sectional cabinets shall be of one-piece construction.
3. Terminal cabinets shall be furnished with ¾ inch thick plywood. Plywood shall be fastened in place with machine screws or factory installed mounting screws.
4. Flush-mounted terminal cabinets shall be finished as specified for flush-mounted panelboard cabinets. Surface and semi-flush mounted terminal cabinets shall be finished as specified for surface-mounted panelboard cabinets.
5. Outdoor terminal cabinets shall be NEMA Type 3R. Construction shall be formed from code gage galvanized steel with ANSI No. 61 gray enamel finish. Provide heavy-duty, three-point latching, vault type door handles with padlocking provisions. Provide stainless steel or galvanized butt hinges on doors. Padlocks shall be furnished, keyed to NLMUSD Standards.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Panelboards and terminal cabinets shall be manufactured by Square D or approved equal by Siemens, Eaton, or General Electric.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Panelboards and terminal cabinets shall be located so they are readily accessible and not exposed to physical damage.
- B. Panelboards and terminal cabinets installed outdoors shall be specifically listed for wet locations and shall be weatherproof in NEMA Type 3R cabinets.
- C. Panelboard and terminal cabinet locations shall provide sufficient working space around panels to comply with the California Electrical Code.
- D. Panelboards and terminal cabinets shall be securely fastened to structure and mounted on surface by at least four points.
- E. Unused openings in cabinets shall be effectively closed as required by the manufacturer.
- F. Cabinets shall be grounded as specified in Article 250 of the California Electrical Code.

- G. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
- H. Lugs shall be suitable and listed for installation with the conductor being connected.
- I. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- J. Maintain the required bending radius of conductors inside the cabinet.
- K. Clean the cabinet of foreign material such as cement, plaster, and paint.
- L. Distribute and arrange conductors neatly in the wiring gutters.
- M. Use the manufacturer's torque values to tighten lugs.
- N. Before energizing panelboards, the following steps shall be taken:
 - 1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been provided.
 - 2. Remove shipping blocks from component devices and panelboard interiors.
 - 3. Manually exercise circuit breakers to verify they operate freely.
 - 4. Remove debris from panelboard interior.
- O. Follow manufacturer's instructions for installation.
- P. Do not install in highly corrosive environments, unless rated for the application.

3.02 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.03 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 50 10

LIGHTING

1.01 PART 1 - GENERAL

1.02 SUMMARY

- A. Section Includes: LED Luminaires, LED modules, drivers, wiring, and lighting controls.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 05 00: Common Work Results for Electrical.
 - 3. Section 26 05 13: Basic Electrical Materials and Methods.
 - 4. Section 26 05 26: Grounding and Bonding.
 - 5. Section 26 05 19: Low-Voltage Wires (<600 Volt AC).
 - 6. Section 26 52 00: Emergency Power Systems.
 - 7. Division 32 - Site Concrete Work.

1.03 REFERENCES

- A. American National Standards Institute/American National Standard Lighting Group ANSI/ANSI/SLG – C78.377-2008 Specifications for the Chromaticity of Solid State Lighting Products.
- B. American National Standards Institute/American National Standard Lighting Group ANSI/ANSI/SLG – C82.77-2002 Harmonics Emission Limits.
- C. Federal Communication Commission (FCC) 47 CFR Part 15 – Radio Frequency Devices.
- D. Illuminating Engineering Society of North America (IESNA) LM-79-, LM-80-15, and TM-21.
- E. National Electrical Manufacturers Association (NEMA) SSL-1-2010 Electronic Drivers for LED Devices, Arrays, or Systems.
- F. SSL-3-2010 Solid State Lighting High Power LED Binning for General Illumination.
- G. National Fire Protection Association (NFPA) NEC-70-2011
- H. Underwriters Laboratories (UL) 8750-Light Emitting Diode (LED) Equipment for Use in Lighting Products.
- I. Underwriters Laboratories (UL) 1598C- Light Emitting Diode (LED) Retrofit Luminaire Conversion Kits.

1.04 SUBMITTALS

- A. List of Materials: Submit a complete list of proposed materials.
- B. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of sockets, size of lamps, and complete details of method of fitting suspension and fastening luminaires in place. Provide wiring diagrams for lighting control equipment. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
- C. Prior to start of construction; provide photometric calculations with graphic of lighting foot-candle levels at work plane, ceiling and walls. Calculations shall comply with IESNA recommendations.
- D. Installation Instructions: Submit manufacturer's written installation instructions for luminaires and accessories.

1.05 SUBSTITUTIONS

- A. Luminaires that deviate from these requirements shall not be accepted without written approval from the District Representative. When deviating or substituting luminaires, the following information shall be submitted:
 - 1. Substitution request form substantiating reasons and benefits to OWNER.
 - 2. OWNER'S approval shall be obtained for any equipment or materials substitutions.
 - 3. Submit a completed luminaires evaluation form with supporting documentation for any and all fixtures' performance claims.
- B. Substitutions: Submittals must comply with contract general provisions.

1.06 QUALITY ASSURANCE

- A. Design of lighting luminaires, accessories, supports, and method of luminaire installation shall comply with requirements for earthquake-resistant construction of the State of California.
- B. Provide suspension points at no more than two feet from luminaire ends. Spacing between supports shall not exceed eight feet.
- C. Components and luminaires shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes, including those mentioned under Article 1.03 – References.

1.07 WARRANTY

- A. Provide the following warranties:
 - 1. One-year labor warranty.
 - 2. Material warranty:
 - a. LED modules: five years minimum.
 - b. Drivers: five years minimum.
 - c. Lighting Pole (Standards): five year minimum.

- B. Warranty period shall begin at substantial completion or at project acceptance for beneficial occupancy, whichever occurs first.
- C. CONTRACTOR shall warranty Luminaires, including drivers, LED modules and ancillary components via a single warranty source. Multiple warranty sources are not acceptable.

PART 2 - PRODUCTS

2.01 MATERIAL AND FABRICATION

- A. Luminaires of same type shall be of one manufacturer.
- B. Manufacturer and model number references are indicated as a standard of performance and quality; other manufacturers' models may be submitted for review, provided the product meets or exceeds the product's specified requirements.
- C. Conductors that pass over edges or through metal opening(s) shall be secured from contacting the edges and be protected from cutting and abrasion. This requirement shall be met through one of the following:
 - 1. Rolling the edge of the metal not less than 120 degrees.
 - 2. A bushing or grommet of a material other than rubber at least 1.2 mm (0.047") thick.
 - 3. Glass sleeving at least 0.025 mm (0.010") thick.
- D. Lighting luminaires shall meet the following requirements:
 - 1. Industry standards as indicated under Article 1.03.
 - 2. Luminaire shall be from a manufacturer who has been in the business of manufacturing LED lighting luminaires for interior and exterior applications for a minimum of 5 years.
 - 3. Luminaires shall comply with the California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act or be in compliance with the European Restriction of Hazardous Substances (RoHS), whichever is more stringent.
 - 4. Luminaires shall be baked-on enamel or powder-coated, unless otherwise specified in this section.
 - 5. The luminaire(s) lens, including end caps shall be 0.187 nominal thickness.
 - 6. Drivers shall be easily accessible without the use of special tools.
 - 7. Wiring cavity shall be field accessible for service or repairs.
 - 8. Luminaires shall be capable of being operated by standard motion/ vacancy sensors, daylight sensors, and dimmers.
 - 9. Luminaires shall be provided with a manufacturer's stencil or permanent legible sticker that states manufacturer business information and date of delivery.
 - 10. Temperature rating; -20 degrees Celsius minimum starting temperature. Luminaire accessories including LEDs and drivers shall be able to withstand temperatures in excess of 110 Fahrenheit degrees.

11. Color Rendering Index (CRI):
 - 1) Interior Applications: +82 CRI.
 - 2) Exterior Applications: +70 CRI
12. Power factor: Greater than 0.9 at 120V and 277V.
13. Total Harmonic Distortion: Less than 20% at 120V and 277V.
14. Color Correlated Temperature: 4000K minimum $\pm$ 275K degrees.
15. LED's and driver's life expectancy: 50,000 minimum projected hours at 6,000 hours testing for both LEDs and drivers.
16. Luminaires in contact with insulation materials shall be IC rated.

2.02 DRIVERS and LED MODULES

A. Drivers:

1. Approved Driver Manufacturers:
 - a. Osram – Optotronic.
 - b. Philips – Advance and Xitanium.
 - c. Universal Lighting Technologies – Everline.
 - d. General Electric – Ligttech.
 - e. Thomas Research Products
 - f. Kenall – Low Profile LED Driver
 - g. EldoLED
 - h. Equal. Only if approved by the District Representative through a deviation request.
2. Driver Type and Characteristics:
 - a. Comply with the state of California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act, or be RoHS compliant, whichever is more stringent.
 - b. Dimming for 0-10-volt DC control circuits. Drivers shall be specifically compatible with the lighting control system being provided.
 - c. Comply with applicable state, federal, and industry standards listed under References article.
 - d. Wattage as stated in Luminaire's LM-79 test report.
 - e. Driver performance requirements:

DRIVERS PERFORMANCE CHARACTERISTICS		
No.	Characteristic	Minimum Requirements
1	Input Voltage range	120V, 277V
2	Input Overvoltage	320-VAC for 48 hours, 350-VAC for 2 hours.
3	Frequency	50/60 Hz Nominal
4	Power factor	+0.95 Minimum
5	Inrush Current	Less than 30 amps @ 120V Less than 70A @ 277V
6	Input Current Range	54A @ 120V, 23A @ 277V
7	Output Current	1670 mA Maximum
8	Maximum Power	65 Watts
9	Total Harmonic Distortion	Less than 20%
10	Leakage Current	Less than 500 mA
11	Output Protection	Short and Open Circuit Protection
12	Maximum Case Temperature	90 ⁰ C
13	Minimum Starting Temperature	-20 ⁰ C
14	Storage Temperature	No less than 70 ⁰ C
15	Humidity	Rated for dry and damp
16	Cooling	Convection
17	Sound Rating	Class A
18	Life Expectancy	>50,000 hours at +50 ⁰ C
19	Dimming, Motion Sensors and Daylight Sensors Controllability	0-10V

B. LEDs:

1. Approved Manufacturers:

- a. General Electric.
- b. Philips.
- c. NICHIA
- d. Samsung LED Co.

- e. CREE
 - f. Equal. With OWNER's approval.
2. LEDs Characteristics:
- a. Color Correlated Temperature (CCT):
 - 1) Chromaticity target Duv and tolerance 0.001 plus/minus 0.006.
 - 2) Nominal CCT for 4000K, target CCT 3985K $\pm$ 275K.
 - 3) CCT measurements in compliance with ANSI C78.377-2008.
 - b. Lumen Maintenance: Greater than 90% at 500 C degrees.
 - c. LEDs must be from same manufacturer and batch.
 - d. TM-21 and LM-80 reported hours of no less than 50,000 with a minimum of 6000 hours testing.
 - e. LM-79 reported CCT and CRI in compliance with articles 2.01.D.11 and 14.

2.03 LUMINAIRES

- A. Refer to LIGHTING FIXTURE SCHEDULE on the Drawings for list of approved luminaires.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install a lighting luminaire for each lighting outlet indicated and label with day of installation.
- B. Luminaire voltage shall be as indicated on Drawings.
- C. Install recessed and surface-mounted luminaires, with plaster frames compatible with ceiling and wall systems employed; secure luminaires mechanically to frames.
- D. Align rows of suspended and surface-mounted luminaires to form straight lines at uniform elevations.
- E. Recessed luminaires shall fit snugly against ceilings to prevent light leakage.
- F. Luminaire installations shall comply with CBC Seismic requirements
- G. Support suspended recessed luminaires in T-bar ceilings as follows: Luminaires shall be attached to ceiling grid to resist a horizontal force equal to weight of luminaires. For heavy-duty grid systems, luminaires weighing less than 56 pounds must also have two 12 gage slack safety wires from diagonal corners to the structure above; luminaires weighing more than 56 pounds shall be independently supported by not less than four taut 12 gage wires capable of supporting four times the load. For intermediate duty grid systems, luminaires shall be independently supported by not less than four taut 12 gage wires capable of supporting four times the load. Luminaire hanger wire ends shall be twisted three tight turns within a 1 ½ -inch distance. Provide positive point of attachment to T-bar ceiling with four, #8 wafer head tek screws (one at each corner), avoiding conflict with operation of the lens. Luminaire installation shall be coordinated with acoustical ceiling installation.

- H. Emergency light luminaires shall be labeled "Emergency Luminaire" with one inch high letters produced with a P-touch or similar labeling system.
- I. Continuous suspended luminaires:
 - 1. Luminaire suspension device shall allow vertical adjustment of luminaire without the use of tools. Cable shall be minimum seven strand twisted stainless steel capable of supporting minimum four times the luminaire weight. For continuous linear suspended luminaires longer than eight feet, provide not less than three suspension points.
 - 2. Top of luminaire shall be suspended as shown on the Drawings, typically 24 inches below the ceiling and a minimum of 18 inches from the ceiling.
 - 3. Luminaire shall utilize factory furnished or approved hardware and canopy for either hard or T-bar ceilings.
- J. Surface mount luminaires shall be attached to structure. Toggle bolts are NOT permitted. Provide backing where required.
- K. Low level exit signs shall be installed with the bottom of the sign not less than six inches, or more than eight inches above the floor level and shall indicate the path of exit travel. For exit and exit-access doors, the sign shall be on the door or adjacent to the door with the closest edge of the sign within four inches of the door frame.

3.02 TESTING

- A. Check and adjust luminaires for required illumination.
- B. Replace defective LED strips and drivers.
- C. Test and adjust lighting control equipment for proper operation.

3.03 SPARE PARTS

- A. Furnish ten percent spare LED strips with a minimum of one spare strip of each type.
- B. Furnish ten percent spare motion detectors of each type with a minimum of one spare detector of each type.
- C. Furnish ten percent spare drivers of each type with a minimum one spare driver of each type.

3.04 HAZARDOUS WASTE DISPOSAL

- A. Hazardous waste disposals shall be handled and disposed of by an approved, licensed contractor.
- B. Products with PCBs are not acceptable. Hazardous waste shall be placed in appropriate containers provided by hazardous waste contractor labeled clearly with:
 - 1. Project Name
 - 2. Quantity of materials
 - 3. Date materials became waste
- C. Store, remove, transport and dispose of hazardous materials in accordance with state and federal regulations.

- D. Provide Owner with copy of manifest and certificate of destruction.

3.05 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.06 CLEANUP

- A. Remove rubbish, debris, and waste materials from all areas of work each day.
- B. Clean luminaire surfaces of dirt, cement, plaster and debris. Furnish cleansers compatible with material surfaces being cleaned.

END OF SECTION

SECTION 26 52 00

EMERGENCY POWER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Emergency system for emergency lighting, signal systems, and electrical loads – as indicated on the Drawings.
- B. This specification defines the electrical and mechanical characteristics and requirements for a stand-by, three-phase, solid-state uninterruptible power supply, hereafter referred to as the CIS (Central Inverter System). The CIS shall provide high quality, computer grade AC power for today's electronic lighting loads (power factor corrected and self-ballast fluorescent, incandescent, quartz re-strike and halogen, HID and LED) during emergency backup.
- C. The CIS shall incorporate a high frequency pulse width modulated (PWM) inverter utilizing IGBT technology, a microprocessor-controlled inverter and a temperature compensating battery charger, a user-friendly control panel with audible and visual alarms.
- D. Related Requirements:
 - 1. Section 26 05 13: Basic Electrical Materials and Methods.

1.2 DEFINITIONS

- A. CIS: Central Inverter System.

1.3 DESIGN REQUIREMENTS

- A. Emergency systems shall be supplied from storage batteries with charging unit with a minimum of 90 minutes back-up capacity for lighting and power systems by the furnishing of an CIS. Systems shall be installed in accordance with requirements of all codes and regulations.
- B. The CIS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall supersede.
 - 1. UL 924 Standard for Emergency Lighting and Power Equipment
 - 2. ANSI C62.41 (IEEE 587)
 - 3. ANSI C62.42.45 (Cat. A & B)
 - 4. National Electrical Code NFPA-70
 - 5. Life Safety Code NFPA-101
 - 6. OSHA

1.4 SYSTEM DESCRIPTION

- A. Design Requirements - Electronics Module
 - 1. Nominal Input / Output Voltage

The input and output voltage of the CIS shall be pre-configured to match the user specified input and load requirements. Available voltages are 120/208 or 277/480 VAC.

Input: 277/480 VAC, 3-phase, 4-wire-plus-ground

Output: 277/480 VAC, 3-phase, 4-wire-plus-ground

- B. Output Load Capacity Rating: 10 kW / kVA – or as noted on the Drawings
1. The output load capacity of the CIS shall be rated in kVA at unity power factor. The CIS shall be able to supply the rated kW from .5 lagging to .5 leading.
- C. Design Requirement - Battery System
1. Battery Cells
 - a. The CIS shall be provided with sealed, valve regulated lead acid batteries.
 2. Reserve Time
 - a. The battery system shall be sized to provide the necessary reserve time to feed the inverter in case of a mains failure.
 - b. Battery reserve time: 90 minutes (minimum)
 3. Recharge Time
 - a. The battery charger shall recharge the fully discharged batteries within a 24-hour period. The charger shall be an integrated 3-step with equalize, microprocessor controlled and temperature compensating.
 4. Modes of Operation
 - a. The CIS shall be designed to operate with less than a 2-millisecond (no break) transfer time:
 - b. Normal
 - 1) The CIS Inverter is normally off and the commercial AC power continuously supplies the critical load. The input converter (bi-directional transformer) derives power from the commercial AC power source and supplies to the inverter while simultaneously providing floating charge to the batteries.
 - c. Emergency
 - 1) Upon failure of the commercial AC power the inverter instantaneously, with a maximum of a 2-millisecond break, switches its power supply from the input converter to the battery system. There shall be no loss of power to the critical load upon failure or restoration of the utility source.
 - d. Recharge
 - 1) Upon restoration of commercial AC power after a power outage, the input converter shall automatically restart and start charging the

batteries. The critical loads are powered by the commercial AC power again.

D. Performance Requirements

1. AC Input to CIS

- a. Voltage Configuration for Standard Units: 3-phase, 4-wire-plus-ground.
- b. Voltage Range: (+10%, -15%)
- c. Frequency: 60 Hz (+/- 3%)
- d. System short circuit rating: UL listed for 65kAIC, RMS symmetrical
- e. Power Factor: .5 leading/lagging
- f. Inrush Current: 1.25 times nominal input current, 10 times 1 line cycle for incandescent loads
- g. Current Limit: 125% of nominal input current
- h. Current Distortion: Less than 3% THD maximum from 50% to full load
- i. Surge Protection: Sustains input surges without damage per standards set in UL924

2. AC Output, CIS Inverter

- a. Voltage Configuration for Standard Units: 3-phase, 3 or 4-wire-plus-ground
- b. Static Voltage Stability: Load current changes +/- 2%
- c. Dynamic Voltage Stability: +/- 2% (25% step load), +/- 3% (50% step load)
- d. Dynamic Recovery Time to within 1% of nominal: 3Hz (0-100% load step)
- e. Output Harmonic Distortion: < 3% (with linear load)
- f. Frequency: 60 Hz (+/- .05Hz during emergency mode)
- g. Load Power Factor Range: 0.5 lagging to 0.5 leading
- h. Output Power Rating: kVA = kW
- i. Overload Capability: to 100% continuous rating
to 115% for 5 minutes
to 125% for 12 line cycles
- j. Crest Factor: <= 2.8

E. ENVIRONMENTAL CONDITIONS

1. The CIS shall be capable to operate within the specified design and performance criteria provided that the following environmental conditions are met:
 - a. Storage/Transport Temperature:
 - 1) -4° to 158°F (-20° to 70°C) without batteries
 - 2) 0° to 104°F (-18° to 40°C) with batteries
 - 3) Maximum recommended storage temperature for batteries is 25°C for up to six months. Storage at up to 40°C is acceptable for a maximum of three months.
 - b. Relative Humidity: 0 to 95% non-condensing
 - c. Altitude:
 - 1) Operating: to 10,000 ft. (3,000 m) above sea level (De-rated 5% per km above 3 km)
 - 2) Storage/Transport: to 40,000 ft. (12.2 km) above sea level
 - d. Audible Noise: 45 dBA @ 1 meter from surface of the CIS on emergency

1.5 SUBMITTALS

- A. Submit a materials list for this system with catalog cuts, technical data and manufacturer's specifications of all system components including batteries. With submittal, include evidence furnished batteries provide a true 10-year life by furnishing a copy of a test performed by a recognized test laboratory according to Bellcore TR-766.
- B. Submittals shall include the following:
 1. System configuration with single-line diagrams
 2. Functional relationship of equipment including weights dimensions and heat dissipation
 3. Descriptions of equipment to be furnished, including deviations from these specifications
 4. Size and weight of units to be handled by installing contractor
 5. Detailed layouts of customer power and control connections
 6. Detailed installation drawings including all terminal locations
 7. One set of instruction manuals. Manuals shall include a functional description of the equipment, installation, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

1.6 QUALITY ASSURANCE

- A. The manufacturer shall have been producing inverter system equipment for at least ten consecutive years.
- B. Systems shall undergo full load burn-in testing at the factory.

- C. Systems shall be listed by UL, or another Nationally Recognized Testing Laboratory (NRTL).
- D. A manufacturer's technical representative shall be available for system start-up, warranty work, and service calls.

1.7 WARRANTY

- A. Central Inverter Module: The inverter manufacturer shall warrant the CIS module against defects in materials and workmanship for 24 months after initial start-up.
- B. Battery: The battery manufacturer's standard warranty shall be passed through to the end user. Sealed Lead Calcium VRLA, 10-year life expectancy one-year full replacement warranty plus an additional nine years pro-rata.
- C. Installer shall provide a two-year labor warranty.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. CIS:

1. FABRICATION: All materials of the CIS shall be new, of current manufacture, high grade, free from all defects and shall not have been in prior service except as required during factory testing.
 - a. The CIS module shall be housed in a single freestanding NEMA type 1 enclosure. Battery cabinets are designed to allow stacking to minimize the overall system's footprint. Front access only shall be required for installation, adjustments and expedient servicing (MTTR: < 15 minutes). All components shall have a modular design and quick disconnect means to facilitate field service.
 - b. The CIS shall be painted with a powder coat finish in the manufacturer's standard color. The inverter shall be constructed of replaceable subassemblies. Like assemblies and like components shall be interchangeable.
 - c. Cooling of the CIS shall be forced-air in emergency mode with internally mounted fans to minimize audible noise. Fans shall not operate in the battery charge / standby mode. Fan power shall be provided by the inverter. Maximum acoustical noise on emergency at one meter from the cabinet surface shall be no greater than 50 dBA.
2. COMPONENTS: The CIS shall be comprised of the following components:
 - a. CIS Module - The inverter module shall contain an inverter, an AC distribution panel with an input circuit breaker, backfeed relay, control, and monitoring subsystems.
 - b. Battery Module - The battery module shall contain the battery plant required to produce the reserve energy to supply the inverter during abnormal AC mains conditions. The battery module may be contained in an external cabinet(s) depending on the system VA.

c. Battery Charger

- 1) General: In the standard configuration the charger converts AC voltage to DC voltage. With commercial power present, the inverter power transformer is powered and the IGBT modules are microprocessor controlled to recharge the batteries. The temperature compensated battery charger circuit supplies constant voltage and constant current to the batteries. Once the batteries have received a full recharge, a constant trickle charge maintains batteries at maximum level. Recharge time is 24 hours maximum at nominal AC input voltage. The AC ripple current of the DC output meets the battery manufacturer specification, thus ensuring the maximum battery lifetime.
- 2) AC Input Current: The charger unit is provided with an AC input current limiting circuit whereby the maximum input current shall not exceed 125% of the output full current rating.
- 3) Automatic Restart: Upon restoration of utility AC power, after a utility AC power outage and after a full CIS automatic end-of-discharge shutdown, the CIS will automatically restart, performing the normal CIS start up.
- 4) DC Filter: The charger shall have and output filter to minimize AC ripple voltage into the battery. Under no conditions shall ripple voltage into the battery exceed 2% RMS.
- 5) Battery Recharge: The charger is capable of producing battery-charging current sufficient enough to recharge the fully discharged battery bank within a 24-hour period. After the battery is recharged, the charger shall maintain full battery charge until the next emergency operation.
- 6) Over-voltage Protection: The charger is equipped with a DC over-voltage protection circuit so that if the DC voltage rises above the pre-set limit, the charger is to shut down automatically and initiate an alarm condition.

d. Inverter

- 1) General: The inverter converts DC voltage supplied by the battery to AC voltage of a precisely stabilized amplitude and frequency that is suitable for powering most sophisticated electrical equipment. The inverter output voltage is generated by sinusoidal pulse width modulation (PWM). The use of a high carrier frequency for PWM and a dedicated AC filter circuit consisting of a transformer and capacitors, ensure a very low distortion of the output voltage (THD<3% on linear loads).
- 2) Overload Capability: The inverter during emergency modes shall be capable of supplying current and voltage for overloads exceeding 100% and up to 125% of full load current for 12 line cycles, 115% for 5 minutes and 110% for 10 minutes.

- 3) Output Power Transformer: A dry type power transformer provides the inverter AC output. The transformer is built with copper wiring exclusively. The hottest winding temperature of the transformer shall not exceed the temperature limit of the transformer insulation class of material at ambient temperature.

e. Display and Controls

- 1) Monitoring and Control: The CIS system provides operation monitoring and control, audible alarms, LED indicators, and diagnostics. The front-mounted control panel includes a 2-line 20-character LCD display, a keypad to control and monitor the internal operation of the system. This allows the operator to easily “watch” system functions as they occur and check on virtually any aspect of the system's operation. Monitoring and control are microprocessor-based for accuracy and reliability. To ensure only authorized personnel can operate the unit, the system is multi-level password protected for all control functions and parameter changes.
- 2) Metering: Scrolling through the meter functions can monitor the following measurements:
 - Utility input voltage
 - System output voltage
 - Battery voltage
 - Battery current
 - System output current
 - System output VA
 - Inverter wattage
 - System temperature
 - Date & time
- 3) LED Indication: The front panel with integrated LEDs, allows a quick check of the CIS operating status.
 - AC Present (Green)
 - System Ready (Green)
 - Battery Charging (Yellow)
 - Battery Power (Yellow)
 - Fault (Red)
- 4) Audible Alarm: Audible alarm will activate with any of the following conditions and automatically store the 50 most recent events.
 - High battery charger voltage
 - Low battery charger voltage
 - High AC input voltage
 - Low AC input voltage
 - Near low battery voltage
 - Low battery voltage
 - Load reduction fault
 - High Ambient temperature
 - Inverter fault
 - Output fault
 - Output overload

f. RS-232 Interface

- 1) The system shall be equipped with an RS-232 serial port (DB9) for remote communications.
- g. Manual and Programmable Testing
 - 1) The system shall incorporate a manual test function and two automatic test modes. The system will perform a programmable, self-diagnostic monthly test for 5 minutes. The monthly test is preset for the 15th of every month and the user can program the event time of day. The yearly self-diagnostic test is for 90 minutes and the user can program the time of the day the event is to take place. The microprocessor automatically records the last 75 test events in its own separate test result log.
- h. Battery Assembly
 - 1) The batteries are sealed, lead-acid valve regulated battery cells with a ten-year prorated warranty.
 - 2) Precut cable wires are included to provide easy installation. A means of disconnect shall be included for isolation of battery assembly from the CIS module.
3. OPTIONS
 - a. The central inverter system shall include the following options:
 - 1) Fast Charge
 - 2) Summary Form C Contacts
 - 3) E-Mail Modem
 - 4) Factory Start-Up
 - 5) 5-Year Preventative Maintenance Plan

4. ORDERING NUMBER

- 1) The system shall be Myers Emergency Power Systems, LLC Illuminator CIII Series:

Catalog # 2-D-4-S-C/20/2-SNMP-Z-5YP or pre-approved equal

PART 3 - EXECUTION

3.1 INSTALLATION, SYSTEM SHIPPING, START-UP AND TESTING

- A. Shipping: System shall be shipped separately from batteries. Batteries shall be shipped to Project site directly from battery supplier and shall remain in their sealed cartons until opened and examined in presence of the Project Inspector. Batteries shall be shipped to Project site not more than 30 days before system start-up.

- B. WIRING: All wiring shall be installed in conduit. Input and output wiring shall enter the cabinet in separate conduits.
- C. UNIT START-UP and SITE TESTING: System start-up shall be performed by a technical representative of manufacturer, in the presence of the Project Inspector, with loads connected, and shall include testing and adjusting to assure proper operation of system functions. System start-up shall include follow-up visits. Following start-up, maintain system on a normally OFF input circuit until Substantial Completion.
 - 1. Site start-up and testing shall be provided by the manufacturer's field service representative during normal working hours (Mon. - Friday, 8 a.m. - 5 p.m.). Individual scheduling requirements can usually be met with 7 working days advance notice. Site testing shall consist of a complete test of the CIS and accessories by the inverter manufacturer in accordance with manufacturer's standards. Manufacturer's approved service representative must perform commissioning for two-year warranty to apply.
- D. TESTING: Before Substantial Completion, conduct in the presence of the Project Inspector, a complete performance testing of system. Testing shall include operating system in emergency mode for at least 90 minutes for CIS, with loads connected, while monitoring battery voltage, output voltage and output frequency. Power factor of load shall be measured to ascertain compatibility with system. Furnish and operate necessary test equipment.
- E. Equipment shall be anchored in accordance with CBC seismic requirements.

3.2 REPLACEMENT PARTS

- A. Parts shall be available through Field Service Centers throughout the country and directly from the factory. Recommended spare parts shall be fully stocked by local field service personnel with back up available from manufacturing location.

3.3 SERVICE MANUALS

- A. Service Manuals: Submit service manuals to Owner's Authorized Representative including following:
 - 1. A detailed explanation of operation of system.
 - 2. Instructions for routine maintenance.
 - 3. Detailed instructions for repair of major components of system.
 - 4. Pictorial parts list and parts numbers.
 - 5. Pictorial and schematic electrical drawings of wiring systems, including operating and safety devices, and major components.
 - 6. Programming Instructions.
 - 7. Program listing.
 - 8. Final test report.
 - 9. Installation Instructions: Submit manufacturer's written installation instructions.

3.4 TRAINING

- A. Before Substantial Completion, provide the services of a manufacturer's representative on the Project site to instruct persons designated by the Owner in the operation and maintenance of the system. Instruction time shall not be less than four hours. Provide training video and training materials to designated owner's personnel.

3.5 PROTECTION

- A. Protect Work of this section until Substantial Completion.

3.6 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

3.7 MAINTENANCE CONTRACTS

- A. A five-year preventative maintenance contract shall be included and must include unit start-up and site testing. Factory-trained service personnel shall perform warranty and preventive maintenance service.

END OF SECTION

SECTION 26 56 29

SITE LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Lighting fixtures - general
- B. Exterior Lighting
 - 1. Site Lighting
 - 2. Area Lighting
- C. LED light engines and LED drivers
- D. Poles and Pole Accessories

1.2 RELATED SECTIONS

- A. Division 01: GENERAL CONDITIONS
- B. Division 03: CONCRETE
- C. Division 26: ELECTRICAL
- D. Section 26 56 68 – ATHLETIC FIELD LIGHTING
- E. Division 31: EARTHWORK

1.3 REFERENCES

- A. California Building Code (CBC)
- B. California Electric Code (CEC)
- C. National Electrical Contractors Association (NECA)
- D. California Administrative Code Title 24
- E. American National Standards Institute (ANSI)
- F. Institute of Electrical and Electronics Engineers (IEEE)
- G. National Electric Manufacturer's Association (NEMA)
- H. City, State and other local codes and requirements as applicable

1.4 SUBMITTALS

- A. Refer to Division 01 for procedures for shop drawings and submittals.

- B. Product Data: Submit manufacturer's product data and installation instructions on each type of exterior lighting fixture and component as per the requirements of Basic Electrical Requirements Section. Data shall be sufficient to show conformance to specified requirements and shall include the following:
 - 1. Luminaires, including LED light engines and drivers, and all mounting hardware.
 - 2. Poles, brackets, anchor bolts, yokes, mounting devices & all required accessories.
 - 3. Data for each type of LED light engine and LED driver
- C. Shop Drawings:
 - 1. Luminaires: Submit light fixture shop drawings in booklet form with separate sheet for each fixture, assembled in "fixture type" alphabetical or numerical order, with proposed fixture and accessories clearly indicated on each sheet. Include dimensions, accessories and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio.
 - 2. Poles: Include dimensions, wind load determined in accordance with AASHTO LTS-1, pole deflection, pole class and other applicable information. Include information for anchor bolts, hand holes, pole shaft, base plate, finish, etc.
 - 3. Mounting Accessories: Submit complete details for all mounting accessories, including stainless steel straps for tree mounting of fixtures.
- D. Wiring Diagrams: Submit control wiring diagrams for exterior lighting indicating all control devices, photocells, time switches, contactors, etc. as indicated, described or required.
- E. Samples: Submit samples as requested. Samples will be required for all substitutions, to allow proper evaluation of the proposed substitute.
- F. Should the Contractor desire to propose substitutions, the Contractor shall provide all tests, data, samples, calculations, etc. that may be required by the Owner's Representative, as necessary to evaluate such substitutions, all at no cost to the Owner. Submittal for proposed substitutes shall include a complete computer generated "point by point" foot-candle calculation with horizontal and vertical foot-candle levels indicated for all surfaces of the illuminated area, etc.

1.5 SECTION SUMMARY

- A. The work of this section shall include all services, labor, materials, transportation, equipment, plant and facilities to furnish and install all lighting, lighting controls, and accessory items indicated on the Drawings and specified herein.
- B. Comply with requirements of California Administrative Code Title 24, California Electrical Code and all other codes referenced herein.

1.6 CODES, REGULATIONS AND STANDARDS

- A. The materials herein shall be new and furnished in accordance with specifications of the Institute of Electrical and Electronics Engineers, National Electric Manufacturer's Association, National Fire Protection Association and the California Electrical Code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver exterior lighting fixtures and accessories in factory-fabricated containers or wrappings, which properly protect fixtures from construction debris and physical damage.

- B. Store exterior lighting fixtures and accessories in original wrappings in a clean dry space. Protect from weather, dirt, fumes, water, construction debris, and damage.
- C. Handle exterior lighting fixtures and accessories carefully to prevent damage, breaking, and scoring. Do not install damaged fixtures or components; remove units from site and replace with new.

1.8 SEQUENCING AND SCHEDULING

- A. Coordinate with other electrical work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of exterior lighting fixtures with other work.
- B. Sequence exterior lighting installation with other civil and landscaping work to reduce possibility of damage and soiling of fixtures during remainder of construction period.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES GENERAL

- A. All lighting fixtures of one type shall be of one manufacturer and of identical appearance. The catalog numbers indicated on fixture list are for individual units. Where multiple fixtures are installed in combination, the manufacturer shall furnish the necessary accessories and hardware required.
- B. Furnish, install and connect a lighting fixture at each fixture symbol indicated on the drawings. The fixtures shall be complete with all glassware, canopies, sockets, lenses, and accessories for a complete installation. All fixtures shall be supplied LED light engines and drivers of the type and wattage indicated.
- C. Fixtures as specified in the "Fixture List" on the Drawings include catalog numbers indicating the basic design intent. The fixtures installed shall be suitable for the circuit electrical characteristics indicated for supply.
- D. Lighting fixtures of the same type, including all fixtures represented by a single fixture type designation, and in addition, fixtures of different designation but obviously intended to match each other, shall be the product of the same manufacturer. The decision of the Owner's Representative regarding the acceptability of any fixture shall be final.
- E. Fixtures shall bear the label of the Underwriter's Laboratories, Inc. or other nationally recognized testing laboratory indicating compatibility with Code requirements for the location and usage indicated.

2.2 LUMINAIRES

- A. Provide luminaires complete with LED light engines and drivers, accessories, mounting hardware, etc. as indicated on fixture schedule.
- B. Luminaires shall be complete with LED light engines and drivers (as applicable) of the proper type, wattage, and characteristics.
- C. Luminaires shall be furnished with all necessary mounting brackets and hardware for a complete installation.
- D. Should the Contractor desire to propose substitutions, the Contractor shall provide all tests, data, samples, calculations, etc. that may be required by the Owner's Representative, Engineer or Owner as necessary to evaluate such substitutions, all at no cost to the Owner. Submittal for proposed substitutes shall include a complete computer generated "point by point" foot-candle

calculation with horizontal and vertical foot-candle levels indicated for all surfaces of the illuminated areas, etc.

2.3 POLES AND POLE ACCESSORIES

A. Pole Shafts

1. The pole shafts shall be fabricated of steel or aluminum as noted on the Drawings. Poles shall be round or square as noted on the Drawings.

B. Anchor Bases

1. The anchor base (base plate/flange) shall be fabricated from structural material as specified by manufacturer and shall be welded to the pole shaft as required per manufacturer's drawings.

C. Anchor Bolts

1. Anchor bolts shall be fabricated from a commercial quality hot rolled carbon steel. Bolts shall have an "L" bend on one end and shall be threaded on the opposite end. Four (4) properly sized bolts, furnished with hex nuts (2 per bolt for leveling purposes) and flat washers shall be provided per pole.
2. Factory supplied template must be used when setting anchor bolts. Manufacturer will not honor any claim for incorrect anchorage placement resulting from failure to use factory supplied template. Template will be furnished by the manufacturer upon request, after approval of "Shop Drawings".

D. Base Covers

1. Poles shall be complete with a base cover. Base cover shall completely cover and seal the entire base plate and anchorage. The base cover shall be secured together with stainless steel screws. Type and style of base cover varies by pole type – refer to Fixture List for specific catalog numbers.

E. Handhole

1. Poles shall be complete with a handhole. The handhole rim shall be reinforced. Nominal handhole opening shall be the manufacturer's standard opening size. The handhole shall be provided with a cover, with stainless steel screws. The handhole shall be welded in the pole shaft.

F. Finish

1. The pole shall be finished as described on the Fixture List on the Drawings.

- G. Should the Contractor desire to propose substitutions, the Contractor shall provide all tests, data, samples, calculations, etc. that may be required by the Owner's Representative, Engineer or Owner as necessary to evaluate such substitutions, all at no cost to the Owner. Submittal for proposed substitutes shall include structural calculations (signed by a California Registered Structural Engineer) for the concrete base required for the substitute poles. The concrete base design indicated on the Drawings was engineered specifically for the poles and equipment that are specified. Any substitutions will require complete revised calculations and design based on the proposed substitute equipment.

2.04 LIGHT SOURCES

- A. LED light engines shall be of wattage and rating indicated and shall have a minimum power factor of 90% with a total harmonic distortion of less than 20%. LED light engines shall have a rated life of 100,000 hours at 25 degrees C ambient. LED light engines shall have a color temperature rating of as noted in the Fixture List on the Drawings.

- B. Light sources shall be of the type, size, and rating as indicated on the Drawings and/or as required for the fixture.

PART 3 - EXECUTION

3.1 FIXTURE INSTALLATION GENERAL

- A. Fixtures shall be installed complete including lenses, lamps and finish trims. All fixtures shall be cleaned of dirt and grease.

3.2 EXAMINATION

- A. Examine areas and conditions under which lighting fixtures are to be installed, and substrate that will support lighting fixtures. Notify Owner's Representative in writing of conditions detrimental to proper completion of the Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.3 INSTALLATION OF EXTERIOR LIGHTING FIXTURES

- A. Install exterior lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of CEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the California Electrical Code.
- C. Fasten electrical lighting fixtures and brackets securely to indicated structural supports, including poles/standards; and ensure that installed fixtures are plum and level.
- D. Furnish and install "cast-in-place" concrete base for each pole mounted fixture. Concrete base shall be furnished as indicated on the Structural Engineer's details for the base. Contractor shall obtain a template from the fixture/pole manufacturer for proper setting and alignment of the anchor bolts for the pole.
 - 1. Pole base shall be complete with the proper concrete mix, reinforcing steel, etc. and shall be of the depth and circumference as designed by the Structural Engineer.

3.4 GROUNDING

- A. Provide equipment grounding connections for exterior lighting fixtures as indicated. Tighten connections to comply with tightening torques specified in UL STD 486A to assure permanent and effective grounds.
- B. Bond equipment grounding conductors to the grounding lug provided inside the hand-hole of each pole. Contractor shall provide proper lugs and hardware as necessary for this bond connection.

3.5 FIELD QUALITY CONTROL

- A. Replace defective and burned out LED light engines and drivers for a period of one year following the Date of Substantial Completion. At the Date of Substantial Completion, replace LED light engines and drivers in exterior lighting fixtures that are observed to be noticeably dimmed after Contractor's use and testing, as judged by the Owner's Representative.

3.6 CLEANING

- A. Clean lighting fixtures of dirt and debris upon completion of installation.
- B. Protect installed fixtures from damage during construction period.

3.7 DEMONSTRATION

- A. Upon completion of installation of exterior lighting fixtures, and associated electrical supply circuitry, apply electrical energy to circuitry to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION

SECTION 26 56 68

ATHLETIC FIELD LIGHTING

PART 1 - GENERAL

1.1 SUMMARY - LIGHTING SYSTEM WITH LED LIGHT SOURCE

- A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.
- B. The purpose of these specifications is to define the lighting system performance and design standards for La Mirada High School Football using an LED Lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications.
- C. The sports lighting will be for the following venues:
 - 1. Football
 - 2. Soccer
 - 3. Track and Field
 - 4. Bleachers and surrounding spaces
- D. The primary goals of this sports lighting project are:
 - 1. Guaranteed Light Levels: Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators; therefore, light levels shall be guaranteed to not drop below specified target values for a period of 25 years.
 - 2. Environmental Light Control: It is the primary goal of this project to minimize spill light and glare.
 - 3. Cost of Ownership: In order to reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be eliminated for the duration of the warranty.
 - 4. Control and Monitoring: To allow for optimized use of labor resources and avoid unneeded operation of the facility, customer requires a remote on/off control system for the lighting system. Fields should be proactively monitored to detect luminaire outages over a 25-year life cycle. All communication and monitoring costs for 25-year period shall be included in the bid.

1.2 RELATED SECTIONS

- A. Division 01: GENERAL CONDITIONS
- B. Division 03: CONCRETE
- C. Division 26: Electrical
- D. Division 31: EARTHWORK

1.3 REFERENCES

- A. California Building Code (CBC)
- B. California Electric Code (CEC)
- C. National Electrical Contractors Association (NECA)
- D. California Administrative Code Title 24
- E. American National Standards Institute (ANSI)
- F. Illuminating Engineers Society (IES)
- G. Institute of Electrical and Electronics Engineers (IEEE)
- H. National Electric Manufacturer's Association (NEMA)
- I. City, State and other local codes and requirements as applicable

1.4 SUBMITTALS

- A. Refer to Division 01 for procedures for shop drawings and submittals.
- B. Product Data: Submit manufacturer's product data and installation instructions on each type of exterior lighting fixture and component as per the requirements of Basic Electrical Requirements Section. Data shall be sufficient to show conformance to specified requirements and shall include the following:
 - 1. Luminaires, including LED light engines and drivers, and all mounting hardware.
 - 2. Poles, brackets, anchor bolts, yokes, mounting devices & all required accessories.
 - 3. Data for each type of LED light engine and LED driver
- C. Shop Drawings:
 - 1. Luminaires: Submit light fixture shop drawings in booklet form with separate sheet for each fixture, assembled in "fixture type" alphabetical or numerical order, with proposed fixture and accessories clearly indicated on each sheet. Include dimensions, accessories and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio.
 - 2. Poles: Include dimensions, wind load determined in accordance with AASHTO LTS-1, pole deflection, pole class and other applicable information. Include information for anchor bolts, hand holes, pole shaft, base plate, finish, etc.
 - 3. Mounting Accessories: Submit complete details for all mounting accessories, including stainless steel straps for tree mounting of fixtures.
- D. Wiring Diagrams: Submit control wiring diagrams for exterior lighting indicating all control devices, photocells, time switches, contactors, etc. as indicated, described or required.
- E. Samples: Submit samples as requested. Samples will be required for all substitutions, to allow proper evaluation of the proposed substitute.
- F. Should the Contractor desire to propose substitutions, the Contractor shall provide all tests, data, samples, calculations, etc. that may be required by the Owner's Representative, as necessary to evaluate such substitutions, all at no cost to the Owner. Submittal for proposed substitutes shall

include a complete computer generated "point by point" foot-candle calculation with horizontal and vertical foot-candle levels indicated for all surfaces of the illuminated area, etc.

1.5 CODES, REGULATIONS AND STANDARDS

- A. The materials herein shall be new and furnished in accordance with specifications of the Institute of Electrical and Electronics Engineers, National Electric Manufacturer's Association, National Fire Protection Association and the California Electrical Code.

1.6 LIGHTING PERFORMANCE CRITERIA

- A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified below. Appropriate light loss factors shall be applied and submitted for the basis of design. Average illumination level shall be measured in accordance with the IESNA LM-5-04 (IESNA Guide for Photometric Measurements of Area and Sports Lighting Installations). Illumination levels shall not to drop below desired target values in accordance to IES RP-6-15, Page 2, Maintained Average Illuminance and shall be guaranteed for the full warranty period.

- a. Refer to Paragraph 3.5 for 'post-installation' testing and reporting requirements.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Football	50 footcandles	2.0:1	72	30' x30'
Soccer	50 footcandles	2.0:1	96	30' x 30'
Track	19 footcandles	N/A	52	30' x 30'
Egress	4 footcandles	10.0:1	474	10' x 10'

Bleacher Lighting - Home				
Bleacher - Field	7 footcandles	N/A	217	10' x 10'
Egress	6 footcandles	N/A	217	10' x 10'
ADA East Ramp	1.5 footcandles	N/A	27	5' x 5'
ADA Egress East Ramp	5 footcandles	N/A	27	5' x 5'
ADA West	3.5 footcandles	N/A	14	5' x 5'
ADA Egress West	6 footcandles	N/A	14	5' x 5'

Bleacher Lighting - Visitor				
Bleacher - Field	7.5 footcandles	N/A	128	10' x 10'
Egress	6 footcandles	N/A	128	10' x 10'
ADA West Ramp	4 footcandles	N/A	30	5' x 5'
ADA Egress West Ramp	7 footcandles	N/A	30	5' x 5'
ADA East Ramp	4 footcandles	N/A	30	5' x 5'
ADA Egress East Ramp	7 footcandles	N/A	30	5' x 5'

- B. Color: The lighting system shall have a minimum color temperature of 5700K and a CRI of 75.
- C. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, minimum mounting heights shall be as described below. Higher mounting heights may be required based on photometric report and ability to ensure the top of the field angle is a minimum of 10 degrees below horizontal.

# of Poles	Pole Designation	Pole Height
1	F5	110'
5	F1-F4, F6	100'

1.6 ENVIRONMENTAL LIGHT CONTROL

- A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers and external shields. No symmetrical beam patterns are accepted.
- B. Spill Light and Glare Control: To minimize impact on adjacent properties, spill light and candela values must not exceed the following levels taken at 3 feet above grade.

Foster Road Spill	Average	Maximum
Specified Spill Line Horizontal Footcandles	.1 fc	.1 fc
Specified Spill Line Max Vertical Footcandles	.1 fc	.2 fc
Specified Spill Line Max Candela	<2000 Cd	<7000 Cd

- C. Spill Scans: Spill scans must be submitted indicating the amount of horizontal and vertical footcandles along the specified lines. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights. Illumination level shall be measured in accordance with the IESNA LM-5-04 after 1 hour warm up.
- D. The first page of a photometric report for all luminaire types proposed showing horizontal and vertical axial candle power shall be provided to demonstrate the capability of achieving the specified performance. Reports shall be certified by a qualified testing laboratory with a minimum of five years of experience or by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products. A summary of the horizontal and vertical aiming angles for each luminaire shall be included with the photometric report.

1.7 COST OF OWNERSHIP

- A. Manufacturer shall submit a 25-year Cost of Ownership summary that includes energy consumption, anticipated maintenance costs, and control costs. All costs associated with faulty luminaire replacement - equipment rentals, removal and installation labor, and shipping - are to be included in the maintenance costs.

1.8 SUBSTITUTIONS

- A. Approved Product: Musco's Light-Structure System™ with TLC for LED™ is the approved product. All substitutions must provide a complete submittal package for approval as outlined in Submittal Information at the end of this section at least 10 days prior to bid. Special manufacturing to meet the standards of this specification may be required. An addendum will be issued prior to bid listing any other approved lighting manufacturers and designs.
- B. Design Approval: The owner / engineer will review pre-bid submittals, per this section, from all the manufacturers to ensure compliance to the specification 10 days prior to bid. If the design meets the design requirements of the specifications, a letter and/or addendum will be issued to the manufacturer indicating approval for the specific design submitted.
- C. All listed manufacturers not pre-approved shall submit the information at the end of this section at least 10 days prior to bid. An addendum will be issued prior to bid; listing approved lighting manufacturers and the design method to be used.
- D. Bidders are required to bid only products that have been approved by this specification or addendum by the owner or owner's representative. Bids received that do not utilize an approved system/design, will be rejected.
- E. REQUIRED SUBMITTAL INFORMATION FOR ALL MANUFACTURERS (NOT PRE-APPROVED)
10 DAYS PRIOR TO BID

1. All items listed below are mandatory, shall comply with the specification and be submitted according to pre-bid submittal requirements. Complete the Yes/No column to indicate compliance (Y) or noncompliance (N) for each item. Submit checklist below with submittal.

Yes/ No	Tab	Item	Description
	A	Letter/ Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included.
	B	Equipment Layout	Drawing(s) showing field layouts with pole locations
	C	On Field Lighting Design	Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), Illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics d. Height of light test meter above field surface. e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), coefficient of utilization (CU) uniformity gradient; number of luminaires, total kilowatts, average tilt factor; light loss factor.
	D	Off Field Lighting Design	Lighting design drawing showing initial spill light levels along the boundary line (defined on bid drawings) in footcandles. Lighting design showing glare along the boundary line in candela. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights.
	E	Photometric Report	Provide first page of photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience.
	F	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period.
	G	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of California, if required by owner.
	H	Control & Monitoring System	Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system. They will also provide ten (10) references of customers currently using proposed system in the state of California.
	I	Electrical Distribution Plans	Manufacturer bidding an alternate product must include a revised electrical distribution plan including changes to service entrance, panels and wire sizing, signed by a licensed Electrical Engineer in the state of California.

	J	Warranty	Provide written warranty information including all terms and conditions. Provide ten (10) references of customers currently under specified warranty in the state of California.
	K	Project References	Manufacturer to provide a list of five (5) projects where the technology proposed for this project has been installed in the state of California. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.
	L	Product Information	Complete bill of material and current brochures/cut sheets for all product being provided.
	M	Delivery	Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.
	N	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.
	O	Cost of Ownership	Document cost of ownership as defined in the specification. Identify energy costs for operating the luminaires. Maintenance cost for the system must be included. All costs should be based on 25 Years
	P	Environmental Light Control Design	Environmental glare impact scans must be submitted showing the maximum candela from the field edge on a map of the surrounding area until 500 candela or less is achieved.

2. The information supplied herein shall be used for the purpose of complying with the specifications for La Mirada High School Football. By signing below I agree that all requirements of the specifications have been met and that the manufacturer will be responsible for any future costs incurred to bring their equipment into compliance for all items not meeting specifications and not listed in the Non-Compliance section.

Manufacturer: _____ Signature: _____

Contact Name: _____ Date: ____/____/____

Contractor: _____ Signature: _____

PART 2 - PRODUCTS

2.1 SPORTS LIGHTING SYSTEM CONSTRUCTION

- A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.
- B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel of 18-8 grade or better, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM

B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.

1. System Description: Lighting system shall consist of the following:
 - a. Galvanized steel poles and cross-arm assembly.
 - b. Non-approved pole technologies:
 - 1) Square static cast concrete poles will not be accepted.
 - 2) Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long-term performance concerns.
 - c. Lighting systems shall use concrete foundations. See Section 2.4 for details.
 - 1) For a foundation using a pre-stressed concrete base embedded in concrete backfill the concrete shall be air-entrained and have a minimum compressive design strength at 28 days of 3,000 PSI. 3,000 PSI concrete specified for early pole erection, actual required minimum allowable concrete strength is 1,000 PSI. All piers and concrete backfill must bear on and against firm undisturbed soil.
 - 2) For anchor bolt foundations or foundations using a pre-stressed concrete base in a suspended pier or re-inforced pier design pole erection may occur after 7 days. Or after a concrete sample from the same batch achieves a certain strength.
 - d. Manufacturer will supply all drivers and supporting electrical equipment
 - 1) Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure will be located in the enclosure. Integral drivers are not allowed. If allowed, integral drivers mounted at the top of the pole will require a pole mounted enclosure approximately 10 feet above grade. The enclosure shall include a disconnect per circuit, individual luminaire fusing, and surge protection. The pole shall include steps, cables, and platforms for luminaire maintenance, if owner responsible for removal of faulty luminaires.
 - 2) Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2_2002.
 - e. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
 - f. All luminaires, visors, and cross-arm assemblies shall withstand 150 mph winds and maintain luminaire aiming alignment.
 - g. Control cabinet to provide remote on-off control, monitoring features of the lighting system. See Section 2.3 for further details.
 - h. Manufacturer shall provide lightning grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.
 - 1) Integrated grounding via concrete encased electrode grounding system.

- 2) If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780. The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.
- i. Enhanced corrosion protection package: Due to the potentially corrosive environment for this project, manufacturers must provide documentation that their products meet the following enhanced requirements in addition to the standard durability protection specified above:
 - 1) Exposed carbon steel horizontal surfaces on the crossarm assembly shall be galvanized to no less than a five (5) mil average thickness.
 - 2) Exposed die cast aluminum components shall be Type II anodized per MIL-STD-8625 and coated with high performance polyester.
 - 3) Exposed extruded aluminum components shall be Type II anodized per MIL-STD-8625 and coated with high performance polyester.
 - j. Safety: All system components shall be UL listed for the appropriate application.

2.2 ELECTRICAL

A. Electric Power Requirements for the Sports Lighting Equipment:

1. Electric power: 480- Volt, 3-Phase
 - a. Maximum total voltage-drop: Voltage-drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.
 - b. Energy Consumption: The kW consumption for the lighting system shall be 75.96 kW.
2. UL Listing - There shall be provided a UL listing for all electrical components from its connection to the feeder conductors, to its completion at the lamp socket including all connections. This listing shall be based upon UL testing and evaluation of the compatibility of the enclosures and the components for use in combination in this application in addition to the individual components being UL listed or recognized.
3. UL Test Report - Bidder shall supply in advance of bid a copy of the complete Underwriters Laboratory report covering the entire luminaire assembly being bid for the owner's review and retention. Partial UL files will not be accepted per the requirements of UL. In addition, bidder must supply proof of most recent Underwriters Laboratory inspection process.
4. Codes - Sports Lighting Structure shall meet California Electrical code.

2.3 CONTROLS

- A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.
- B. Lighting contactor cabinet(s) constructed of NEMA Type 4 aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.

- C. Dimming: System shall provide for 3-stage dimming (high-medium-low). Dimming will be set via scheduling options (Website, app, phone, fax, email).
- D. Remote Lighting Control System: System shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, fax or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute "early off" commands by phone. Scheduling tool shall be capable of setting curfew limits.

Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

- E. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).

- 1. The Musco Control & Monitoring Cabinet shall be furnished with factory installed Digital Cellular Antenna for connection to remote monitoring and remote controls.

- F. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of luminaire outages, control operation and service. Mobile application will be provided suitable for IOS, Android and Blackberry devices.

Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.

- 1. Cumulative hours: shall be tracked to show the total hours used by the facility.
 - 2. Report hours saved by using early off and push buttons by users.

- G. Communication Costs: Manufacturer shall include communication costs for operating the controls and monitoring system for a period of 25 years.
- H. Communication with luminaire drivers: Control system shall interface with drivers in electrical components enclosures by means of powerline communication.

2.3 STRUCTURAL PARAMETERS

- A. Wind Loads: Wind loads shall be based on the 2019 California Building Code. Wind loads to be calculated using ASCE 7-10, a design wind speed of 110 mph, exposure category C and wind importance factor of 1.0.
- B. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to 2009 AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-5).
- C. Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report. If no geotechnical report is available, the foundation design shall be based on soils that meet or exceed those of a Class 5 material as defined by 2016 CBC Table 1806.2.
- D. Foundation Drawings: Project specific foundation drawings stamped by a registered engineer in the state where the project is located are required. The foundation drawings must list the moment, shear

(horizontal) force, and axial (vertical) force at ground level for each pole. These drawings must be submitted at time of bid to allow for accurate pricing.

PART 3 - EXECUTION

3.1 ATHLETIC FIELD LIGHTING -- INSTALLATION GENERAL

- A. Athletic field lighting shall be installed complete including fixtures, poles, lamps, controls, etc. All equipment shall be cleaned of dirt and grease.

3.2 SOIL QUALITY CONTROL

- A. It shall be the Contractor's responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner's approval / payment for additional costs associated with:
 - 1. Providing engineered foundation embedment design by a registered engineer in the State of California for soils other than specified soil conditions;
 - 2. Additional materials required to achieve alternate foundation;
 - 3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

3.3 DELIVERY TIMING

- A. Delivery Timing Equipment On-Site: The equipment must be on-site 6-14 weeks from receipt of approved submittals and receipt of complete order information.

3.4 WARRANTY AND GUARANTEE

- A. 25-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 25 years from the date of shipment. Warranty shall guarantee specified light levels. Manufacturer shall maintain specifically-funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.
- B. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and luminaire outage for 25 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Owner agrees to check fuses in the event of a luminaire outage.

3.5 FIELD QUALITY CONTROL

- A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA LM-5-04.
 - 1. Manufacturer's Representative shall generate a report of the results of these measurements and shall submit it to the Owner's Representative for review and record.
- B. Field Light Level Accountability

2. Light levels shall be guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 years. These levels will be specifically stated as "guaranteed" on the illumination summary provided by the manufacturer.
 3. The contractor/manufacturer shall be responsible for an additional inspection one year from the date of commissioning of the lighting system and will utilize the owner's light meter in the presence of the owner.
 4. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities. Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.
- C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including foot-candles and uniformity ratios are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.
- D. Commissioning of the Control Systems:
1. The installing contractor, in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, shall "commission" the lighting control system upon completion of installation. The commissioning process shall confirm that the control system is functioning properly (all zones turn on, dimming works, etc.). All controls shall be tested locally (manually at the control panel) and remotely via the remote monitoring and control system (Control-Link).
 2. The Manufacturer's Representative shall coordinate and conduct Control-Link training for the District maintenance and facilities departments. The training shall be conducted via, teleconference training. Training session(s) shall take place at a time and date acceptable to the District. An agenda of the training sessions(s) shall be distributed to the attendees prior to the session(s) to allow them to familiarize themselves with the system.

3.06 FIELD TECHNICIAN ON-SITE VISIT

- A. Manufacturer shall provide an on-site visit by a factory technician after completion of the installation. The factory technician shall make any necessary adjustments to the aiming in order to ensure that specified maximum foot-candle levels are not exceeded. This service shall be included at no additional cost to the owner or installing contractor.

END OF SECTION

DIVISION 27

COMMUNICATIONS

SECTION 27 10 14

STRUCTURED CABLING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications collectively apply to work of this Section.

1.2 DESCRIPTION

- A. Provide, install, integrate, configure, test and document Cable & Wiring Telecommunications Infrastructure for Local Area Networks at the school. Provide equipment, materials and labor to render the cabling systems complete and operable for all outlet locations of the buildings, as specified within this document, the drawings and other work description and scope description documents.
- B. Principal Items of Work in this Section shall include labor and materials that consist of provisions, installing, terminating, testing, and documenting a complete and fully functional communications structured cabling system. Contract shall review all documents and include all work. Part of the scope of work is shown on the drawings but the majority of work is indicated on other scope description documents. Where there is conflict between documents, most restrictive, greater quantity or size, better quality or other superior condition of all representations shall prevail. All work shall be included in bid and all work shall comply with the specifications. The work shall include but not limited to the following:

1. Local Area Network Wiring:

- a. Provide IDF racks where indicated and provide rack space to allow a 50 percent expansion of the number of network data drops provided at the time of initial configuration. This includes space for additional structured cable components as well as active Ethernet equipment. Calculate rack space for one 24 port switch per 20 Category 6A F/UTP drops in IDF. Allow two rack units (1.75 inches per RU) per switch.
- b. Provide exterior and interior optical fiber and copper cabling. Provide new single mode fiber optic cables from existing MDF to new IDF's. Existing MM fibers shall remain. Provide new fiber termination units in all MDF's and IDF's. Provide new data drops and copper wiring in buildings and areas as shown on the drawings and other documents. Provide wiring to new Wireless Access Points ready for District to install the WAP's using only a patch cable. Provide WAP protection boxes. Cabling system colors shall be coordinated using consistent colors for the same type of cabling as used elsewhere on the existing campus.
- c. Furnish and install modular T-568 patch panels for termination of F/UTP within the IDF's.
- d. Furnish and install connectors and faceplates and terminate cable as specified.

- e. Provide high impact plastic wall and/or faceplate covers and connector housings for communication systems outlet locations.
- f. Provide contiguous (home run cables with service loops) optical fiber and copper backbone, link and distribution cables. No splices are permitted between designated termination points.
- g. Furnish and install IDF equipment racks, with required CBC Seismic Design rated seismic bracing and associated accessories.
- h. Furnish and install grounding and bonding of communications components per the CEC.
- i. Furnish and install full labeling of the entire installation prior to testing.
- j. Premise cable shall be tested in compliance with the Testing section of this specification.

C. Related Requirements:

- 1. Section 16010 Basic Materials and Methods.
- 2. Section 16111 Conduit.

D. Acronyms: See Appendix 1.

E. Definitions: See Appendix 2.

1.3 SYSTEM REQUIREMENTS

A. Local Area Networks:

- 1. This specification describes the design, installation, testing, and documentation of elements for premise wiring installations and should be read in conjunction with other applicable divisions and sections of the contract documents. Furnish labor, supervision, tooling, miscellaneous mounting hardware, and consumables, including patch cables, for systems installed; in addition, provide construction and integration services to achieve connectivity for all data outlets. Provide necessary labor and materials for a complete and operable installation.

1.4 SUBMITTALS

- A. Materials list of items proposed to be provided under the specification.
- B. Furnish catalog cuts, technical data, and descriptive literature on components. Data shall be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data.
- C. Shop Drawings shall indicate equipment locations, wiring and schematics, details, panel configurations, sizes and a point-to-point wiring diagram of circuits. Shop Drawings shall indicate interfaces to equipment furnished by others, identifying numbers of wires, termination requirements, and other pertinent details. Responsibility for each end of interfaces shall be noted on Shop Drawings.
- D. Each submittal shall be bound and shall contain an index organized vertically by assembly and item number and horizontally by columns. The first assembly shall be the major head end equipment. The leftmost column shall be the item number; next shall be the description,

followed by the applicable specification section number, and followed by the specified item, which is followed by the submitted item. The rightmost column shall be for notes, which shall be used to reference the reason for submitting items other than as specified.

- E. Each submittal shall contain product data sheets or catalog cut sheets for each item listed in the Index. These shall be arranged in the same order as the index and if more than one item is shown, the submitted items shall be highlighted or marked with an arrow. The product data shall be sufficiently detailed to allow the engineer to evaluate the suitability of the product and to allow other trades to provide necessary coordination.
- F. Provide Shop Drawings, in the same size as the Drawings. Shop Drawings shall be prepared in latest version of AutoCAD.
- G. Provide a Network Protection Plan that defines how an existing school or campus Local Area Network (LAN) will remain in service during the installation of either new LAN cabling or additional LAN cabling segments in a manner that ensures the installation shall not interfere with or disable any portion of existing, working LANs during the project. This plan should be prepared by the Installer and approved by the Engineer prior to the start of work.
- H. Samples: Provide samples of material and equipment as required by the Engineer. If Samples are requested, they shall be submitted within ten days from date of request.
- I. Submit one electronic and one paper copy of cable records.

1.5 CODES AND STANDARDS

- A. Complete installation shall meet or exceed the latest edition of following standards:
 - 1. Underwriters Laboratories Inc. (UL): Applicable listings and ratings.
 - 2. UL 50, Cabinets and Boxes.
 - 3. UL 943, GFCI.
 - 4. UL 489, Molded Case Circuit Breakers.
 - 5. California Building Code.
 - 6. California Electrical Code.
 - 7. California Electrical Code, Article 384, 770, 800, latest issue.
 - 8. National, State, and Local Occupational Safety and Health Administration (OSHA) building and fire codes.
 - 9. NEMA PB1.
 - 10. Federal Specifications W-P- 115C and WC-375B.
 - 11. ANSI/TIA/EIA Telecommunications Building Wiring Standards.
 - 12. ANSI/TIA-568-C, Commercial building telecommunications wiring standard and current addenda.
 - 13. ANSI/TIA/EIA-568-C.3 Optical Fiber Cabling Components Standard.

14. ANSI/TIA/EIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces, current issue.
15. ANSI/TIA/EIA-569-A-1, Commercial Building Standard for Telecommunications Pathways and Spaces Addendum 1 – Surface Raceways, current issue.
16. ANSI/EIA/TIA-598-A, Optical Fiber Cable Color Coding, current issue.
17. ANSI/TIA/EIA-606-A, The Administration Standard for the Telecommunications Infrastructure of Commercial Building, current issue.
18. ANSI/TIA/EIA-607-A, Commercial Building Grounding and Bonding Requirements for Telecommunications, current issue.
19. ANSI/TIA/EIA-758-A, Customer-Owned outside Plant Telecommunications Cabling Standard, current issue.
20. Institute of Electrical and Electronic Engineers (IEEE) 802.3 (Ethernet), 802.3Z (Gigabit Ethernet over optical fiber), 802.3ab (Gigabit Ethernet over 4 pair category 5 or higher), 802.11 (Wireless LAN).
21. BICSI Telecommunications Distribution Methods Manual, current issue.
22. FCC Part 68.50.
23. National Electrical Manufacturer's Association (NEMA).
24. National Fire Protection Association (NFPA), NFPA-70.

1.6

SYSTEM DESCRIPTION

- A. Local Area Network Cabling Infrastructure: The network-cabling infrastructure shall utilize a star topology design consisting of horizontal cabling, backbone cabling, and various telecommunications cabling pathways and spaces.
 1. Proposed solutions shall be in compliance with TIA/EIA 568-C, centralized optical cabling. The installation of the backbone and horizontal cable plant shall include the following:
 - a. The interconnect or splice method as shown in figure 3 of ANSI/TIA 568-C shall be used in all cases. The pull through and splice methods are not acceptable.
 - b. Fiber termination units (FTU) are required to cross-connect backbone fiber at IDF's.
 2. Backbone Cabling - The backbone cabling as a minimum, unless otherwise noted, shall be an indoor-outdoor, Riser rated single-mode fiber optic cable with a minimum composition of 12 strand single-mode fiber optic cabling for inter- building and intra-building backbone cabling. Backbone cables shall meet or exceed the ICEA-S-104-696 Standard for Indoor-Outdoor Optical Fiber Cable. Connectors, distribution panels, ferrules, enclosures, and consumables shall be included to provide the backbone connectivity between the MDF's and the IDF's.

3. Horizontal Cabling – Each data outlet unless otherwise noted shall consist of one Category 6A F/UTP cable.
 - a. Each Category 6A F/UTP cable shall be terminated on an eight-position, eight-conductor Category 6A F/UTP jack wired in accordance with T-568B to match existing configuration used throughout the schools. Contractor must verify the existing configuration. Associated faceplates shall accommodate two jacks at a minimum. Supply Category 6A F/UTP rated patch panels and same manufacturer patch cords for telecommunications closets and workstations to maintain an end-to-end Category 6A F/UTP channel for horizontal cabling.
4. New IDF's shall be located to maintain compliance with the 90 meter horizontal cable running distance limitations as specified in ANSI/TIA568-C.1.

1.7 QUALITY ASSURANCE

- A. Use adequate numbers of skilled personnel who are manufacturer certified, trained and experienced on the necessary crafts, and familiar with the specified requirements and methods needed for the proper performance of the work.
- B. The work of this section shall conform to California Code of Regulations, Part 3, and other applicable codes and standards.
- C. Only a qualified Installer holding licenses required by legally constituted authorities having jurisdiction over the work, shall do the work.
 1. Contractor shall have completed at least five projects of equal scope to systems described herein and shall have been in the business of supplying and installing specified type of systems for at least five years.
 2. Include in the Product Data list submission, copies of current manufacturer certificates indicating that the Contractor is an authorized distributor of the manufacturer's products, has been trained in the installation of those products, and has a service organization capable of responding within 24 hours of receipt of written notification and resolution within one day.
- D. Material or work damaged during the planning, installation, testing, and clean-up of this project must be replaced or repaired, at no expense to the Owner, to meet current Owner specifications before final acceptance of work. Examination of, or failure to examine, work by the Owner shall not relieve Contractor from these obligations.
- E. Installation shall be performed in accordance with applicable building codes, industry standards, and best trade practices.
- F. Include in the Material List Submission copies of the manufacturers' certifications that the Contractor is a current authorized distributor of the submitted manufacturer's products and Contractor's staff has been adequately trained and certified in the installation of those products. This requirement applies to structured cable components and cable described in this specification.
- G. Coordinate cable runs and rack equipment locations with the Owner's Authorized

Representative prior to the start of construction. Contractor and Owner's Authorized Representative must agree as to the final location of devices and the cable plant design.

1.8 WARRANTY

- A. Warranty that work executed and materials furnished shall be free from defects in materials, fabrication and execution for a minimum period of three years from date of installation acceptance, excluding specific items of work that require a warranty of a greater period that may be set forth in this Specification. In the event a manufacturer's warranty is longer than three years, the manufacturer's warranty shall be the warranty period. Immediately upon receipt of written notice from the District, repair or replace at no expense to the District, any defective material or work that may be discovered before final acceptance of work or within the warranty period; any material or work damaged thereby; and adjacent material or work that may be displaced in repair or replacement. Examination of or failure to examine work by the District shall not relieve Contractor from these obligations.
- B. Provide a performance warranty for the installed data cabling system and components for a minimum of twenty years after system is turned over to the Owner. Components of the optical data backbone cable system including cables, distribution shelves, LIUs and connectors must carry a twenty year single manufacturer's applications warranty at speeds of ten Gbit/second.

PART 2 - PRODUCTS

2.1 EQUIPMENT STANDARDS - APPLIES TO ALL SYSTEMS

- A. Where required by Specifications, components installed under this Contract shall be listed by UL or another Nationally Recognized Testing Labs (NRTL).

2.2 APPROVED MANUFACTURERS

- A. SIEMON or approved equal.
- B. Equal product by other manufacturer must equal or better published performance of SIEMON products.

2.3 LOCAL AREA NETWORK CABLING

- A. Single-Mode Optical Fiber.
 - 1. Single-mode optical fibers shall be Class IVa Dispersion-Unshifted Single-mode Optical Fibers and shall comply with ANSI/EIA/TIA-492BAAA. Fiber conductors shall have a nominal core diameter of 8.7 microns. Cable shall have transmission window centered at 1310 and 1550 nanometer wavelengths.
 - 2. The mechanical and environmental specifications for single-mode fiber distribution cables shall be indoor/outdoor, riser rated, tight-buffered type cables. The cable shall meet the requirements of the National Electrical Code (NEC) section 770 and the requirements of TIA-455-82B water ingress test. The Installer shall confirm the cable is listed for the specified application.
 - 3. Cabled optical fiber shall meet the attenuation performance specifications of ANSI/TIA-568-C. Attenuation shall be measured in accordance with ANSI/EIA/TIA – 455-78ASP-3-3644-RV2 or 61. The cable shall be measured at 23 °C ± 5 °C.

B. SC Fiber Optic Connectors

1. Materials:

- a. Fiber optic connectors will be provided for all fiber optic cables and will provide the following features:
 - (1) Field installable SC shall be compatible high-precision glass-in-ceramic ferrule accommodating all 125- micron multi-mode fibers.
 - (2) Installation methods utilize quick drying UV epoxy, Hot-melt, or anaerobic method.
 - (3) Typical average loss of 0.2 dB and a maximum of 0.4 dB with no more than 0.2 dB loss after 1000.

2. Manufacturer:

- a. SIEMON or approved equal.

C. Fiber Optic Terminal Panels (24 Port) and Coupling Panels

1. Materials:

- a. Panel is to be a rack mount unit.
- b. All connectors will be snap-in SC couplings as defined in the Contract Documents.
- c. The fiber optic patch panel couplings shall provide .4dB or less insertion loss

2. Manufacturers: SIEMON or approved equal.

D. Cable Tags and Labels

1. Materials: Laser Warning Signs

- a. Laser warningsigns shall be provided for areas with single-mode fiber optics. LED warning signs shall be provided for areas with multi- mode fiber optics.
- b. Appropriate warning signs are to be in plain view for technicians to see.

2. Materials: Identification Tags

- a. Metal or heavy plastic identification tags with cable type and number, copper pair or optic number assignments, and destination shall be provided on both ends of all cables (except copper station cable) and all splice cases.

3. Manufacturer: Edmund Scientific, Erico, 3M or equal.

E. Fiber Optic Jumper Cables.

1. Single-mode duplex cable, OFN rated. Length: one meter and two meters, pre-manufactured with LC-LC connectors (verify with District IT Department) with same transmission characteristics as the terminated fibers as defined in Article 2.02.
2. Fiber optic patch cables shall be supplied in sufficient quantity to connect each active fiber pair. Patch cables are not required for spare fibers.
3. Fiber optic patch cables shall be OFN type, jacketed with polyvinyl chloride with yellow indicating a single-mode patch cable. The cable shall meet requirements of TIA/EIA-568 except for the more stringent requirements on bandwidth and attenuation identified in this Specification.

F. Copper station Cable (CATEGORY 6A F/UTP):

1. Conductors shall be copper wire, individually insulated and color coded, with multiple conductors in foiled twisted pairs (F/UTP). An overall non-conductive jacket shall encase the copper wires.
2. Cables shall be UL listed, Category 6A shielded rated for 10GBASE-T transmission as defined by previously referenced Standards.
3. Copper F/UTP cables shall be SIEMON 9A6P4-A5- (xx)-RIA or approved equal.
4. Cables in underground conduits shall be underground rated, Commscope or equal.

2.4 CATEGORY 6A SHIELDED JACKS FOR WORK AREA OUTLETS

- A. Contractor shall provide RJ45 Cat 6A Shielded modular jacks color coded blue for data, black for voice.
- B. Provide a lockable blank dust cover for each open jack port in the work area. The port cover shall protect the insert from contamination until a workstation or patch cord is plugged into the outlet.
- C. Provide mounting hardware and work area appliance (flush mount or surface mount faceplate or box) compatible with the outlet box, floor box, and/or surface raceway containing the connectors.
- D. Contractor shall install Category 6A Z-MAX Shielded outlets jacks using the T568-B pinout according to manufacturer's instructions.
- E. Jacks, flush-mount faceplates and blank locking inserts suitable for copper F/UTP terminations: SIEMON Z6AS06 or equal.

2.5 COPPER WIRE PATCH PANELS

- A. Copper patch panels shall be a Category 6A Shielded/Class EA, Z-MAX or equal Shielded panels and shall terminate 4-pair, 22 – 26 AWG, 100 ohm unshielded twisted pair cable with

an industry standard single wire 110 ZMAX tool.

- B. Patch panels shall include a universal label coded for T568A and T568B wiring schemes and mount to 19" and 23" racks.
- C. Contractor shall terminate copper patch panels according to 568B pin-out matching wire map terminations at far end of F/UTP cable links.
- D. Patch panels shall be easy to identify with pre-printed numbers, write-on areas and optional label kits.
- E. The copper wire connector installed in the patch panel shall be the same configuration, manufacturer and type as the corresponding copper wire connector provided in the remote computer/data workstation outlet to meet the 10 Gb E data rates and certification.
- F. Copper patch panels shall be of angled type, allowing for direct dressing of patch cords from panel face into vertical cable managers, eliminating the need for traditional horizontal cable managers.
- G. Category 6A F/UTP copper patch panels shall be SIEMON Z6AS-PNL-24K or equal.

2.6 RACKING SYSTEMS AND WIRE MANAGEMENT

A. Wall-Mounted IDF Cabinet.

- 1. Wall-mounted equipment rack for IDF's. IDF cabinet shall provide at least 42, 31 or 21 inches of mounting space as noted on the drawings for 19-inch panels (26 EIA/TIA rack units), and a minimum of 30 inches of usable interior depth. Cabinet bodies shall be 14 gauge or better, all welded steel construction with 14-gauge carbon steel front and rear adjustable mounting rails, tapped for #10-32 screws on EIA spacing, fully adjustable front-rear. Allowable deflection of an open cabinet, when loaded to its maximum weight capacity, shall not exceed .75 inches (3/4 inches) Wall mount IDF cabinets shall be configured to have front to rear rack-mounting rails. Cabinet shall have factory made top or side ventilation capability flush mounted locks on both front and rear sections. Cabinets shall be UL listed. Provide plywood backboard inside each rack.
- 2. Manufacturer: Middle Atlantic Products DWR series, Southwest Data Products, Hoffman or equal.

B. Floor Mounted IDF Cabinet

- 1. Floor mounted equipment rack for IDF's. Floor-standing equipment cabinet for IDF installation use as required. Cabinet shall provide at least 84 inches (48 EIA/TIA rack units) of total mounting space for 19-inch panels and 36 inches of usable interior depth. If two cabinets are required or indicated for an IDF, structured cabling components shall terminate within the same rack with the Backbone Switch. Cabinet shall be constructed of steel, with 14-gage carbon steel front and rear adjustable mounting rails tapped for #10-32 screws on EIA spacing front and rear. Cabinet shall be tested and certified to the seismic specifications set forth by NEBS Telcordia Technologies GR-63-CORE. Cabinet shall be provided with a thermostatically controlled heat dissipation fan; textured antique finish; matching side panels and louvered top panel; a hinged, key locking, bronze-tinted acrylic window door in front keyed to Corbin Cat 80; and a full length, hinged, key-locking rear door keyed to Corbin Cat 90. Cooling fan thermostat shall be set at 78 degrees Fahrenheit. When installed, both doors

shall be able to swing fully open. Cabinets shall be UL listed.

2. Manufacturer: Middle Atlantic Products DWR series, Southwest Data Products, Hoffman or equal.

2.7 PORTABLE COPPER AND FIBER PATCH CORDS (JUMPERS)

A. General:

1. Provide portable patch cords for all copper wire and fiber optic cable infrastructure outlets:
 - a. For interconnecting electronic network equipment to electronic network workstation outlets.
 - b. For interconnecting equipment rack patch panel outlet patch locations with each other.
 - c. For interconnecting patch panel outlets and rack mounted equipment.
2. Patch cords shall be factory assembled tested and certified with factory terminated plugs or appropriate fiber connector at each end.
3. Field terminated portable patch cords or fiber jumpers shall not be permitted.
4. Copper patch cords shall be UL listed, complying with National Electrical Code and certified to comply with or exceed specified TIA requirements for Category 6A F/UTP, related standards, addendums and TSB.
5. Patch cords and fiber jumpers which are not installed shall be delivered to the District in cardboard boxes. The patch cords shall be neatly bundled and tied together. Contractor shall mark each box with quantity and type of cords contained in the box.
6. Patch cords and fiber jumpers shall comply with the same cable communication performance requirements and testing requirements as the respective infrastructure cables and outlets to which the patch cords are intended to be connected.
7. The outer jacket of each portable patch cord shall be imprinted with date, manufacturer's model and catalog number.

B. Computer/Data Copper Wire Portable Patch Cords

1. Computer/Data Patch General
 - a. "Male" eight (8) position modular "RJ" male style jacks installed on each end of the patch cord cable.
 - b. Patch cord cable shall be F/UTP to match premise wiring, 4-pair twisted, stranded copper individually insulated wires, thermoplastic jacket over all the wires.
 - c. Exceed requirements of ANSI/TIA-568-C.2 Category 6A, IEEE 802.3an 2006, and ISO 11801 Class EA channel standards.
 - d. Meet requirements of IEEE 802.3af and IEEE 802.3at for PoE applications.

- e. Incorporate MaTriX Technology for suppression of alien crosstalk (PSANEXT and PSAACRF).
 - f. Have available a headroom warranty providing high margins above the industry standard for both electrical and alien crosstalk performance.
 - g. Be available in color-coded, keyed modular plugs that mechanically and visually distinguish connections to prevent unintentional mating with unlike keyed or non-keyed jack modules accommodating more discrete networks.
 - h. Be 100% performance tested and wired to T568B.
 - i. Have plug which meets all applicable ANSI/TIA-968-A requirements and exceeds IEC 60603-7 specifications.
 - j. Feature a slender strain relief boot provides easy access in high density applications
 - k. Have plug using an integral pair manager to optimize performance and consistency by reducing untwisting of conductors within the plug with documented performance in center of TIA defined component range.
 - l. Have patented tangle-free latch prevents snags while providing easy release.
2. Patch cord quantities and lengths for connecting port-to-port equipment rack patch panel:
- a. Patch cord quantity: In the telecom closet, Contractor shall provide in the equipment rack one complete patch cord assembly for each copper wire computer workstation outlet port. Pinout shall be 568B standard wiring. Cable jacket color in the patch system shall be blue for data.
3. Patch cord quantities and lengths - for connection from computer workstations to computer workstation outlets.
- a. Patch cord quantity: Provide one complete patchcord assembly for each new copper wire computer workstation outlet and each Wireless Access Point located remote from the equipment rack patch panels. Cable jacket color in the work area shall be blue for data black for voice.
 - 1) Ethernet network outlet segments the pin-to-pin patch cord wiring configuration and jacks shall be wired (pinout) T568B and compatible with the network interface card, and computer workstation outlet.
4. Patch cord quantities and lengths - for connection from equipment rack patch panel ports to network switch ports. Cable jacket color shall be blue.
- a. Patch cord quantity: Provide one complete patch cord assembly for each new copper wire outlet port located in network switches.
 - 1) Ethernet network outlet segments - the pin-to-pin patch cord wiring configuration and jacks shall be standard patch cord T568B pinout and compatible with the respective network equipment and patch

panel outlets as applicable.

- C. Category 6A F/UTP patch cords are as follows: SIEMON or equal

Description	Part Number
3 foot	ZM6A-S03-06
5 foot	ZM6A-S05-06

- D. Fiber Optic Portable Patch Cords

1. Patch cord quantity: Provide one complete patch cord assembly for each fiber optic patch panel outlet in the equipment rack.
 - a. Contractor shall provide self-laminating fiber jumper labels affixed to rotating sleeve as specified in table below.

2.8 PATHWAYS

- A. Pathways - J-Hooks

1. The j-hook system shall feature a "chaining" bracket making possible the addition of more j- hooks at a later date.
2. J-hooks shall be made of non-metallic material rated to UL 2043 and CAN/ULC S102.2 and suitable for use in air handling spaces, and mountable in such fashion that cables to not come in contact with metal.
3. J-hook system shall feature hooks in sizes .75", 1.31", 2 .00" and 4.00".
4. J-hook mounting options shall include appliances for mounting to walls, ceilings, threaded rod, I-beams, vertical or angled flanges and under- floor pedestals.
5. J-hooks shall have designated channel for securing cable bundles with hook and loop cable ties.
6. J-hook systems are as follows: Panduit J-Mod J-hook system or equal

2.9 GROUNDING AND BONDING

- A. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system.
- B. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.
- C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. shall be grounded using a minimum #6 AWG stranded copper bonding conductor and compression connectors.
- D. All wires used for telecommunications grounding purposes shall be identified with a green insulation.

- E. Non-insulated wires shall be identified at each termination point with a wrap of green tape.
- F. All cables and busbars shall be identified and labeled in accordance with the System Documentation Section of this specification.

PART 3 - EXECUTION

3.1 PREMISE WIRING INSTALLATION

Site Conditions. Examine the areas and conditions under which the work of this Section will be performed. Unsatisfactory conditions shall be reported to Owner before the contractor begins work.

A. Local Area Network IDFs:

1. IDFs shall be located in sufficient quantity to maintain compliance with the horizontal cable running distance limitations as specified in TIA/EIA 568.
2. Category 6A F/UTP Termination Installation:
 - a. Provide and install necessary patch cords, both copper and fiber optic, for internal cabinet interconnections.
 - b. One EIA rack unit of horizontal wire management shall be provided adjacent to each patch panel both above and below.
 - c. Cables shall be dressed and terminated in accordance with TIA/EIA-568, manufacturer recommendations, and this Specification.
 - d. Bend radius of the cable in the termination area shall not be less than four times the outside diameter of the cable.
 - e. Cables shall be neatly bundled, not overly tight, and dressed to their respective panels or blocks. Cable wraps shall not be tight enough to disturb the internal cable pair twists and positioning.
 - f. The cable jacket shall be maintained as close as possible to the termination point.
 - g. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties.
 - h. Patch cords used at the rack or cabinet shall include single-mode and multi-mode duplex fiber, and Category 6A F/UTP, four- pair assemblies, as indicated on the drawings.
3. Fiber Termination Hardware Installation:
 - a. Stripped fiber slack shall be neatly coiled within the fiber termination panel.

No stripped slack loops shall be allowed external to the fiber panels. Fiber loops must not be smaller than minimum bend radius of the cable.

- b. Cables shall be individually attached to the respective termination panels by mechanical means.
 - c. Each fiber cable shall be stripped upon entering termination panels and the individual fibers routed neatly into termination panels.
 - d. Each cable shall be clearly labeled at the entrance to the termination panel.
 - e. Dust caps shall be installed on unused connectors and couplings.
4. Backbone Cabling:
- a. Proper bending radius and pulling strength requirements of cables shall be followed during handling and installation. Cables, splice cases, punch-down frames, LIUs, patch panels, and supporting hardware shall be installed in accordance with manufacturer recommendations.
 - b. Outside plant fiber shall be installed in 1 ½-inch or one inch corrugated inner duct installed within the backbone conduit.
 - c. Interior innerduct and cable shall be plenum or riser rated, as required by applicable code regulation or standard. Riser rated innerduct as a minimum shall be installed on floor-to-floor fiber optic cabling.
 - d. Interior fiber not installed in cable tray, conduit or raceways shall be installed in innerduct. Innerduct installations shall be properly strapped and supported every four feet in concealed spaces only. Innerduct shall be rated for indoor or outdoor use as applicable by code.
 - e. Cables in panels, cabinets, trays, and racks shall be neatly grouped and strapped using hook and loop cable straps. Cables shall be placed in a manner that allows equipment installation without rerouting. Full rack rail travel adjustments shall not be impeded by cable installation. Cables and panels shall be clearly identified at both ends with a unique cable numbering system and in compliance with ANSI/TIA 606.
 - f. When cable runs are being installed, provide additional slack at both ends to accommodate future cabling system changes. The minimum amount of allowable slack at the:
 - (1) MDF shall be ten feet.
 - (2) IDF shall be three feet.Include the slack in length calculations to ensure that the cable does not exceed maximum allowable lengths as defined herein. Do not store slack in bundled loops. Store cable slack in an extended loop or in a figure eight configuration to alleviate stress.
 - g. Fiber optic strands shall be terminated and no fiber cable shall be spliced.

- h. Cable shall be installed in accordance with manufacturers' recommendations and best industry practices.
- i. Cable raceways shall not be filled greater than the NEC maximum fill for the particular raceway type.
- j. Cables shall be installed in continuous lengths from origin to destination with no splices.
- k. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
- l. Replace any cable damaged or subjected to installation practices outside of those specified within this document.

5. Horizontal Cabling:

- a. Copper Horizontal distribution cable shall be TIA/EIA-568, Category 6A, four-pair Shielded twisted pair, and CMP or CMR rated cable, as required. Each Category 6A cable shall be terminated on an eight-position, eight-conductor Category 6A jack (at the workstation locations) or patch panel (in the MDF/IDF/LDF). Terminations shall be wired in accordance with T568. Associated faceplates shall accommodate four jacks. Quantities of cables to each outlet shall be in accordance with the location type and project document
 - (1) Cable shall be installed in accordance with manufacturers' recommendations and best industry practices.
 - (2) Copper horizontal cable shall not exceed 90 meters in length.
 - (3) Cable raceways shall not be filled greater than the NEC maximum fill for the particular raceway type.
 - (4) Cables shall be installed in continuous lengths from origin to destination (no splices or cross-connects are permitted).
 - (5) The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
 - (6) Shielded twisted pair cable shall be installed so that there are no bends less than four times the cable outside diameter.
 - (7) When cable runs are being installed, provide additional slack at both ends to accommodate future cabling system changes. The minimum amount of allowable slack at the:
 - (a) MDF, IDF or LDF will be three feet.
 - (b) Work Area Outlets will be 12 inches.
 - (8) Pulling tension on four-pair UTP cables shall not exceed 25 pounds

for a single cable or cable bundle

- (9) Replace, before terminations are completed, cables damaged or subjected to installation practices outside of those specified within this document, at Installer's expense.

6. Labeling and Marking:

- a. The Contractor shall legibly label all voice, data, and RF outlets, faceplates, cable, blocks, frames, patch panels, and other technology equipment per district standard and as defined herein.
- b. A uniquely numbered label for each face plate and a unique letter for each jack shall be supplied and installed. The labels shall be machined printed (not embossed) on vinyl tape using a Panduit label maker or equal. The labels shall have protective overlays.
- c. Labels shall be numbered according to a scheme developed in consultation with the District.
- d. The Contractor shall employ a cable labeling and tagging scheme that meets ANSI/TIA/EIA-606.
- e. Construction labels shall be installed on all cables as they are pulled. These labels shall contain the same information as the finished labels. Typed labels on self-sealing tape, with plastic overlay, shall be used. Each cable shall have a unique number that shall be related to the appropriated face plate number and jack letter.
- f. A label shall be installed on each conduit attached to a communications wall box and shall be affixed to the end of the conduit near the cable tray. The label shall have a unique number related to the appropriate face plate number and jack letter.
- g. Labels shall be installed on all station cables within two (2) inches of the end of the outer jacket material within the back box and the blocks/patch panels. Typed labels on self-sealing tape, with a plastic overlay, shall be used. Each cable shall have a unique number related to the appropriate face plate number and jack letter.
- h. An example of appropriate classroom outlet labeling should be as follows:

(1) Outlet label on wall = D-C100-01-C

(a) Labeling Information:

V = Voice

D = Data

TV = Video

C100 = Building designation and room number

01 = Port number

C = IDF number or designation

- i. IDF/MDF workstation labeling shall indicate corresponding room and workstation outlet on appropriate 110 label strips and/or patch panels.
- j. An example of appropriate interbuilding cable labeling at MDF/IDF locations for multi-pair copper and fiber optic cabling should be as follows:
 - (1) Termination labels on 110 block or coupling label on fiber optic terminal panel = C100-01
 - (a) Labeling information:
 C100 = Building designation and room number
 01 = port number

B. Racks/Cabinets

- 1. Racks and cabinets shall be attached to building structures. Provide additional accessories required for a complete functional system. Racks and cabinets shall be seismically braced.
- 2. Racks shall be grounded as specified in Article 250 of the California Electrical Code.
- 3. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
- 4. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- 5. Maintain the required bending radius of conductors inside the cabinet.
- 6. Clean the cabinets of foreign material such as cement plaster and paint.
- 7. Distribute and arrange conductors neatly in the wiring gutters.

3.2 CERTIFICATION AND TESTING

- A. Provide the Owner's Authorized Representative (OAR) with copies of factory calibration certificates for each test set used in the testing procedures. Test equipment used shall have been factory calibrated within the previous 12 month period. Operators of the test equipment shall have factory training in the use of the equipment and its software. Cables and termination hardware shall be 100 percent tested for defects in installation and to verify cable performance under installed conditions. Conductors of each installed cable shall be verified useable prior to system acceptance. Defect in the cabling system installation including, but not limited to, cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100 percent usable conductors in cables installed (at the expense of the contractor).

B. Local Area Network:

- 1. Copper:
 - a. Each cable shall be tested for continuity on all pairs and conductors.

- b. Enhanced Category 6A data cable shall be performance verified using an automated test set for Category 6A link configurations.
 - c. Test set shall be certified Level IIE. To ensure verifiable equipment calibration, the Owner shall require field calibration each time a new set of tests are performed. Test for the continuity parameters defined above, and provide results for the performed tests. This test set shall be capable of testing for the continuity and length parameters defined above, and provide results for the following tests:
 - (1) Attenuation.
 - (2) Wire Map.
 - (3) Attenuation to Crosstalk Ratio ACR.
 - (4) Pair-to-pair NEXT loss.
 - (5) PSNEXT loss.
 - (6) Return Loss.
 - (7) Pair-to-pair ELFEXT.
 - (8) PSELFEXT.
 - (9) Propagation delay.
 - (10) Delay skew.
 - (11) Cable length.
 - d. Cable length shall be tested using the cable manufacturers' published Nominal Velocity of Propagation (NVP) parameter. Owner's Quality Assurance Agent shall verify the NVP setting prior to commencement of the testing process. Generic settings not using the published NVP parameter will not be accepted.
 - e. Test results shall be automatically evaluated by equipment, using the most up-to-date criteria from the ANSI/TIA-568-C standard and the results shown as pass/fail.
 - f. Test results shall be printed directly from the test unit in native format, and both hard and soft copies in native format shall be provided to the Owner. The printed test results shall include tests performed, the expected test result, and the actual test result.
2. Fiber Optics:
- a. Terminate, test, and document multi-mode and single-mode fiber optic cables with approved connectors at the drop locations and on approved fiber optic patch panels at the MDF, IDFs, and LDFs. No fiber optic cables shall remain un-terminated.
 - b. Fiber optic cables shall meet EIA/TIA performance standards and shall be tested in accordance with applicable standards. Light source and power meter tests shall be dual wavelength and shall be tested in both directions at each wavelength on each fiber strand. Optical time domain reflectometer (OTDR) tests shall be performed with an instrument suitable for testing campus cable plants. OTDR tests shall be conducted at both wavelengths from the MDF with sufficient launch cables installed at both ends of the fiber

run to clearly identify the mated connectors. OTDR launch and landing cables shall not be less than 100 meters in length. The light pulse duration used shall not be greater than 50 nanoseconds. Sampling resolution shall not be less than five feet per 100 meters.

- (1) Single-mode fiber optic cable runs less than or equal to 200m shall be tested in both directions at each frequency with a power meter and light source combination that can verify distance and attenuation. Wavelengths tested shall include 1310nm and 1550nm.
- (2) Single-mode fiber optic cable runs greater than 200m shall be tested with a power meter and light source combination and with an OTDR. Wavelengths tested shall include 1310nm and 1550nm.

3. Completion: Work for the installation shall be considered complete after the following have been accomplished:

- a. System testing has been completed. Certify that system is in working order. Cable Test Forms and equipment-specific test documentation, both electronic files and paper records, have been submitted to the Owner.
- b. Ceiling panels previously removed have been put back in place.
- c. System labels have been put in place.
- d. Construction debris and scrap materials have been removed from project site.
- e. Marked up, project record documents have been returned to the Owner
- f. Unused customer material has been returned to the Owner.
- g. The Owner has successfully completed acceptance testing of the network wiring installation.
- h. The Owner's Inspector has inspected and accepted the installation.
- i. Punch list items have been completed.

3.3 PROJECT RECORD DOCUMENTS

A. As-Built Documentation

1. Block diagrams indicating items and their point- to-point connections in a manner following floor plan layout.

B. Operating and Servicing Manuals, Record Drawings:

1. Deliver three copies of operating, specification descriptions, and/or service manual. Each complete manual shall be bound in a three ring binder, and data shall be typewritten or drafted.
 - a. Manuals shall include a page with Project site and Project name, date of Substantial Completion, Contractor name, address, telephone, and fax numbers.
 - b. Manuals shall contain a letter, signed by an officer of the company indicating

the beginning and ending date of any warranties described in Article 1.07 of this specification and shall describe the company's commitment to service the warranty during the terms specified.

- c. Manuals shall include specifications and instructions necessary for proper operation and servicing of system.
 - d. Manuals shall include installation and coordination drawings specifically related to this section shall be included as follows:
 - (1) Size A (8 ½ by 11) and size B (11 by 17) shall be bound into the manual.
 - (2) Larger drawings shall be folded and inserted into transparent envelopes and bound into the manual.
2. Deliver two copies of Record drawings on labeled CDs (Compact Disks) representative of the work performed shall be presented at completion of work in the most recent Autodesk's AutoCAD format (.dwg), for Microsoft Windows.
- a. The submittal shall contain systems wiring installed including telephone, LAN, and any other low voltage system Contractor- installed wiring.
 - b. The submittal shall consist of two electronic copies on CD-ROM and three paper record copies on no less than "E" size drawings, presented prior to the acceptance inspection.
 - c. Owner utilizes layers as a key tool in controlling visibility of drawing elements and to provide consistent information between drawings, yet provide control over what is seen on each sheet. Premise wiring shall be shown on a separate layer, labeled as "Premise Wiring" that uses both building floor plans and conduit supporting structure layers below. The use of any version control blocks or company logos shall be on a layer separate from the premise wiring as- built drawings.
 - d. AutoCAD, electronic files supplied shall be multi-layer drawings with the following layers as a minimum:
 - (1) Layer 1 shall contain title blocks only.
 - (2) Layer 2 shall contain building or site plan backgrounds only.
 - (3) Layer 3 shall contain terminal cabinets, devices, cabling, and other system components.

C. Cable Numbering Records:

- 1. Owner requires both labeling and record documentation at the conclusion of each cable installation project. Labels and cable records allow the Owner to locate, identify, and diagnose cases of trouble more efficiently. They are required for each cable installation project regardless of size and scope.
 - a. Installation, provide a cable management spreadsheet that shall include the following:
 - (1) Cable Schedule.

- (2) Cable Test Forms.
- (3) Cable Labels.
- (4) Network planning chart.

- b. Present the data in an Excel spreadsheet that will operate on Windows XP or Windows 7 platforms. Information shall be presented in paper and electronic forms in a format that will be provided by the Owner.
- c. A paper copy of the cable schedule in a transparent plastic sleeve shall be affixed to the front door of each Intermediate and Local Distribution Frame (IDF and LDF). In the MDF cabinet, the cable schedule shall be affixed to the rear door of the cabinet.

3.4 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.5 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

APPENDIX 1 – ACRONYMS

ANSI	American National Standards Institute
BICSI	Building Industry Consulting Services, International
CESM	Compact Edge Switch – Managed
CLDF	Classroom Local Distribution Frame
EIA	Electronic Industries Alliance
ESM	Edge Switch-Managed
FEP	Fluorinated Ethylene Propylene
HVAC	Heating, Ventilation, and Air Conditioning
IDF	Intermediate Distribution Frame
IEC	International Electro technical Commission (IP Code)
IEEE	Institute of Electrical and Electronic Engineers
IP32	Degree of Ingress Protection Provided by Enclosures (IEC)
IP	Internet Protocol
IPX	Inter-network Packet Exchange
ISA	Industry Standard Architecture
ISDN	Integrated Services Digital Network
ISM	Intermediate Switch-Managed
ISP	Internet Service Provider
LAN	Local Area Network
LDF	Local Distribution Frame
LIU	Light Interconnection Unit
MDF	Main Distribution Frame
MDF-BBS	Main Distribution Frame Backbone Switch
MPOE	Minimum Point of Entry
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
OAR	Owner Authorized Representative
OFNR	Optical Fiber Non-Conductive Riser
OTDR	Optical Time Domain Reflectometer.
PA	Public Address
TIA	Telecommunications Industry Association
UL	Underwriters Laboratories Inc.
UTP	Unshielded Twisted Pair
WAN	Wide Area Network

END OF APPENDIX 1

APPENDIX 2 – DEFINITIONS

BBS	The Backbone Switch that serves as the central point of network termination, and provides network connectivity to IDFs, computer labs, student nutritional service areas, and libraries.
ISM	The Intermediate Switch–Managed serving as the network termination point for horizontal cabling to classrooms and other areas excluding computer labs and libraries.
ESM	The Edge Switch–Managed serving as the network termination point for horizontal cabling within computer labs, student nutritional service areas, and libraries.
CESM	The Compact Edge Switch-Managed and is a small form factor network access point within the classroom or other designated area for network connections.
MDF	The structure that serves as an entrance facility or main cross-connect, serving the building or campus.
IDF	Located between the MDF and the LDFs and provides a network access point for horizontal fiber cabling.
LDF	A wall-mounted cabinet that serves as the termination point for Category 6A cabling within the room/area in a computer lab, student nutritional service area, or library.

END OF APPENDIX 2

SECTION 274116

SOUND REINFORCEMENT SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes all professional services, transportation services, supervision, coordination, etc., necessary to complete the installation of a high quality Audio System as specified. "Audio System" references the system and "Audio System Installer" references the installer. The Audio System Installer is responsible for sizing the sound cabinet, amplifiers, patch panels, transformers, etc. to ensure a complete and properly operating system in accordance with the performance criteria set forth in this specification. All installed equipment must be new and in unused condition. It is the intent of the specifications to indicate the quality, configuration, and performance of the Audio System. The Audio System installation includes the following:
 - 1. Point Source Sound System
 - 2. Audio Control System
 - 3. Cables, connectors, plates and wiring
 - 4. All necessary design, fabrication, processing and amplification equipment, and installation for a complete sound system as described
- B. The section also includes:
 - 1. Scope of work
 - 2. Verification of dimensions and conditions at the job site
 - 3. Preparation of submittal information
 - 4. Installation in accordance with the contract documents, manufacturers recommendations, and all applicable code requirements
 - 5. Instruction of operating personnel: provision of manuals
 - 6. Maintenance services and warranty

1.2 REFERENCES

- A. Audio System Design and Installation, G.H. Philip Giddings, 1990
- B. Digital Audio Engineering - Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data, Recommended Practice (AES-3), ANSI S4.40, 1992
- C. Handbook for Sound Engineers (Third Edition) Glen M. Ballou, 2002
- D. Loudspeaker Components Used in Professional Audio and Sound Reinforcement, ANSI S4.26, 1984 (R1992)
- E. Sound System Engineering (Third Edition), Don Davis and Eugene Patronis, Jr., 2006
- F. Standard for Safety for Audio, Video, and Similar Electronic Apparatus – Safety Requirements: IEC 60065, UL 60065, EN 60065, and CAN/CSA C22.2 #60065
- G. Information Technology Equipment-Radio Disturbance Characteristics: EN 55022:2010 / AC:2011, Class A / CISPR 22 (ed.5); am1
- H. *Electromagnetic Compatibility*: EN 61000-3-2:2006 +A1:2009 +A2:2009 / IEC 61000-3-2 (ed.3); am1, am2
- I. *Electromagnetic Compatibility*: EN 61000-3-3:2008 / IEC 61000-3-3 (ed.2)
- J. *Information Technology Equipment – Immunity Characteristics*: EN 55024:2010 / CISPR 24 (ed.1); am1, am2; 47 CFR, Part 15:2010, §15.107 and §15.109, Class A; ICES-003, Issue 4:2004

- K. National Electric Code

1.3 SYSTEM DESCRIPTION

- A. The following is intended to provide an overview of the design concepts and is not an exhaustive description of the Audio System.
- B. The Audio System consists of a main speaker cluster that may be integrated with a display structure. It is composed of horn-loaded, three-way, full-range tri-amplified design with built-in signal processing.
- C. The Audio System includes speaker amplification and signal processing components that are 100% self-contained within the speaker cabinet. All electronic components are to be properly housed and shielded from the elements to ensure long life. Fiber optic cable utilized to interconnect the control rack at the audio mix location to the main cluster. Design the system to ensure that all processing and amplification equipment meets project and manufacturer's recommendations for allowed headroom. The services of the Audio System Installer include all necessary acoustical, electrical, mechanical, and structural engineering to incorporate a complete sound system.
- D. The Audio System has remote diagnostics capabilities including – temperature monitoring, amplifier status, and speaker coil impedance.
- E. The audio system will incorporate an analog back-up system. In the event of a failure in the digital audio system, the operator will be able to engage a single switch to bypass all digital equipment to deliver analog audio to the power amplifiers.
- F. Scope of work includes the following: fiber optic cable between the press box (designated by owner) and the control enclosure supplied by the Audio System Installer, and AC power feeds to the main speaker cluster and control equipment. A licensed electrician must perform all high voltage electrical work.
- G. All structural components provided by the Audio System Installer must be certified by a structural engineer. Documentation of engineering reviews and structural certification of the speaker cabinet structures must be provided. Structural steel accommodations for incorporating the speaker cabinet into a complete display structure will be the responsibility of the Audio System Installer. The internal structure of the cabinet is constructed to minimize structural vibrations induced by the speaker components. Access doors on the back of the cabinet allow for easy access to internal components. The mesh on the front of the cabinet is bolted into place.
- H. Provide the front of the main speaker cabinet that consists of an extruded aluminum grille frame covered with signage grade, vinyl mesh material. The vinyl material must be acoustically transparent and provide the capability of creating a speaker grille covering with custom printed graphics. The specified graphic art is printed using a large format, photographic quality, color printing process.
- I. Provide external surfaces of the cabinets that are skinned with powder-coated black aluminum. Provide exterior paint which is automotive grade, resistant to fading, peeling or chipping.
- J. Loudspeaker
 - 1. Safe, secure and permanent manner in their operating position.
 - 2. The aiming direction of the mid/high loudspeakers must be adjustable by 0-30 degrees horizontally.
 - 3. Rigging, mounting and support systems for loudspeakers reviewed and certified by a registered professional engineer.
 - 4. Structural support members to have an appropriate safety factor (determined by a structural engineer). All fasteners to be graded and certified for use in the intended applications.
 - 5. All loudspeakers rigidly supported inside of the sound cabinet. Wire rope and/or chain suspension of loudspeaker components inside the sound cabinet is unacceptable.

- K. The Audio System is to achieve the following performance standards: continuous output level of 122 dBA at 1 meter with sufficient headroom to allow for peaks. The frequency response of the sound system to be at least 45 Hz to 13 kHz, -10 dB at 1 meter.
- L. The Audio System utilizes digital signal processing for all applications. All digital signal processing is contained within each amplifier. Each amplifier's digital signal processor will provide the following signal processing capability: gain control, minimum four band filtering or equalization, delay, crossover, and limiting.

1.4 SUBMITTALS

- A. Submit the following documents with bid proposal. Failure to provide a complete set of submittals will result in disqualification. Provide shop drawings and submittal data containing sufficient information to describe the work to be performed. Prepare drawings at an appropriate scale. Submit shop drawing information at one time. Provide the following information, but not necessarily limited to:
 - 1. System description
 - 2. Complete system equipment list, with individual specification sheets for each piece of equipment
 - 3. Functional system block diagram showing all major equipment and signal flow
 - 4. Basic speaker cabinet design drawings consisting of the cabinets' overall dimensions, cabinet integration with a display structure and estimated weight of entire system with all equipment installed
 - 5. Speaker cluster drawings showing all speakers in their installed position and estimated electrical draw of the entire system
 - 6. Proof of performance illustrations as generated by an acoustical CAD modeling program (EASE or equivalent). Illustrations to include direct field sound pressure level performance throughout the stadium at 125 Hz, 250 Hz, 500 Hz, 1,000 Hz, 2,000 Hz and 4,000 Hz.

1.5 DELIVERY, STORAGE AND HANDLING

- A. The Audio System Installer will be responsible for transporting all related audio equipment to the job site. Upon installation, audio equipment becomes the responsibility of the owner.
- B. The Audio System Installer will be responsible for audio equipment once it is received at the job site. In addition, Audio System Installer will be responsible for unloading the shipment truck, providing safe storage of audio equipment, installation of audio equipment and all necessary welding of structure.
- C. All transportation expenses of equipment to the job site will be the responsibility of the Audio System Installer.

1.6 PROJECT CONDITIONS

- A. Audio System Installer desiring to submit a proposal are responsible for acquiring, from the owner, any plans or documentation pertaining to the audio system installation and are encouraged to perform a pre-bid site survey.
- B. Confirm conditions on the jobsite pertinent to this work. Give notice to the owner in writing of discrepancies, conflict, or omissions promptly upon discovery.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of audio equipment through one source from a single manufacturer.
- B. ETL listed and conform to IEC 60065, UL 60065 and EN 60065
- C. Certified to CSA C22.2 #60065
- D. Carries the ETL US, ETL Canada, ETL EU, and CE marks

- E. Manufacturer's qualifications: A minimum of five (5) years' experience with the specified types of products and installation.
- F. Installer's qualification: Business familiar in the installation of systems similar in complexity to those essential for this project; and fulfillment of the following:
 - 1. The primary business of contractor shall be in the installation of sound and video systems.
 - 2. At least (5) five years' experience with systems of the specified types and products included.
 - 3. Experience with comparable scale sound reinforcement projects within the last three (3) years.
 - 4. Retain a fully staffed and equipped service facility with fulltime field technicians.
 - 5. Be a franchised dealer and approved service facility for all amplifiers, digital and analog signal processing equipment and loudspeaker products specified or proposed; if not, supply detailed description of how warranty service on these items will be obtained, and if any manufacturer's warranties will become void.
 - 6. Installer to be factory educated in the installation and maintenance of any digital signal processed based control systems.
 - 7. At the request of the owner, the Installer must demonstrate that he has:
 - a. Sufficient plant and equipment to complete the work within the agreed timetable
 - b. Sufficient staff with commensurate technical experience
 - c. Appropriate financial status to meet the obligations of the work
 - d. Capability to provide performance bonding

1.8 WARRANTY

- A. Provide a complete system parts warranty for a minimum period of one year after completion and acceptance of audio system.
- B. This warranty will not void specific warranties issued by manufacturers for greater periods of time. Nor will it void any rights guaranteed to the owner by law.
- C. The Audio System Installer must provide the owner an opportunity to purchase a preventive maintenance inspection agreement or full service agreement. The minimum term of any maintenance or service agreement consists of one year.
- D. Warranty replacement and service of equipment will not apply to any owner-furnished equipment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. To establish the minimum functional, aesthetic and quality standards, products and product series of the manufacturers listed below are required.
- B. Substitutions: Products of other manufacturers are acceptable provided they meet the performance and reliability standards of the recommended equipment.

2.2 GENERAL

- A. Regardless of the length or completeness of the descriptions below, each device shall meet published manufacturers' specifications.
- B. Equipment and materials must be new and conform to applicable UL or ANSI provision.
- C. Product quantity is as required. If a quantity is given, Audio System Installer shall provide at least the given amount.

2.3 MAIN SPEAKER CLUSTER

- A. Engineered speaker cluster consisting of self-powered three-way active devices
 - 1. Frequency response (-10 dB @ 1 m): 45 Hz to 13 kHz
 - 2. Max SPL (@ 1 m): 122 dBA
 - 3. Overall cluster dispersion: 40 V X 60 H @ 2
 - 4. Audio input: CobraNet® digital audio
 - 5. Weather treatment: polyurea coating
 - 6. Acceptable products:
 - a. Daktronics Sportsound® 500HD-D System
 - b. JBL PD764-WRC (@ 2) and ASB6125 (@ 1)
- B. Amplifier Rack
 - 1. Tri-amplified system with CobraNet® input, DSP and monitoring for each speaker set
 - 2. Frequency response: 20 Hz to 20 kHz +/-1 dB
 - 3. Signal to noise: -95 dB, 20 Hz to 20 kHz
 - 4. THD+N: 0.02%
 - 5. Acceptable products:
 - a. Daktronics Audio 500-1000-1000 and 500-1000 amplifiers
 - b. Crown Cts 600 w/ PIP-USP3/CN (@ 1) and Cts 3000 w/ PIP-USP3/CN (@ 2)
- C. Fiber Conversion Box
 - 1. Media Converter/Network Switch
 - a. Four (4) 10/100 Mbps ports
 - b. Auto speed sensing UTP ports
 - c. One (1) 10/100 BASE-TX (RJ45) to 100BASE-FX 1300nm multimode
 - d. Acceptable products:
 - 1) MOXA EDS-205A-M-ST-T
 - 2) Netgear ProSafe™ FS105 (@ 1) and Transition Networks J/E-PSW-FX-02 (@ 1)
 - 2. CobraNet® Injector
 - a. Two channel analog input
 - b. CobraNet® networking protocol
 - c. Frequency response: +/- .25 dBv 20 Hz to 20 kHz at unity gain
 - d. Input impedance: 20 kΩ balanced
 - e. Acceptable products: Biamp Audia EXPI/O-2, or equal.

2.4 AUDIO CONTROL SYSTEM

- A. Equipment Rack
 - 1. Top is (10U) angled rackmount rails + 6" in rear for cables
 - 2. (6U) vertical rackmount space below
 - 3. Locking covers
 - 4. Acceptable products: SKB 10x6 Roto Rack Console, or equal.
- B. Audio Mixer
 - 1. Eight mic/line inputs
 - 2. Two 1/4" stereo inputs
 - 3. Three band EQ per channel
 - 4. Frequency response, mic/line input to any output: 20 Hz to 20 kHz +/- 0.5 dB
 - 5. One insert per channel
 - 6. Gain control per channel: +5 to +60 dB
 - 7. Two aux outputs (pre or post-fader selectable)

8. 2-track inputs and outputs: Unbalanced RCA connector
 9. Acceptable products:
 - a. Soundcraft EPM8
 - b. Allen and Heath WZ3-8:2
 - c. Or equal.
- C. Rackmount Surge Suppressor
1. 9 outlets
 2. Resettable circuit breaker
 3. Max surge current: 50 kA
 4. Joule rating: 1800 joules
 5. Acceptable product: Middle Atlantic PD-915R, or equal.
- D. Audio Signal Switch
1. Style: 2 Position
 2. Operator action: maintained
 3. 1 RU standard rack space, black
 4. Laser etched text
 5. Acceptable products: Daktronics Signal Switch, or equal.
- E. Wireless Microphone Receiver
1. 1/2 RU unit
 2. 24 bit digital audio
 3. XLR balanced mic/line outputs
 4. RF Sensitivity: -97 dBm at 10^{-5} BER
 5. Audio Frequency Response: 20 Hz to 20 kHz, +/- 1 dB
 6. Audio Dynamic Range: > 120 dB (A)
 7. Total Harmonic Distortion: < 0.1%
 8. Acceptable products:
 - a. Shure QLXD4.
 - b. AKG DSR700 V2.
 - c. Or equal.
- F. Wireless Handheld Transmitter
1. Microphone element: Cardioid, Dynamic Vocal Microphone
 2. Working Range: 100 m (328')
 3. Battery life: 9+ hours
 4. RF Output: Selectable 1 mW or 10 mW
 5. Acceptable products:
 - a. Shure QLXD2/58.
 - b. AKG DHT700 V2.
 - c. Or equal.
- G. Professional CD/Media Player
1. MP3, WAV, AAC, and WMA file playback
 2. Support for SD/SDHC cards and USB memory devices
 3. Wireless playback via Bluetooth™ devices
 4. AM/FM radio tuner
 5. Balanced XLR and Unbalanced RCA outputs
 6. Acceptable products:
 - a. TASCAM CD-400U
 - b. Denon DN-300Z
 - c. Or equal.

- H. Laptop Interface
1. 1/8" (3.5 mm) male input
 2. Balanced XLR male output
 3. Adjustable output volume control
 4. Acceptable products:
 - a. LTIBLOX Laptop Interface
 - b. Whirlwind podDI
 - c. Or equal.
- I. USB Audio Interface
1. 24-bit, 96 kHz quality audio
 2. Two balanced XLR outputs (left and right)
 3. 3.5mm TRS headphone output
 4. Ground lift and mono-sum switches
 5. Acceptable product: Radial® Engineering USB-Pro™, or equal.
- J. Self-powered Monitor Speaker
1. Three inputs: one 1/4" phone, one RCA, one XLR
 2. Tone control (High/Low)
 3. Acceptable product: Yamaha MSP3, or equal.
- K. Push-to-Talk Announcer Interface
1. Balanced XLR input, balanced XLR output, and 1/4" headphone jack
 2. Momentary and continuous audio output modes
 3. Acceptable products:
 - a. Daktronics Announcer's Interface
 - b. Studio Technologies, Inc. Model 210 Announcer's Console
 - c. Or equal.
- L. Handheld Vocal Microphone
1. Dynamic microphone with unidirectional (cardioid) polar pattern
 2. Frequency response: 50 Hz to 15 kHz
 3. Acceptable product:
 - a. Shure SM58
 - b. AKG D5
 - c. Or equal.
- M. Dynamic Headphones
1. Neodymium magnet
 2. Gold 1/4" and 1/8" plug
 3. Acceptable product: Sony MDR7506, or equal.
- N. Single-Muff Headset
1. Neodymium magnet
 2. Cardioid condenser microphone
 3. Acceptable product: Beyerdynamic DT 287, or equal.
- O. Additional Wireless Microphone Receiver
1. 1/2 RU unit
 2. 24 bit digital audio
 3. XLR balanced mic/line outputs
 4. RF Sensitivity: -97 dBm at 10⁻⁵ BER
 5. Audio Frequency Response: 20 Hz to 20 kHz, +/- 1 dB

6. Audio Dynamic Range: > 120 dB (A)
7. Total Harmonic Distortion: < 0.1%
8. Acceptable products:
 - a. Shure QLXD4.
 - b. AKG DSR700 V2.
 - c. Or equal.

P. Wireless Bodypack Transmitter

1. Connector: 4-pin male mini connector (TA4M) for microphone or mute switch
2. Working Range: 100 m (328')
3. Battery life: 9+ hours
4. RF output: Selectable 1 mW or 10 mW
5. Acceptable products:
 - a. Shure QLXD1
 - b. AKG DPT700 V2
 - c. Or equal.

Q. Referee Headset

1. Electret condenser microphone element
2. Unidirectional cardioid polar pattern
3. Acceptable product: Shure SM35, or equal.

R. In-Ear Monitor System

1. Audio frequency response: 35 Hz to 15 kHz
2. Operating range: 300 ft
3. Total harmonic distortion: 0.8% typical
4. Signal-to-noise ratio: 90 dB typical
5. RF output power: 100 mW typical
6. Acceptable products:
 - a. Shure PSM-900
 - b. Sennheiser EN300 IGMG2
 - c. Or equal.

S. ADA Hearing Assist

1. Signal-to noise ratio: SQ enabled: 70 dB; SQ disabled 50 dB
2. 57 channels
3. Frequency response: 50 Hz to 15 kHz +/- 3dB
4. Acceptable products:
 - a. Listen LS-54-216
 - b. Telex SMP400
 - c. Or equal.

T. High Gain Antenna Kit

1. Cardioid directional antenna
2. 6 dB gain
3. Acceptable product: Shure PA805 @ 2, or equal.

2.5 CABLE AND CONTROL WIRING

- A. All cables must be installed in conduit or closed raceway areas. Use plenum cable as necessary. Exposed cable is not acceptable. Cable specifications are as follows:

1. Multi-mode fiber optic cable from audio control to sound cabinet.
2. Microphone level cables: No. 22 shielded jacketed - Belden 9451 with black jacket.

3. Or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate work with other trades to prevent delays in the construction schedule.
- B. Verify dimensions and location of equipment to be mounted.

3.2 INSTALLATION

- A. Mount equipment and enclosures square and plumb. Permanently installed equipment to be held firmly and safely in place. Loudspeaker mounting systems and sound cabinet mounting systems to be approved by a structural engineer. All mounting brackets must be approved by a structural engineer.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation and initial test adjustments, the audio system installer will conduct a performance evaluation in the presence of the owner or the owner's representative (owner's option). The audio system installer will notify the owner or the installer's representative of the testing schedule.

END OF SECTION

SECTION 27 51 00

INTEGRATED COMMUNICATIONS SYSTEM

PART 1– GENERAL

1.01 SCOPE

- A. Expand and interconnect the existing campus-wide, Bogen Quantum Multicom IP Communications System to the new stadium and ancillary structures. Upon completion of the project the expanded, integrated communications system shall be complete with all the capabilities of the latest Norwalk La Mirada Unified School District standard for integrated communications systems as noted in this specification. All provisions for a complete and operable system with interface to existing Telephone System shall be included under this scope of work. The existing Integrated Communications System is integrated with the existing telephone system.
- B. The Contractor shall furnish all labor, materials, appliances, tools, equipment, facilities transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the applicable Contract Drawings and/or specified herein.
- C. Any material and/or equipment necessary for the proper operation of the system, which is not specified or described herein, shall be deemed part of this Specification.
- D. The existing Integrated Communications System specified herein shall be expanded to the new stadium and ancillary structures.
 - 1. Contractor shall coordinate with the Owner or his representative to ascertain the required number of telephone to intercom circuit interfaces (minimum of four).

1.02 QUALIFICATIONS

- A. Equipment
 - 1. This specification is based on the equipment of manufacturer(s) who have been approved by the Owner and the Manufacturer(s) herein named shall be considered as meeting the requirements of this specification.
 - 2. The equipment manufacturer shall be a United States manufacturer, who has been regularly engaged in the manufacture of communication systems for at least thirty (35) years.
 - 3. Equipment provided for this project shall be the product of Bogen Communications, Inc., Engineered Systems Division and Advanced Network Devices (AND). No substitutions shall be approved.
 - 4. All equipment shall conform to applicable codes and ordinances.
 - 5. All equipment shall bear the label of a Nationally Recognized Testing Laboratory (NRTL) such as Intertek Testing Services NA, Inc. (ITSNA - formerly ETL) or Underwriters Laboratories Inc. (UL) and be listed by their re-examination service.
- B. System Supplier/Installer
 - 1. The system shall be provided and installed by the Manufacturer's Authorized Distributor who is trained and certified by the Manufacturer in the proper installation, programming, service and maintenance of the system.
 - a) Contact Bogen Communications, Inc., Engineered Systems Division (480) 892-7614 for the local authorized distributor.
 - b) Contact Advanced Network Devices (AND) www.anetd.com for a local authorized distributor.

2. The System Supplier/Installer shall hold a valid State of California Contractor's License, C-10.
3. The System Supplier/Installer shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization capable of furnishing adequate inspection, service and maintenance of the system. The System Supplier/Installer shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.
4. The System Supplier/Installer shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.
5. The System Supplier/Installer shall be an established communications and electronics contractor that has and currently maintains a locally run and operated business for at least twenty (30) years.
6. The System Supplier/Installer shall perform the entire installation consisting of: wiring, device connection terminations, programming, inservices and warranty repair.
7. The System Supplier/Installer shall be a Low voltage systems Contractor, normally engaged in the business of sound reinforcement / intercom systems installation.
8. The System Supplier/Installer shall designate one person to act as the project manager having total responsibility for communications and project technical integrity. This project manager shall have a minimum of five (5) years experience as a supervisor and installer of the systems specified herein.

1.03 RELATED SPECIFICATIONS

- A. The conditions of the General Contract (General, Supplementary, and other Conditions) and the Division 1 - General Requirements specifications are hereby made a part of this Section.

B. RELATED WORK BY OTHERS

1. All conduits with pull cords, all electrical pull boxes, grounding rods, terminal cabinets, backboards and all outlet boxes shall be provided and installed by the Division 26 Contractor. Coordinate as necessary for proper installation. Specialty boxes shall be provided by the system Supplier/Installer and shall be installed by the Division 26 Contractor.
2. All 120VAC power conductors and conduits associated with power circuits to all low voltage system equipment locations shall be provided and installed by the Division 26 Contractor.
3. An insulated stranded copper ground wire shall be provided from each equipment rack to the building grounding system, in compliance with CEC Article 250, by the Division 26 Contractor.
4. Labeling of pullboxes and terminal cabinets shall be provided and installed by the Division 16 Contractor.

1.04 APPLICABLE CODES & STANDARDS

- A. 2019 Building Standards Administrative Code, Part 1, Title 24, California Code of Regulations
- B. 2019 California Building Code (CBC) Part 2, Title 24, California Code of Regulations (International Building Code, Volumes 1 & 2 with California Amendments)
- C. 2019 California Electrical Code (CEC) Part 3, Title 24, California Code of Regulations (National Electrical Code with California Amendments)
- D. 2019 California Fire Code (CFC) Part 9, Title 24, California Code of Regulations (International Fire Code with California Amendments)

1.05 SUBSTITUTIONS

- A. No substitutions shall be approved.

1.06 SUBMITTALS

- A. Within thirty-five (35) calendar days after the date of the award of the contract, the Contractor shall submit to the Architect for review, ONE (1) Electronic Copy and TWO (2) hard copies of a complete Submittal Package. The Submittal Package shall consist of the following sections, with each section separated with index tabs.
1. Title Page
 - a) Project Title
 - b) Project address
 - c) Architect's name and address
 - d) Contractor's name and address
 2. Index of Submittal Contents
 - a) Each Section of the Submittal Package shall be numbered chronologically and shall be summarized in the Index.
 3. Certifications
 - a) Index of Certification Section Contents
 - b) Valid State of California Contractors License
 - c) Manufacturer's Certifications
 - 1) Authorized Distributor
 - 2) Factory Trained Technician
 4. Project List
 - a) A substantial list (minimum of 20) of completed projects equal in scope to that specified herein.
 - 1) Contact information shall be made available upon request.
 5. Product Data
 - a) Index of Equipment Data Sheets
 - b) Manufacturer's Data Sheets including cable types
 - 1) Applicable Listings and Approvals

PART 2- PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The existing Integrated Communications System provides a comprehensive communication network between administrative and staff locations. The central processor and switching unit shall be of modular plug-in printed circuit board type, using HMOS microprocessor and TTL logic and HCMOS memory and sensing. HCMOS circuitry shall be protected with transient voltage surge suppression devices on all inputs and outputs. Non-volatile EPROM shall store permanent memory and non-volatile EEPROM shall store field-programmable memory. Systems, which use a battery to maintain system configuration information, shall not be acceptable.
- B. All upgrades and modifications to the system are to be designed and configured for maximum ease of service and repair. All major components of the system shall be designed as a standard component of one type of card cage. All internal connections of the system shall be with factory-keyed plugs designed for fault-free connection. The printed circuit card of the card cage shall be silk screened to indicate the location of each connection.

- C. Plug disconnect: All major equipment components shall be fully pluggable by means of multi-pin receptacles and matching plugs to provide for ease of maintenance and service.

2.02 ACCEPTABLE MANUFACTURERS

- A. The Integrated Communications System equipment model numbers specified herein are that of the Bogen Communications, Inc., Ramsey, New Jersey.
 - 1. The intent is to establish a standard of quality, function and features. It is the responsibility of the bidder to insure that the proposed product meets or exceeds every standard set forth in these specifications.
 - 2. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.
- B. Exterior speakers shall be products of Advanced Network Devices (AND) www.anetd.com.

2.03 SECTION INCLUDES

- A. Expansion and extension of the Existing Integrated Communications System. The existing system provides the following functions:
 - 1. Intercom System - Two way communication between any administrative phone and any interior speaker.
 - a) Call initiation switches. (As required on drawings)
 - 2. Classroom telephones.
 - 3. Public Address System
 - 4. Master Clock functionality with bell schedules and timed events.
 - 5. Public automated building exchange system (Passing Bells)
 - 6. Voice over Internet Protocol (VoIP) communication modules.
 - 7. Interface to Private Branch Exchange (PBX) or Voice over Internet Protocol (VoIP) system.

2.04 SYSTEM SOFTWARE PARAMETERS

- A. The existing communication system is a Bogen Quantum Multicom IP, and provides a comprehensive communication network between administrative areas and staff locations throughout the facility. The existing system provides the following features and functions:
 - 1. Telephonic communication (complete with DTMF signaling, dial tone, ringing and busy signals, and data display) on administrative stations shall use two wires. Systems that use more than two wires for communication, tones and data display shall not be acceptable.
 - 2. Amplified-voice communication with loudspeakers shall use a shielded audio pair (shield can be used as one of the two required conductors for administrative phone or call-in switch).
 - 3. Quantum IP Intercom must be capable of supporting existing Multicom 2000 hardware and functions as well as the features across the Quantum Processor's interfaced over the LAN.
 - 4. The system shall consist of the following: Administrative VoIP Phones..
 - a) Staff Classroom Stations shall consist of wall- or ceiling-mounted loudspeakers with call-in switches or handsets.
 - b) Administrative phone stations shall consist of VoIP phones.
 - 5. The system shall be a global switching system, providing up to 512 unrestricted simultaneous private telephone paths per facility. The system shall also be capable of providing up to 512 amplified intercom paths per facility. One amplified intercom path shall automatically be provided with each increment of 24 stations of system capacity. All hardware, etc., required to

achieve the necessary number of amplified-voice intercom channels for this system shall be included in this submittal. Amplified-voice intercom channels shall provide voice-activated switching. Systems requiring the use of a push-to-talk switch on administrative telephones shall not be acceptable. There shall be an automatic level control for return speech during amplified-voice communications. The intercom amplifier shall also provide control over the switch sensitivity and delay times of the VOX circuitry.

6. It is of utmost importance that emergency calls from staff stations receive prompt attention. Therefore, it is important that there be an alternate destination in case the emergency call does not get answered at the primary location. To this end:
 - a) The system shall provide 911 Dial-Through with specific outside line(s) dedicated only for this function to ensure that the line is available all the time for 911 calls. The 911 Dial-Through is available to any station that can dial.
 - b) The 911 CO lines will be pre-configured and reserved. If the 911 reserved lines are busy, the normal CO lines will be connected to route the 911 calls. If all the normal CO lines are busy, the ongoing call shall be disconnected and the 911 call shall be placed.
 - c) Staff-generated Emergency calls shall be treated as the second highest system priority. Therefore, all Emergency calls shall announce at the top of the call queue of their respective administrative telephone(s). Should that emergency call go unanswered for 15 seconds, the call shall be re-routed to an alternate speaker station then prompt the caller to make a verbal call for help. During the transfer, the original administrative telephone shall continue to ring the distinctive Emergency Ring. Should the Emergency Transfer to Station have an associated administrative telephone, it too shall ring the distinctive Emergency ring.
 - d) The Emergency Transfer to Station shall be field programmable.
 - e) Should the original administrative telephone be engaged in a non-emergency conversation, its conversation shall be automatically terminated, indicated with an alert tone, and then reconnected to the station that generated the Emergency Call.
 - f) Should the administrative telephone be engaged in an emergency conversation, successive emergency calls shall log into the call queue as well as transfer to the Emergency Transfer Station for their verbal call for help. Upon termination of the initial emergency conversation, the next one shall immediately ring the administrative telephone.
 - g) Systems failing to transfer unanswered Emergency calls or failing to immediately connect to the administrative telephone shall not be deemed as equal.
7. There shall be a System-Wide Facility Emergency All-Call feature. The Emergency All-Call shall be accessed from designated administrative phones or by the activation of an external contact closure which shall give the third audio program input emergency status. The Emergency All-Call function shall have the highest system priority and shall override all other loudspeaker-related functions including Time Tone Distribution.
 - a) Considering that emergencies calls are to be treated with the highest level of concern. Systems which do not regard Emergency-All-Call page from an administrative telephone with the highest priority shall not be deemed as equal.
 - b) Upon picking up the receiver and dialing "9", a menu shall appear on the display prompting the user to enter each subsequent digit. In this way, the user shall not be required to memorize complicated key sequences in order to access emergency functions.
 - c) The Emergency All-Call shall capture complete system priority, and shall be transmitted over all speakers in the facility. It shall also activate an external relay, which can be used to automatically override volume controls and other systems.
 - d) Systems without Emergency All-Call, or systems with All-Call that cannot be activated by external means, or which do not capture complete system priority or activate an external relay, shall not be acceptable.

8. There shall be at least four Dedicated Emergency Alarm Tones. Each may be accessed by dialing a three-digit number from designated administrative telephones. These emergency tones should be separate from the time tones. Systems using external alarm generators, or having less than four emergency alarm tones shall not be acceptable.
 - a) Upon picking up the receiver and dialing "9", a menu shall appear on the display prompting the user to enter each subsequent digit. In this way, the user shall not be required to memorize complicated key sequences in order to access Emergency Alarm Tones.
9. There shall be four (4) External-Function Relay Driver Outputs, accessible from designated Quantum Commander Users or Administrative Display Telephones by dialing a four-digit number. These outputs remain set until accessed and reset at a later time. The user shall have the ability to review the status of each relay driver. A plain English menu, prompting the user through the fields without requiring the user to remember any dialing sequences shall support this feature. Systems that require the user to remember complicated dialing schemes or prompt the user via cryptic commands shall not be deemed equal.
 - a) The stations shall be capable of being programmed for security contact relays for use with magnetic locks, motion detectors, cameras or any low-voltage, dry contact creating device. System using security stations for control of external functions shall not be acceptable.
 - b) Upon picking up the receiver and dialing "9", a menu shall appear on the display prompting the user to enter each subsequent digit. In this way, the user shall not be required to memorize complicated key sequences in order to access external relay functions.
10. There shall be a program-material interface included with each node, which shall accept up to four (4) Bogen Power Vector Series program modules. Systems requiring an external program source interface shall not be acceptable.
11. There shall be an outside line feature. The circuitry shall interface with the station ports of an external telephone system, and shall provide facilities for up to 960 incoming lines per facility which shall be designated by the user to ring "day" and "night" administrative display stations or administrative stations. Where an administrative display station is designated to receive outside line calls, the phone shall ring with a unique tone and the outside line number shall appear on the display panel. The option shall also provide the ability to make outside line calls from Administrative Display Stations or Administrative Stations. This ability shall be programmable for each phone and there shall be thirty-two Classes of Service available to any station. This feature shall be capable of supporting DID, DISA, and a Security DISA function.
 - a) Cellular system access for Security is of the utmost concern. Wireless security page offers a password-protected Security DISA feature that shall be accessible only from authorized Police, Fire, Emergency personal or an off-premise security office, which monitors the facility's security system. It shall function as follows: upon confirmation of the password DISA number, the system shall allow security personnel to dial access any station and monitor the activity without pre-announce tone or the privacy tone. This will then allow the security office to determine exactly what the conditions are in the station and the actions need to be taken.
12. The system shall provide for field-programmable three-, four-, five-, or six-digit architectural station numbers.
13. There shall be an automatic level control for return speech during amplified-voice communications.
14. Each station loudspeaker shall be assignable to any one, any combination, or all of 64 Multi-purpose zones or any of the 16,000 hard-wired zones per facility.
 - a) Each station loudspeaker shall be assignable to any one, any combination, or all of 64 Multi-purpose zones. Systems with less than 64 Multi-purpose zones shall not be acceptable.

15. There shall be thirty-two (32) Flexible Time-Signaling Schedules with a total of 1024 user-programmed events per facility. Each event shall sound one of user-selected tones or external audio. It shall be possible to assign each schedule to a day of the week, or manually change schedules from an authorized Quantum Commander User via Web browser. Systems, which do not provide a minimum of thirty-two (32) flexible time-signaling schedules or a choice of eight (8) time tones plus external audio, shall not be acceptable.
16. An internal program clock (with battery backup) shall be included, allowing a total of 1024 user-programmed events per facility. It shall be possible to synchronize the internal program clock with an external master clock. Systems, which do not provide an internal program clock and/or can not synchronize with an external master clock to meet these specifications, are not equal.
 - a) There shall be thirty-two (32) flexible time-signaling schedules. It shall be possible to assign each schedule to a day of the week, or manually change schedules from an authorized Quantum Commander User via Web browser on the LAN/WAN.
 - b) The built-in Master Clock corrects time by accessing the LAN/WAN NTP time server.
 - c) The Quantum Processor is capable of adjusting the Daylight Savings Time automatically.
 - d) Each event shall be able to be directed to any one or more of the sixty-four (64) Multi-purpose time-signaling zones.
 - e) Each of the 64 Multi-purpose zones shall have a programmable "tone duration" unique unto itself. For example: the gymnasium shall receive a time tone for ten (10) seconds while the rest of the facility receives a tone for five (5) seconds.
 - f) Each event shall sound one of eight (8) user-selected tones or external audio. Each event may utilize a different custom tone. It shall be utilized to send the gymnasium, shop classes, and pool (if necessary), a separate time tone to indicate "clean up." Minutes later the entire facility can then receive the same time tone to indicate class change.
 - g) Each of the eight (8) Distinct Time Tone Signals may be manually activated by selected Administrative Display Phones or from an authorized Quantum Commander User via web-browser. These tone signals shall remain active as long as the telephone remains off-hook, or until canceled from the keypad or Quantum Commander.
 - 1) Upon picking up the receiver and dialing "9", a menu shall appear on the display prompting the user to enter the next digit. In this way, the user shall not be required to memorize complicated key sequences in order to access manual time-tone functions.
 - 2) Systems that do not provide at least thirty-two (32) flexible time signaling schedules or do not provide automatic activation of schedules shall not be acceptable.
17. There shall be a zone-page/all-page feature that is accessible by selected administrative VoIP phones and administrative phones.
 - a) There shall be automatic muting of the loudspeaker in the area where a page is originating.
 - b) There shall be a pre-announce tone signal at any loudspeaker selected for voice paging.
18. There shall be a voice-intercom feature that is accessible by selected administrative phones, administrative VoIP phones and all administrative display phones.
 - a) There shall be a periodic privacy tone signal at any loudspeaker selected for amplified-voice communication.
 - b) There shall be a pre-announce tone signal at any loudspeaker selected for voice-intercom communication.

- c) Privacy and pre-announce tone signals shall be capable of being disabled during system initialization.
 - d) There shall be an automatic switchover to private telephone communication should the person at the loudspeaker pick up his handset.
 - e) By picking up the receiver and dialing the first digit of the number of the station to be called, that number shall appear on the display along with a loudspeaker symbol, prompting the user to enter the next digits. There shall be no confusion as to the type of conversation that is to be established.
19. There shall be a telephonic communication feature, which is accessible by all Administrative VoIP Phones, Administrative Phones, and Administrative Display Phones.
- a) There shall be an audible ring signal announcing that a call has been placed to that station.
 - b) Upon picking up the receiver and dialing * (star), a telephone symbol shall appear on the display, prompting the user to enter the number of the station to be called. There shall be no confusion as to the type of conversation that is to be established.
 - c) There shall be an automatic disconnect of Staff Handsets left off-hook to prevent them from tying up communications channels. The station shall receive a busy signal and shall automatically disconnect after 45 seconds. Systems shall also be capable of doing off hook emergency call-in.
 - d) There shall be an automatic disconnect of Administrative Display Phones, Administrative VoIP Phones, and Administrative Phones to prevent them from tying up communications channels. When a phone goes off-hook and does not initiate a call within ten seconds, the station shall receive a busy signal and shall automatically disconnect after 45 more seconds.
 - e) Staff and Administrative Phone Stations may be programmed to ring an Administrative Display Phone during day hours and another Administrative Phone during night hours. Day and Night Hours shall be user-programmable. Assignment of Staff Stations shall not be restricted to any particular Administrative Station. Systems that limit the number and assignment of staff call-in to particular Administrative Station of Administrative Stations shall not be acceptable.
20. Each staff call station shall be programmable for one of three call-in types, as follows:
- a) Normal / Emergency
 - b) Urgent / Emergency
 - c) Emergency
 - 1) Staff Call Stations programmed for access Normal / Emergency or Urgent / Emergency shall be able to initiate an emergency call by repeated flashing of the hook switch or repeated pressing of the call-in switch. Systems, which require additional switches and/or conductors to initiate an emergency call, shall not be acceptable.
 - 2) Emergency Calls from Administrative VoIP Phones, Administrative Phones or Staff Call Switch Stations shall interrupt a non-emergency call in progress at the designated Administrative Display Phone. The administrator shall receive a warning tone and be connected to the emergency caller. The disconnected party shall receive a busy signal. Systems which do not provide emergency call interrupt shall not be acceptable.
 - 3) It shall be possible to connect a single push emergency call-in switch to any Administrative VoIP Phone or Administrative Phone, without effecting normal station operation.

- 4) Normal and Urgent calls shall be logged into queue for the designated administrative display phones.
 - 5) Administrative Display Phones shall ring for a period of 45 seconds when they receive a call, and then stop ringing.
 - 6) Each queue shall first be sorted according to call priority (emergency calls, then urgent calls, and then normal calls). Calls are sorted within each priority level on a first-in, first-out basis. When a call is answered, it shall automatically be removed from the queue. Systems, which do not sort calls according to priority and order received, shall not be acceptable. 1) The display shall simultaneously show up to four (4) Staff Call Switch Station Calls pending. Additional calls, beyond four (4), shall be indicated by an arrow pointing down thus prompting the user that additional calls are waiting.
 - 7) It shall be possible to answer any incoming call simply by picking up the handset while it is ringing. It shall not be necessary to hit any buttons to answer a call unless the call has dropped into the queue.
21. Administrative VoIP Phones or Administrative Phones shall receive dial tone upon going off-hook. Outgoing calls are made by dialing the desired station. Incoming calls can be directed to the telephone or to the associated loudspeaker for a hands-free reply. There shall be an automatic switchover from loudspeaker to private telephone communication should the person pick up the handset.
- a) Administrative VoIP Phones or Administrative Phones shall be able to make a normal call to any Administrative Display Phone by dialing the number. They shall also be able to initiate an Emergency Call by flashing the hook switch. Emergency Calls shall ring the Designated Day/Night Administrative Display Phone and then their speaker will be connected to the emergency station if not answered within a predetermined time period. The system shall provide for selected administrators to have a PIN Numbers. By dialing the PIN at any system telephone, the administrator shall have access to emergency paging regardless of the restrictions on the particular phone being used.
22. Student Phone
- a) Student Phone shall be supported. The Student Phone can only make 10-digit (7 digit or less than or equal to 10 digit), 0 local and 911 calls. The call duration shall be set to 5 minutes. The dial tone shall be fed momentarily at 00:04:30, 00:04:40, 00:04:50, then at five minutes, calls are disconnected. The student phone can not receive any incoming calls.
 - b) The Station is not allowed to dial the same number within 30 minutes and a busy signal shall be fed to the Station if the number is dialed.
23. Administrative Display Phones shall be equipped with a 4x16 character alphanumeric display panel.
- a) Administrative Display Phones shall receive dial tone upon going off-hook. Outgoing calls are made by dialing the desired stations. Incoming calls can be directed to the telephone or to the associated loudspeaker for a hands-free reply. There shall be an automatic switchover from loudspeaker to private telephone communication should the person pick up his handset.
 - b) The display shall normally show the time of day and day of week, the current time signaling schedule, and the numbers of up to four stations calling in along with the call-in status of each station (normal, urgent, emergency). When dialing from the Administrative Display Phone, the display shall indicate the station number and type of station (loudspeaker or handset) being dialed.
 - c) The display shall also provide user-friendly menu selections to assist the operator when paging and distributing program material. Displays shall be in English with internationally recognized symbols for maximum ease of use. Systems, which require

the operator to memorize long lists of operating symbols or control codes, shall not be acceptable.

- d) Administrative Display Phones shall be programmable for one of 3 station types for system access, as follows:
 - 1) Shall permit dialing any station in the system; turn program material on/off at their location; scroll, erase and auto-dial call-waiting queue; make conference calls and transfer calls; call forward to other administrative stations; make all-zone pages and emergency all-zone pages; have access to outside lines and be designated to receive outside line calls.
 - 2) Select and distribute or cancel program material to any combination of stations, paging zones, or all zones; set/reset alarm/external functions and zone paging.
 - 3) Bump or join a conversation in progress, manually initiate time tones.
 - e) Program selection, and its distribution or cancellation shall be accomplished from a designated administrative display telephone, with the assistance of the menu display system. Distribution and cancellation shall be to any one, or combination of speakers, or any zone(s), or all zones. It shall be possible to provide three program channels at the same time.
 - f) It shall be possible, via an Administrative Display telephone, to manually initiate any of eight (8) tones or any of the emergency tones. The tones shall be separate and distinctly different from the emergency tones. The tone selected shall continue to sound until it is canceled, or until the administrative display phone is placed back on-hook.
 - g) Each Administrative Phone shall maintain a unique queue of all stations calling that particular phone.
24. System programming shall be from an authorized Quantum Commander User via Web browser. All system programming data shall be stored in nonvolatile memory. A valid password shall be required to gain access to the following programmable functions:
- a) Station Initialization shall be accomplished from an authorized Quantum Commander User via web browser. All station initialization data shall be stored in nonvolatile memory. A password (separate from the password necessary for system programming) shall be required to gain access to the following station initialization parameters:
 - 1) Programming and diagnostics shall be built into the Quantum Commander Web server browser and be accessible only by authorized personnel. Diagnostics shall indicate passes and failures of system memory, system clock, all audio busses, tone generators, DTMF generators and decoders and the integrity of the field wiring.
 - 2) The diagnostics feature shall be the Quantum Commander. It shall be possible to individually select the test and card, or all to run diagnostics on. This shall be a standard feature of the system and supplied at the time of installation. It shall be accessible only by authorized stations and personnel.
 - 3) Systems not capable of supporting web-based diagnostics and any computer interface for programming and diagnostics, nor supportive of built-in diagnostics for the end user shall not be deemed as equal.
25. Rollover EOL (End-Of-Line Device)
- a) This feature shall be supported for all the Stations (Staff/Enhanced/Admin/SIP) configured with a loudspeaker. Based on the dialed sequence, (*xxx, xxx) the call will be connected to the corresponding station/speaker. If the speaker/station is busy, the call is rolled over to the station/speaker corresponding to that station.
 - b) If a handset station, configured with this feature, is busy when an Admin User calls the station, the call shall be rolled over to the associated speaker. If the speaker is also busy in this case, then the Admin call can bump the conversation.

- c) Rollover End-of-Line features not applicable with the Station with Call Switch or Station without the speaker.
- d) For calls initiated by a call switch or a non-dial handset, rollover to the admin speaker shall not happen.

26. Admin AAA Group (Always An Answer)

- a) This is an Administrative Phone feature. This feature shall be programmed from the Bogen Commander. A maximum of 10 Admin Phones will be supported in an Admin Group and there shall be a maximum of 32 Admin Groups per facility.
- b) Once the Admin Group is set:
 - 1) For normal calls, if the primary Day/Night Admin Phone is busy/no answer, all the phones in the Admin Group shall ring.
 - 2) For emergency calls, if the primary day/night phone does not answer, all the phones in the Admin Group shall ring.
 - 3) On no answer from any of the admin phones and if the emergency announce link is configured, the call shall be transferred to the emergency announce link as per the existing procedures.
 - 4) On answer from any of the Admin Phones, all the other phones shall stop ringing.

2.05 SYSTEM REQUIREMENTS

A. The existing Integrated Communications System is a Bogen Quantum Multicom IP

B. The existing system provides no less than the following features and functions:

- 1. Integration to public branch-exchange for a complete and integrated telephone intercommunication solution. All features and functionality's of the system shall be accessible from the Private Branch Exchange (PBX or phone switch) or Expansion Key Service Unit (EKSU), so as not to depend on the administrative phones for all functionality.
- 2. The system shall be available in the following conguration:
 - a) Rack mount.
 - b) Single rack (node) capacity from 24 to 240 stations per node, 64 nodes per facility equaling a total of 16,000 stations per site, 100 site capacity.
 - c) All telephone stations shall have the ability to support displays.
- 3. The system shall consist of any combination of Administrative, Staff and Enhanced Staff Stations.
 - a) A minimum of one (1) Administrative Telephone required per system.
 - b) The maximum number of Administrative Telephones with displays shall only be limited by the Station capacity of the system.
 - 1) Systems that limit the quantity of each type of Station or require rewiring or additional equipment and/or system expansion to provide additional Administrative Telephones shall not be accepted as equal.
 - c) Administrative Stations
 - 1) DTMF dialing telephone sets with a four (4) line by 16-character LCD display panel.
 - 2) Standard 12 key pushbutton dialing keypad
 - 3) Loudspeaker may be connected at each location
 - 4) Optional loudspeaker may be included
 - 5) Membrane-type keypads shall not be accepted as equal

- 6) Special function keys to perform common functions shall not be accepted as equal
 - d) Staff Station
 - 1) Wall or ceiling mount loudspeaker with call-in switch
 - e) Enhanced Staff Station
 - 1) DTMF dialing telephone sets connected to the PBX or EKSU
 - 2) Systems that require telephones to be connected to the intercom system shall not be acceptable
 - 3) Optional loudspeaker may be included
 - f) All Station types shall utilize the same field wiring
 - 1) Future Station alterations shall require station type change only, not field wiring or head-end alterations. All field and system head-end equipment shall support any type of Station, at the time of installation. All proposed substitutions shall reflect this capacity. Failure to submit or bid this project in compliance with this feature will be in direct conflict of this Specification and will be rejected.
4. The system shall be capable of providing up to four (4) simultaneously amplified-voice intercom paths. One amplified intercom path shall automatically be provided with each increment of 24 stations of system capacity.
- a) All hardware, etc. required to achieve the maximum number of amplified-voice intercom channels for this system shall be included in this submittal.

C. Remote Access

- 1. The system shall be capable of remote access via LAN/WAN network.
 - a) Remote access features and functions shall include the following:
 - 1) Perform programming of the main processor including all system features and functions noted elsewhere in this specification.
 - 2) The capability to perform system diagnostics and access integral system report software regarding the current system status for the following:
 - (a) Processors
 - (b) Station Cards
 - (c) Amplifiers
 - (d) Speaker Outputs
 - (e) Call Switch Outputs
 - 3) Activation of bell schedules and programming of specific events, zones and action taken.
 - 4) Activation of all time tones, all calls, zone pages and call forwarding.
 - 5) Monitoring of unlimited areas for security purposes.
 - b) External Device Server
 - 1) Shall support RS-232, RS-422 and RS-485 serial connections
 - 2) Shall configure via HTTP, DHCP, Telnet or serial
 - 3) Shall be capable of Flash ROM upgrades
 - 4) Network Interface – (10Base-T or 10Base-T/100Base-TX) Ethernet
 - 5) Serial Interface – DB25F, RS-232/RS-422/RS-485 serial port with DCE configuration.

- 6) Shall be capable of modem emulation and accept modem AT commands on the serial port to establish a network connection to the system.
 2. The contractor shall provide all active electronics, software and peripheral equipment for a complete and operable system.
 3. Systems not capable of remote access requirements of this specification will not be considered acceptable.
- D. Graphical Interface Emergency Response/Crisis Management
1. The intercom system shall be capable of interfacing with a web based emergency management system. The emergency management system shall offer two communications using the intercom speakers located throughout the campus.
 - a) Web based graphical interface
 - 1) System shall allow for graphical representations of the school site & floor plan showing locations of emergency exits, security cameras, emergency access points, hazardous material storage, utility connections and safe zones to be used by emergency personnel.
 - 2) System shall allow for web controlled password protected covert monitoring of any speaker location thru the intercom system in emergency situations by authorized emergency personnel.

2.06 SYSTEM COMPONENTS

A. CONSOLE (existing equipment)

1. Rack-mounted equipment shall be Bogen Model TCPER
 - a) Rack-TCPER61 / TCPER77 (size rack as required)
2. MCRMP
 - a) Rack-mounting panel. Includes the following components:
 - 1) MC512A-Power Supply (1 per system)
 - 2) MC2626B-Power Supply (1 for up to 120 stations, 2 for more than 120 stations)
 - 3) MCAPI-Audio Program Module Interface Assembly (1 per system)
3. MCRMF
 - a) Rack mounting mainframe (1 per 120 stations). Includes built-in ventilation fans and the following circuit cards:
 - 1) QSPC1-Processor card (1 per system)
 - 2) MCACB-Analog card (1 per 24 stations)
 - 3) MCSC-Station card (1 per 24 stations)
 - 4) MCJCA-Ribbon cable assembly (interconnects 2 MCRMF)
4. MCRM
 - a) Relay module (1 per 24 stations). Mounts to:
 - 1) MCRRP-Stand-alone configuration.
5. Program Sources
 - a) Bogen DST-1 Digital Stereo tuner
 - b) Denon DN-C615 CD / MP3 Player
 - c) Provide AM/FM Antenna as needed
6. Power Amplifiers

- a) HTA-125A-125 watt
- b) HTA-250A-250 watt
- 7. Optional Equipment (as may exist)
 - a) MCTC-Telephone access card
 - b) TMC4 – 4 channel IR interface
 - c) DVS – Digital Video Server
 - d) DVSES – Digital MPEG Encoding Station

B. PERIPHERAL DEVICES

1. INTERIOR AND EXTERIOR SPEAKERS

- a) Refer to Schedule on the drawings for interior and exterior speakers

2.07 WIRE AND CABLE

- 1. All wire and cables shall be new and unused. All wire and cable shall be enclosed in conduit unless otherwise noted. Wire not installed in equipment racks, not portable, or not installed in conduit shall meet all applicable codes.
- 2. Indoor dry location Speaker and Call Button
 - a) West Penn 290 or approved equal
 - 1) 22/4 conductor cable, (1) pair shielded (1) pair unshielded, CMR rated, non-plenum, complete with PVC jacket.
- 3. Outdoor wet location (cable pairs to be sized as required for 15% spare capacity) and will include cables pairs for both speakers and classroom call switches.
 - a) Tappan Cable Model No. 2250BT15/CMR/WB or approved equal
 - 1) 22/15 pair – Individual shielded pairs cable, CMR/WB rated, complete with black underground/direct burial, sunlight resistant rated PVC jacket
 - b) Tappan Cable Model No. 2250BT8/CMR/WB or approved equal
 - 1) 22/8 pair – Individual shielded pairs cable, CMR/WB rated, complete with black underground/direct burial, sunlight resistant rated PVC jacket
- 4. Protection
 - a) The contractor shall provide all necessary transient protection on the AC power feed and on all station lines leaving or entering the building.
 - b) The contractor shall note in his system drawings, the type and location of these protection devices as well as all wiring information. Such devices are not to be installed above the ceiling.

2.08 TERMINAL CABINETS & JUNCTION BOXES

- 1. All terminal cabinet and junction boxes are to be provided and installed by the Division 16 Prime Contractor. This contractor and the prime contractor shall coordinate mounting locations prior to install.

PART 3– EXECUTION

3.01 DIVISION OF WORK

- A. While all work included under this specification is the complete responsibility of the contractor, the division of actual work listed following shall occur.

1. All conduits with pull cords, all electrical pull boxes, grounding rods, all outlet boxes, terminal cabinets, backboards, etc., which form part of the rough-in work shall be provided and installed completely by the Division 26 Contractor. Coordinate as necessary for proper installation.
2. The balance of the system, including installation of initiating devices, notification appliances and equipment, making all connections, etc., shall be performed by the System Supplier/Installer.
3. All 120VAC power conductors and conduits associated with power circuits to all low voltage system equipment locations shall be provided and installed by the Division 26 Contractor.
4. An insulated stranded copper ground wire shall be provided from each equipment rack to the building grounding system, in compliance with CEC Article 250, by the Division 26 Contractor.
5. Labeling of pullboxes and terminal cabinets shall be provided and installed by the Division 26 Contractor.

3.02 INSTALLATION

- A. All work shall be completed in strict accordance with all applicable codes and ordinances, by a qualified Manufacturer's Authorized Distributor.
- B. Cable/Wire
 1. All cable/wire for the communications system shall be new.
 2. System cable/wire and equipment installation shall be in accordance with good engineering practices as established by the Electronics Industries Alliance (EIA) and the California Electrical Code (CEC). Wiring shall meet all applicable electrical codes. All cable/wire shall test free from all grounds and shorts.
 3. All #22AWG and #24AWG connections throughout the system shall be made by spring tension clip "punch block", Siemon type 66 terminals or equal. Conductors #20AWG and larger shall be terminated on barrier screw terminals.
 4. All communication system cable/wire shall be labeled at all points of termination. All labeling shall be based on the room numbers as provided by the Owner or his representative.
 5. Protection and dressing of cables:
 - a) Cables mounted on backboards and within equipment racks, etc., shall be grouped and securely attached to the backboard or enclosure in horizontal and vertical bundles in a neat workmanlike manner using Thomas & Betts "Ty-Rap", Panduit cable mounts and Allen-Tel cable management or equal. Edge protection material ("cat-track") shall be installed on edges of holes, lips of ducts or any other point where cables or harnesses cross metallic edge.
 6. Shielding:
 - a) Cable shielding shall be connected to common ground at point of lowest audio level and shall be free from ground at any other point. Cable shields shall be terminated in same manner as conductors.
 7. Underground cables
 - a) Any cable/wire pulled through manholes or pullboxes located below grade shall be continuous with no splices. The cable/wire shall be intact with no cuts in the protective outer jacket.
 - b) Provide 15% spare pair capacity for multi-pair cabling to each building.
- C. Cable/Wire Terminations
 1. All splices in above ground junction boxes shall be made on terminal strips.

3.03 SYSTEM START-UP

- A. All start-up programming and system commissioning shall be performed by a manufacturer's trained and certified technician.

3.04 SYSTEM VERIFICATION

- A. Subsequent to system start-up the system installer shall, at a minimum, verify that the following features are functioning properly.
 - 1. Two way talk-back
 - 2. All call paging
 - 3. Emergency call-in, if applicable
 - 4. Call switches, if applicable
 - 5. Verification of call station identifications with room numbers provided by the Owner or his representative.

3.05 ACCEPTANCE TESTING

- 1. The system installer shall, in the presence of the Inspector of Record (IOR), perform 100% testing as noted in System Verification above.

3.06 DOCUMENTATION

- A. Provide the following directly to the Supervisor of Technology Service.
 - 1. Provide a printed copy of all field programming for all components in system.
 - 2. Provide one copy of all diagnostic software with copy of field program for each unit.
 - 3. Provide one copy of all service manuals, parts list, and internal wiring diagrams of each component of system.
 - 4. Provide one copy of all field wiring runs, location and end designation of system.

3.07 MANUFACTURER'S FIELD SERVICES

- A. The contractor shall, at the owner's request, make available a service contract offering continuing factory authorized service of this system after the initial warranty period.
- B. The system manufacturer shall maintain engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.

3.08 IN SERVICE TRAINING

- A. Provide complete "in service" instructions of system operation to school personnel. Assist in programming of telephone system.
- B. The Contractor shall instruct personnel designated by the Owner in the proper use, basic care and maintenance of the system beyond the warranty period.
- C. The contractor shall provide a minimum of eight hours of in-service training with this system. These sessions shall be broken into segments, which will facilitate the training of individuals in the operation of this system. Operators Manuals and Users Guides shall be provided at the time of this training.

3.09 FACTORY TRAINING & CERTIFICATION

- A. The manufacturer shall provide factory certified training to two (2) technicians employed by the school district. These technicians shall be trained and certified as manufacturers certified technicians capable of performing any work on the system after the installation of the system.
- B. All cost for training including travel, lodging, meals and per diem shall be included in the installing contractors base bid price for this section.

3.10 GUARANTEE AND WARRANTY

- A. Guarantee all parts, labor, and workmanship furnished under this contract for the minimum period of twelve months from the date of substantial completion, or first formal use by the Owner, whichever is last to occur. During the warranty period, report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Non-emergency Warranty service shall be rendered within 24 hours after request by the Owner. Emergency service shall be provided within 8 hours of request by owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made. Where warranties on individual pieces of equipment exceed twelve months, the guarantee period shall be extended to the warranty period of the particular items.
- B. After completion of the work the Contractor shall submit a Certificate of Warranty, stating start-up and expiration dates and conditions of the warranty, for signature of both participating parties. Incremental warranties for completed portions of the work may be negotiated at the discretion of the Owner, if delays occur beyond the control of the Contractor.

3.11 EQUIPMENT MANUFACTURER'S REPRESENTATIVE

- A. All work described herein to be done by the manufacturer's authorized representative shall be provided by a documented factory authorized representative of the basic line of equipment to be utilized.
- B. As further qualification for bidding and participating in the work under this specification the manufacturer's representative shall hold a valid C-10 Contractor's License issued by the Contractor's State License Board of California. The manufacturer's representative shall have completed at least ten (20) projects of equal scope, giving satisfactory performance and have been in the business of furnishing and installing sound systems of this type for at least five (5) years. The manufacturer's representative shall be capable of being bonded to assure the owner of performance and satisfactory service during the guarantee period.
- C. The manufacturer's representative shall provide a letter with submittals from the manufacturer of all major equipment stating that the manufacturer's representative is an authorized distributor. This letter shall also state the manufacturer guarantees service performance for the life of the equipment, and that there will always be an authorized distributor assigned to service the area in which the system has been installed.
- D. The contractor shall furnish a letter from the manufacturer of the equipment, which certifies that the equipment has been installed according to factory intended practices, that all the components used in the system are compatible and that all new portions of the systems are operating satisfactorily. Further, the contractor shall furnish a written unconditional guarantee, guaranteeing all parts and all labor for a period of one (1) year after final acceptance of the project by the owner.

END OF SECTION

DIVISION 28

ELECTRONIC SAFETY & SECURITY

SECTION 28 16 00

INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install a complete extension of the existing campus-wide 12VDC Intrusion Detection System, to the new facilities as indicated on the drawings. The extension shall interface and interconnect to the existing campus-wide system – complete with all materials, labor and programming required to for a complete, operable system. The Intrusion Detection system shall be microprocessor-based, network capable and complete with an integral DACT that is UL listed. The intrusion detection system shall be capable of providing, at a minimum, the following:

1. Intrusion Detection Control Panel
 - a. Integral Digital Alarm Communications Transmitter (DACT).
 - b. Network Interface capability via fiber optic network.
2. Addressable initiation devices
3. Addressable control modules
4. Notification Appliances
5. Remote Power Supplies
6. On-site or remote video monitoring
7. Heating, air conditioning, and lighting management
8. Temperature threshold detection and monitoring
9. Humidity threshold detection and monitoring
10. Pressure threshold detection and monitoring
11. Power loss detection and monitoring, generator switching
12. Leak detection and monitoring
13. Carbon monoxide detection and monitoring
14. Tank level threshold detection and monitoring
15. Remote Access capability via LAN/WAN network
16. Access Control System interface capability
17. Fire Alarm System interface capability

- B. The Contractor shall furnish all labor, materials, appliances, tools, equipment, facilities transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the applicable Contract Drawings and/or specified herein.
- C. Any material and/or equipment necessary for the proper operation of the system, which is not specified or described herein, shall be deemed part of this Specification.
- D. The Addressable Intrusion Detection System is connected to a UL Listed Central Station monitoring company.
 - 1. Contractor shall coordinate with the District/Owner or his representative to ensure that the extended system is programmed to report to the monitoring company to match the existing reporting sequences.
- E. Contractor shall offer intrusion detection system inspection and maintenance contract.

1.02

QUALIFICATIONS

- A. Equipment
 - 1. This specification is based on the equipment of manufacturer(s) who have been approved by the District/Owner and the Manufacturer(s) herein named shall be considered as meeting the requirements of this specification.
 - 2. The equipment manufacturer shall be a United States manufacturer, who has been regularly engaged in the manufacture of intrusion detection systems for at least thirty (30) years.
 - 3. **The campus has an existing DMP Entre Software Management platform. Any new work must be integrated into the Entre software system. Equipment provided for this project shall be the product of Digital Monitoring Products (DMP). No substitutions shall be approved.**
 - 4. **It is the responsibility of the contractor to program the security panel, as well as the Entre management system. The successful contractor must have a minimum of three technicians trained on the Entre software platform on bid day.**
 - 5. The security contractor must be able to provide references from at least three successful Entre installations in the school or college market. The referenced installations have been prior to the bid date.
 - 6. It is the Contractor's responsibility to meet the entire intent of these specifications. Deviations from the specified items shall be at the risk of the Contractor until the date of final acceptance by the Architect, Engineer and the District/Owner's representative. All costs for removal, relocation or replacement of a substituted item shall be at the risk of the Electrical Contractor.
 - 7. All equipment shall conform to applicable codes and ordinances.
 - 8. All equipment shall bear the label of a Nationally Recognized Testing Laboratory (NRTL) such as Intertek Testing Services NA, Inc. (ITSNA - formerly ETL) or Underwriters Laboratories Inc. (UL) and be listed by their re-examination service.
- B. System Supplier/Installer

1. The system shall be provided and installed by the Manufacturer's Authorized Distributor who is trained and certified by the Manufacturer in the proper installation, programming, service and maintenance of the system.
 - a. Contractor shall contact Mr. Jeff Spatz – Southern California Business Development Manager for Digital Monitoring Products (DMP). Mr. Spatz will provide the contact information for the Digital Monitoring Products (DMP) Authorized Distributors for the Southern California Area.
 - b. The System Supplier/Installer shall submit qualification documentation with his sealed bid. The qualification documentation in the sealed bid package shall include the following:
 - a) The System Supplier/Installer shall provide proof of current status as the Manufacturer's Authorized Distributor. The evidence shall be a letter from DMP stating the system provider's authenticity as a dealer and specifically mention this project in the body of the letter. The letter must contain contact information so that the owner can verify.
 - 1) The System Supplier/Installer shall provide proof that a minimum of four (4) technicians have attended and completed all requirements and received certification from the manufacturer's installation and service school as well as be an Authorized DMP Entre Certified installer and programmer.
 - 2) System Supplier/Installer shall provide a list of twenty (20) completed projects of equal scope, with associated District/Owner's Representative contact names and telephone numbers.
 - 3) The System Supplier/Installer shall hold a valid State of California Contractor's License, C-10 and C-7
 - 4) The System Supplier/Installer shall hold a valid State of California Alarm Company Operator License, ACO.
2. The System Supplier/Installer shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization capable of furnishing adequate inspection, service and maintenance of the system. The System Supplier/Installer shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.
3. The System Supplier/Installer shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.
4. The System Supplier/Installer shall be an established intrusion detection systems contractor that has and currently maintains a locally run (within 60 miles of the job site) and operated business for at least twenty (30) years.
5. The System Supplier/Installer shall employ a minimum of seven (5) DMP factory trained technicians and a 24-hour emergency service department.
6. The System Supplier/Installer shall designate one person to act as the project manager having total responsibility for communications and project technical integrity. This project manager shall have a minimum of three (5) years experience as a supervisor and installer of the systems specified herein and hold a factory Authorization for the DMP Entre System

1.03

RELATED SPECIFICATIONS

- A. The conditions of the General Contract (General, Supplementary, and other Conditions) and the Division 1 - General Requirements specifications are hereby made a part of this Section.

1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
2. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
3. Section 26 05 13 BASIC ELECTRICAL MATERIALS AND METHODS
4. Section 26 05 33 RACEWAYS, BOXES, FITTINGS AND SUPPORTS
5. Section 26 24 16 PANELBOARDS AND SIGNAL TERMINAL CABINETS

- B. RELATED WORK BY OTHERS

1. Reference Part 3, sub-section 3.01 of this specification.

1.04

APPLICABLE CODES & STANDARDS

- A. Current Edition of Building Standards Administrative Code, Part 1, Title 24, California Code of Regulations
- B. Current Edition of California Building Code (CBC) Part 2, Title 24, California Code of Regulations (Uniform Building Code, Volumes 1, 2 & 3 with California Amendments)
- C. Current Edition of California Electrical Code (CEC) Part 3, Title 24, California Code of Regulations (National Electrical Code with California Amendments)
- D. Current Edition of California Fire Code (CFC) Part 9, Title 24, California Code of Regulations (Uniform Fire Code with California Amendments)
- E. NFPA Standards
1. The intrusion detection system shall comply with the applicable provisions of the following current National Fire Protection Association (NFPA) standards:
 - a. NFPA 110, Standard for Emergency and Standby Power Systems
 - b. NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems
 - c. NFPA 780, Standard for the Installation of Lightning Protection Systems
- F. ADA - Americans with Disabilities Act
- G. CAC – California Administrative Code, Title 24
- H. U.L. Standards
1. The system shall comply with the applicable provisions of the following U.L. Standards:
 - a. UL 294, Standard for Access Control Systems Units
 - b. UL 609, Standard for Local Burglar Alarm Units and Systems

- c. UL 634, Standard for Connectors and Switches for Use with Burglar-Alarm Systems
 - d. UL 636, Standard for Holdup Alarm Units and Systems
 - e. UL 639 Standard for Safety for Intrusion-Detection Units
 - f. UL 681, Standard for the Installation and Classification of Burglar and Holdup Alarm Systems
 - g. UL 1076, Standard for Proprietary Burglar Alarm Units and Systems
 - h. UL 1610, Standard for Central Station Burglar Alarm Units
 - i. UL 1635, Standard for Digital Alarm Communicator System Units
 - j. UL 2044, Standard for Commercial Closed Circuit Television Equipment
 - k. SUBSTITUTIONS
 - I. The Intrusion Detection System shall be products of Digital Monitoring Products (DMP) AS PER DISTRICT/OWNER STANDARDS. No substitutions shall be approved.
- 1.05 SUBMITTALS
- A. Within thirty-five (35) calendar days after the date of the award of the contract, the Contractor shall submit to the Architect for review, eight (8) copies of a complete Submittal Package. The Submittal Package shall consist of the following sections, with each section separated with index tabs.
 - 1. Title Page
 - a. Project Title
 - b. Project address
 - c. Architect's name and address
 - d. Contractor's name and address
 - 2. Index of Submittal Contents
 - a. Each Section of the Submittal Package shall be numbered chronologically and shall be summarized in the Index.
 - 3. Certifications
 - a. Index of Certification Section Contents
 - b. Valid State of California Contractors License
 - c. Manufacturer's Certifications
 - 1) Authorized Distributor
 - 2) Factory Trained Technician

4. Project List
 - a. A substantial list (minimum of 20) of completed projects equal in scope to that specified herein.
 - 1) Contact information shall be made available upon request.
5. Product Data
 - a. Index of Equipment Data Sheets
 - b. Manufacturer's Data Sheets including cable types
 - c. Applicable Listings and Approvals

PART 2– PRODUCTS

2.01 SYSTEM REQUIREMENTS

- A. The intrusion alarm system specified herein shall include a Digital Alarm Communicator Transmitter (DACT), built-in telephone line monitor, 12,000 event memory buffer, real time clock, calendar, test timer, battery charging / voltage supervision circuitry, battery lead supervision, diagnostics displays, time / event-based scheduling system, lightning / EMI protection circuits, and the associated optional modules and components for a complete intrusion alarm system.
- B. The following describes the general functional requirements of the intrusion alarm system:
 1. The intrusion alarm shall support the connection and reporting of intrusion, fire detection and access control devices to a remote Digital Alarm Communicator Receiver (DACR).
 2. The intrusion alarm shall provide identification, annunciation, and communication of alarmed detectors by point and each access control user by number.
 3. The intrusion alarm shall be capable of segregating the points (i.e., a detector or group of detectors zoned together) into separate, independent "areas."
 4. The intrusion alarm shall be "modularly" expandable using hard-wired address identification modules.
 5. The intrusion alarm shall have electrically supervised detection loops and power supplies (mains and battery(s). This supervision shall be programmable for the purposes of reporting this information to the DACR.
 6. The intrusion alarm shall be capable of monitoring and switching to active telephone lines when trying to establish communications with the DACR and transmitting a report.
 7. The intrusion alarm shall be capable of reporting and communicating alarm or trouble event data by reporting to one, two, three or four off-site remote DACRs via dial-up analog telephone lines or cellular communications via a DMP 463G. If a 463G Interface is required, the cost for (1) One Year of Cellular service shall be included in the base bid for this project.
 8. The intrusion alarm shall be capable of sending (manually or automatically) test and status reports to remote DACRs.
 9. The intrusion alarm shall be programmable locally or remotely. Programming shall be accomplished via a portable programmer or a computer running the DMP Remote Link

Programming Software. Users shall be capable of changing their own user passcode from the Alarm Command Center (ACC) and managers shall be capable of changing the user passcodes and authority assignments by area of other users from the ACC.

10. The intrusion alarm shall annunciate alarm, trouble, service reminders, and other relevant system status messages in custom English text at the ACC.
11. The intrusion alarm shall be capable of executing diagnostics and testing functions locally or remotely
12. The intrusion alarm shall be capable of activating 100 output relays . The intrusion alarm shall be capable of controlling relays and automatically executing system functions based on a time / event scheduling program. The program can be hour, day of week or day of month based. Each scheduled event can be exclusive of one of four holiday date definitions that can include one to 365 selected Julian dates. The following functions can be executed:
 - a. Arm / Disarm a specific area
 - b. Bypass / Un-bypass a point
 - c. Activate / De-activate a relay
 - d. Send a test report
 - e. Adjust system clock for daylight savings time
 - f. Turn an Access Authority Level On/Off
 - g. Hold a Door Open (unlocked and shunted)
 - h. Secure a Door Closed (locked, no valid cards will allow entry)
 - i. Return a Door to Normal Operation (locked, valid cards will allow entry)
 - j. Turn recording of Access Granted events On/Off (and transmittal if routing is ON)
 - k. Turn recording of Access Denied events On / Off (and transmittal if routing is ON)
13. The intrusion alarm shall be capable of controlling up to sixteen separate doors using and providing entry to authorized users based on authority assigned to the user by the area into which the door enters.

2.02

SYSTEM CAPABILITIES

1. The following indicates system software/hardware capabilities, capacities, and formats:
 - a. Number of Loops/Sensors: 574 separately identifiable points. Each of the points shall be capable of supporting "group zoning." Group zoning refers to the combining of sensors into a separately identifiable and separately annunciated (programmable text) area.
 - b. Programming Point Functionality: Each point in the system shall provide for the following type of response in the system
 - 1) Always on (24 hour response)

- 2) On when the system is Master Armed
 - 3) Only on when the system is Perimeter Armed
 - 4) Displays / Does Not Display at the ACC when the point is activated
 - 5) Provides / Does Not Provide entry warning tone
 - 6) Sounds / Does Not Sound audible alarm indication
 - 7) The Point is bypass able / not bypassable
 - 8) Alarm Verification with programmable verification time
 - 9) Relay activation by Point
 - 10) Provides / Does Not Provide "watch point" capability
 - 11) Provides Swinger Bypass
 - 12) Defers Bypass Report
 - 13) Can return to the system after being force armed and then restoring
 - 14) Can return to the system after being bypassed and then restoring
- c. Areas/Accounts: The intrusion alarm shall support 16 independent areas. Each of the sixteen (16) areas shall have custom text associated with the armed state, disarmed state and point-off-normal state. Each and all of the sixteen areas must be capable of Master and/or Perimeter arming (excluding predefined Interior protection).
- 1) The intrusion alarm shall be capable of logically grouping 2 or more points into an area, or conversely, dividing the points into two or more areas.
 - 2) Any area shall be configurable to allow arming by specific users when a programmable number of devices are faulted or bypassed.
 - 3) Areas shall be independently controlled by their corresponding ACC. Each ACC can be designated to control a specific area, or group of areas, or all areas in the system.
 - 4) Independent control or relay functions by area shall be possible through programming assignments.
- d. Number of Alarm Command Centers: 32 ACCs, each capable of displaying custom English text on vacuum fluorescent displays and sounding different patterns of audible alarm for different events, shall be required. Up to Eight (8) ACCs can be supervised at one time. An ACC can be programmed to respond to the entry of any of the specifically authorized 10,000 user passcodes and cycle an assigned access control door using a connected door controller. The event is logged and transmitted (if routing is ON) to the DACR including door and user identity.
- e. Number of User Passcodes: Up to 10,000 different passcodes shall be allowed. Each passcode shall be three (3) to six (6) digits (variable) and be assigned a 16-character user name that shall be printed on the local printer

and DACR with associated opening and closing reports from the user. Passcodes shall be enabled or disabled by area(s) and shall be assigned one of fourteen (14) different authority levels to carry out functions such as the activation of relays from the ACC. These passcodes shall also be required for carrying various system functions such as arming the system, disarming the system, transmitting a duress code, resetting the system and silencing sounders. A single user passcode shall be able to be used in each of the 8 areas with potentially a different authority level in each area. Each of the 10,000 different passcodes shall be able to be associated with 4 individual access cards/tokens. The authority of any of the four cards assigned to the user will be that of the user, but each card will report in the display, local printer, memory event log and at the DACR as a separate user / subuser number pair.

- f. Number of Access Controlled Doors: Up to 16 doors, each connected to a door controller module that is subsequently connected to the DACT. Each door controller is programmed through the DACT from the local programmer or the RAM and can be configured independently from other doors. Each door contact is supervised and is wired to the door controller and can use normally open or normally closed contacts. The door lock can be programmed to reset the door strike time when the door either opens or closes. The door opening can terminate a programmable door buzzer. The door contact is shunted when valid access is being granted through the door. A request to exit and a separate request to enter supervised input are provided on the door controller. A programmable feature provides for door shunting on request to exit without activating the lock output. An optional buzzer can be sounded and an ACC can display a door closing warning if the door is held open beyond a programmable time. The door can be programmed to activate an alarm or trouble in the door left open condition. The intrusion alarm shall be capable of transmitting the Door Left Open indication to the DACR. The door strike shall be capable of being programmed to automatically unlock if the area is completely disarmed and will not automatically unlock if the area is selectively disarmed. The intrusion alarm shall be capable of being programmed, on a time basis, to record access granted and or access denied events by door.
- g. Access Control/User Features: The intrusion alarm shall allow each authority profile to specify whether users holding that authority are to be granted access into the area based on whether the area is completely disarmed, perimeter armed or completely armed. Additionally, the intrusion alarm shall be able to automatically disarm the area or convert the arm state of the area from fully armed to perimeter armed based on the authority level assigned to the user and area. Assigned users shall be able to manually control the door from an ACC by setting the door to Normal Operation, Manually Locked or Secured (valid cards will not operate).
- h. Testing, Diagnostic, and Programming Facilities: Automatic test reports and remote system access for diagnostics, programming, and log (Logger) uploads shall also be supported via a remote central station computer utilizing the DMP Remote Link Software software.
- i. Logger Capacities and Formats: 12,000 events indicating time, date, type of event, account number, area number, user ID, point text, user text and primary/secondary event route each event. Logs shall be viewed locally at the ACC and remotely via an upload to a computer running the Remote Link software. The intrusion alarm shall also support the printing of these events on up to three local printers. The intrusion alarm shall also send a report to the DACR when the log reaches a programmable "percent full capacity" so

that Remote Link can retrieve the stored events. Events can be routed to specific printers by group, signal type and area.

- j. Reports: Reports to DACRs at commercial central stations as a result of system supervision shall include alarm, trouble, missing modules, restoral, system status, AC failure and low battery. The intrusion alarm shall also transmit test reports once every 24 hours. CPU failure shall be annunciated locally. The ACCs should display the following information for the indicated system supervisory conditions:
 - 1) Call for Service
 - 2) Service Panel
 - 3) Service Param
 - 4) Service AC Fail
 - 5) Service Battery Low
 - 6) Service Battery Missing
 - 7) Service Communications Failure
 - 8) Service Keypad
 - 9) Service Route
 - 10) Service Printer
 - 11) Service Point Buss Failure
- k. Telephone Lines and "Phone Routing": The intrusion alarm shall support two (2) telephone lines that are to be alternated for the transmission of consecutive events. The intrusion alarm shall have the capability of communicating with up to four (4) different DACRs (phone numbers). Each Phone Number can be up to 24 digits long. The intrusion alarm reports shall be classified, by event, into one or more of 4 routing groups. Each routing group can specify a DACR to be designated as a primary and another DACR as back up. Assigning an event to multiple routing groups provides for duplicate destination for the event. The transmission of events, allows the reporting of different types of information to different remote DACRs.
- l. Number of Programmability of Relay Output Modules: 100 relays (Form C) are to be provided per system these multi-purpose modules are programmable and shall be used to implement auxiliary functions (manually or automatically).
 - 1) Relays and other outputs may be programmed to follow up to 14 different area conditions or up to 12 panel conditions. Relays may also be programmed to follow individual points or groups of points.
- m. Number and Alarm Output Selections: Four (4) different types of alarm output selections shall be supported by the intrusion alarm: Steady, Pulsed, California Standard, and Temporal Code 3. The system can be configured to provide zoned indication of alarm conditions.

- n. Miscellaneous Features: Programmable alarm output timer, 31 programmable entry delay times, exit delay programmable by area, individually programmable point of protection text, point bypassing, and key switch arming capability with LED outputs.
- o. Real-Time Clock, Calendar, and Test Timer: The intrusion alarm shall incorporate an integral real-time clock, calendar, and a test timer.
- p. Opening and Closing Windows: The system shall be programmed with "normal" opening and closing periods for each day of the week and thus suppress scheduled opening / closing reports and report only the exceptions, i.e., opening / closing outside the pre-defined time window. The intrusion alarm shall have the capability to suppress opening / closing reports, overriding the programmed open / close windows during holidays and automatically arming the intrusion alarm (by area) at the end of the closing period.
- q. Intrusion alarm Power Ratings: The intrusion alarm shall provide 1.4 amps of auxiliary power and 2 amps of alarm power, both rated at 12VDC. Additional auxiliary power shall be provided by adding battery/charger modules up to a maximum of 2 amps.
- r. Intrusion alarm Fault Detection: The intrusion alarm shall check the point sensor loops once every 300 milliseconds. The point response time is programmable over a range of 300 milliseconds to 4.5 seconds.
- s. User-Programmable Features: The intrusion alarm shall provide a "user-friendly" interface for programming / customizing the system to the operational criteria of the application. The intrusion alarm shall be capable of being operated via:
 - 1) The Command Structure
 - 2) Menu/Command List
 - (a) These system features shall have restrictions based on 14 individually programmable levels of passcode authority that can be assigned to system users. The user's passcode shall have the capability of being assigned a different authority level in each of the eight (8) areas. A service passcode can be assigned to the servicing agent allowing the agent limited access to system functions. User-programmable / activated functions include:
 - 3) Arming the system: All areas, specific area(s) only, perimeter instant, perimeter delayed, perimeter partial, watch mode, and arming the system with a duress passcode.
 - 4) Disarming the system: All areas, specific area(s) only and disarming with a duress passcode.
 - 5) Viewing system status: Faulted points, event memory, bypassed points, area status and point status.
 - 6) Implementation functions: Bypass a point, unbypass a point, reset sensors, silence bell, activating relays, initiating the remote programming function locally to allow programming the system from a

remote location. The ACCs can also be temporarily readdressed to view the status of a remote area.

- 7) Testing the system: Local Walk test, Service Walk test, Fire test, send report to remote DACR to check the telephone link, and programming the time and date for the next test report transmission.
- 8) Change system parameters: ACC display brightness, system time and date, and add/delete/change passcodes.
- 9) Extend the closing time of system.
- 10) Transmitting special alerts and activating audible and visible signals.
- 11) Executing multiple commands / ACC keystrokes from a single Menu / Command List item. This function shall be able to have a 16-character (alphanumeric) title to identify it on the ACC display.
- 12) Editing of time / event based scheduling program from the ACC.
- 13) The intrusion alarm shall also provide a "service menu" to implement functions such as viewing and printing the system log, displaying the system firmware revision number, and defaulting (toggling) text displays between custom and default text displays for troubleshooting.

2.03 SYSTEM COMPONENTS

A. Intrusion Detection Control Panel

1. Digital Monitoring Products (DMP) – Model XR-550

- a. Standard commercial burglar control/communicator package shall include the following features and capabilities. Security panel shall be a UL Listed System with a lockable enclosure, transformers and internal battery location.
 - 1) System shall be Network based and capable of accepting and RJ45 Ethernet connection for offsite programming and Networking of Multiple XR500-N Security Panels through a standard network connection.
 - 2) Each System shall be capable of 574 Individual Security Points.
 - 3) Each System shall allow for 32 individual reporting areas
 - 4) Each System shall allow for 10,000 users with 99 user profiles
 - 5) Each shall be capable of 100 programmable output relays.
 - 6) Each Security Panel shall have the built in capability to add 16 Doors of access control.
 - 7) System shall be capable of taking over and utilizing existing Bosch/Radionics POPIT module with a DMP 736P Interface Module.

- B. Addressable Expansion Module shall be supplied in the quantities and type required for a complete and operational system. Below is a sample list for reference.

1. Digital Monitoring Products (DMP) – 708 Bus Extender
2. Digital Monitoring Products (DMP) – 710 Bus Splitter / Repeater
3. Digital Monitoring Products (DMP) – 710 714 4 Zone Class B Expansion Module
4. Digital Monitoring Products (DMP) – 461 Adapter Module
5. Digital Monitoring Products (DMP) – 462N Network Interface Card
6. Digital Monitoring Products (DMP) – 462P Printer Interface Card
7. Digital Monitoring Products (DMP) – 481 Expansion Interface Card
8. Digital Monitoring Products (DMP) – 860 Relay Output Module
9. Digital Monitoring Products (DMP) – 893A Dual Phone Line Module
- a. Actual Expansion Module required will vary based on the scope of work and construction drawings. All required modules shall be included in the base bid and installed for a complete and operable Intrusion Detection System to the satisfaction of the Owner.

C. Remote Power Supplies

1. Altronix – Model No. SMP3
 - a. Power supply for passive infrared detectors, 12VDC provide one in each building. Provide power supply, terminal cabinet, transformer and battery as required for a complete and operable system.
 - 1) Terminal cabinet enclosure
 - (a) Mier Products, Inc. – Model No. MIPW108
 - 2) Transformer 120VAC-12VDC
 - (a) DSC - Model No. DSCPTC1640U
 - 3) Battery
 - (a) Yuasa – Model No. NP7-12

D. Point Single Zone Expansion Module

1. Digital Monitoring Products (DMP) 711
 - a. The 711 module serves as the interface between the addressable data loop from the control panel and the conventional initiation devices (i.e. motion sensors and door switches).
 - b. All 711 modules shall be installed in an accessible location and labeled with the device address.

E. Alarm Command Center (ACC) Keypad

1. Digital Monitoring Products (DMP) 7063A Keypad

- a. Alarm Command Center (ACC) - Built-in multi-tone sounder. Displays status in custom English text on 32-character display illuminated in blue. ACCs provide "command menu" user interface. ACC can be supervised. Provide keypads in locations as per drawings.
 - b. Surface keypad back box shall be a DMP 696-W, back boxes shall be provided in locations required.
 - c. The intrusion alarm system shall be designed to include a predetermined time delay, in the order of one minute between entry and alarm. Operation of the keypad shall abort the alarm condition and disable the system until re-armed.
 - d. During an alarm condition, the alphanumeric readout on the keypad shall indicate, by room name and number, the location of the alarm.
- F. Centralized Monitoring System – LifeGuard Networks IP Based Building Automation and Control System
- 1. The contractor shall furnish and install a complete integration/expansion of the existing LifeGuard Networks IP Based Building Automation and Control System.
 - a. The Contractor shall provide all equipment and labor to integrate the new Security Controls with the existing District's control server for a complete and operable system. This shall include the following:
 - 1) Provide and install a LifeGuard Networks SY-MTIP IP Gateway
 - 2) All necessary modifications, programming and upgrades to the existing SY-FSERX server software.
 - 2. System features
 - a. Communication protocols include RS-485, RS-232, Cellular, Analog Digital, and 2 way audio.
 - b. Serial interface to addressable FACP and/or dry contacts for conventional fire panels.
 - c. Fourteen (14) inputs and eight (8) programmable outputs
 - d. Complete system monitoring and transmission of data via existing network including event based unlimited email notification, itemized system monitoring of each device, wiring and peripherals. System control and response based upon event data.
 - e. Redundant buffer and onboard 2 gigabyte storage
 - f. VOIP Telephony connection of all networked devices
 - g. Six (6) onboard video ports with expansion to twelve (12) with motion control, remote PTZ and remote view.
 - h. Standard 2 Gigabyte memory with expansion capability to 500 Terabytes
 - i. Embedded Script language with logic control

G. Motion Sensors – Passive Infrared (PIR)

1. Dual-Tec – Model No. DT-7450
 - a. Surface wall mount (PIR) passive infrared motion sensor
 - b. 50' x 50' range
 - c. Locate motion sensors as indicated on plans.
 - d. Connect the data loop via 711 Single Zone Expansion Module
- H. Magnetic Door Switch
 1. Sentrol – Model No. 1078W
 - a. Door magnetic switches shall be mounted flush in door jam at locations as indicated on plans
 - b. Locate switches as indicated on plans.
 - c. Connect the data loop via 711 Single Zone Expansion Module
- I. Armored Door Switch
 1. Sentrol – Model No. 2505A
 - a. Surface mount switch shall be utilized for roof hatches
 - b. Locate switches as indicated on plans.
 - c. Connect the wire data loop via 711 Single Zone Expansion Module
- J. Siren
 1. ATW Security – Model No. DS-301SET
 - a. 25 watt speaker in indoor/outdoor stainless steel enclosure. A minimum of (1) siren shall be provided for the interior of the building in the main entry point to the Administration Office or a location to be chosen by the Owner.
- K. Wire/Cable
 1. Type “SEC”
 - a. 22/4 Conductor. Belden Cat# 5502UE (Interior)
 - b. 22/4 Conductor. Belden Cat# 5502UI (Exterior)
 2. Type “SDC”
 - a. 18/6 Conductor. Belden Cat# 5304UE (Interior)
 - b. 18/6 Conductor. Belden Cat# 5304UI (Exterior)

PART 3- EXECUTION

3.01 DIVISION OF WORK

- A. While all work included under this specification is the complete responsibility of the contractor, the division of actual work listed following shall occur.
1. All conduits with pull cords, all electrical pull boxes, grounding rods, all outlet boxes, terminal cabinets, backboards, etc., which form part of the rough-in work shall be provided and installed completely by the Division 16 Contractor. Coordinate as necessary for proper installation.
 2. The balance of the system, including installation of initiating devices, notification appliances and equipment, making all connections, etc., shall be performed by the System Supplier/Installer.
 3. All 120VAC power conductors and conduits associated with power circuits to all low voltage system equipment locations shall be provided and installed by the Electrical Contractor.
 4. An insulated stranded copper ground wire shall be provided from each control unit to the building grounding system, in compliance with CEC Article 250, by the Electrical Contractor.
 5. Labeling of pullboxes and terminal cabinets shall be provided and installed by the Electrical Contractor.

3.02 INSTALLATION

- A. All work shall be completed in strict accordance with all applicable codes and ordinances, by a qualified Manufacturer's Authorized Distributor.
- B. Cable/Wire
1. All cable/wire for the system specified herein shall be new, unless otherwise noted on plans.
 2. System cable/wire and equipment installation shall be in accordance with good engineering practices as established by the California Electrical Code (CEC). Wiring shall meet all applicable electrical codes. All cable/wire shall test free from all grounds and shorts.
 3. All cable/wire shall be labeled at all points of termination. All labeling shall be based on the room numbers as provided by the District/Owner or his representative.
 4. Protection and dressing of cables:
 - a. Cables mounted on backboards and within equipment racks, etc., shall be grouped and securely attached to the backboard or enclosure in horizontal and vertical bundles in a neat workmanlike manner using Thomas & Betts "Ty-Rap", Panduit cable mounts and Allen-Tel cable management or equal. Edge protection material ("cat-track") shall be installed on edges of holes, lips of ducts or any other point where cables or harnesses cross metallic edge.
 5. Shielding:
 - a. Cable shielding shall be connected to common ground at the main control unit terminal board and shall be free from ground at any other point within the system. Cable shields shall be terminated in same manner as conductors.
 6. Underground cables

- a. Any cable/wire pulled through manholes or pull boxes located below grade, shall be continuous with no splices. The cable/wire shall be intact with no cuts in the protective outer jacket.

3.03 SYSTEM START-UP

- A. All start-up programming and system commissioning shall be performed by a manufacturer's trained and certified technician.

3.04 SYSTEM VERIFICATION

- A. Subsequent to system start-up the system installer shall perform a pre-test to verify that the following features are functioning properly.
 - 1. All notification appliances
 - 2. All initiation devices
 - 3. All control modules
 - 4. All monitor modules
 - 5. Communication link to monitoring service

3.05 ACCEPTANCE TESTING

- A. The system installer shall, in the presence of the Inspector of Record (IOR), perform 100% testing as noted in System Verification above.

3.06 IN SERVICE TRAINING

- A. The Contractor shall instruct personnel designated by the District/Owner in the proper use, basic care and maintenance of the system beyond the warranty period. Contractor shall provide up to eight hours of in-service training with this system.

3.07 FACTORY TRAINING & CERTIFICATION

- A. The manufacturer shall provide factory certified training to two (2) technicians from the District/Owner for the DMP system. These technicians shall be trained and certified as manufacturers certified technicians capable of performing any work on the system after the installation of the system.
- B. All cost for training including travel, lodging, meals and per diem shall be included in the System Supplier/Installer's bid for this project.

3.08 CONTRACT CLOSE-OUT DOCUMENTATION

- A. Contractor shall provide the following:
 - 1. One reproducible hard copy of project record drawings.
 - 2. One copy of manufacturer's maintenance and operation manuals.
 - 3. One copy of system warranty

3.09 WARRANTY

- A. The Contractor shall warrant the equipment to be new and free from defects in material and workmanship, and will, within one year from the date of installation, repair or replace any equipment found to be defective. This warranty shall not apply to any equipment that has been subject to misuse, abuse, negligence or unauthorized modification.

3.10 MANUFACTURER'S FIELD SERVICES

- A. The contractor shall, at the District/Owner's request, make available a service contract offering continuing factory authorized service of this system upon expiration of the initial warranty period.
- B. The system manufacturer shall maintain engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.

END OF SECTION

SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of Division 01 apply to this section
- B. Section Includes:
 - 1. Modification, alterations and upgrades to the existing Fire Alarm System for the campus.
 - 2. Alterations, additions, and modifications to the existing Main Fire Alarm Control Panel (MFACP).
 - 3. Extension of existing Fire Detection and Alarm System as indicated on the Drawings, including (but not limited to) New Fire Alarm Control Panel (FACP) for the new Stadium – interconnected to the existing MFACP.
 - 4. New FACP shall provide 'voice evacuation' for all new facilities.
 - 5. All labor, equipment, materials, connections, testing, and performance of operations in the installation of fire alarm system as indicated on Drawings or as specified herein.
- A. Related Requirements:
 - 1. Division 01 General Requirements.
 - 2. Section 23 8000: Heating, Ventilating, and Air Conditioning Equipment.
 - 3. Section 26 0500: Common Work Results for Electrical.
 - 4. Section 26 0513: Basic Electrical Materials and Methods.
 - 5. Section 26 0519: Low-Voltage Wire (600 Volt AC).
 - 6. Section 26 0526: Grounding and Bonding.
 - 7. Section 26 0533: Raceways, Boxes, Fittings, and Supports.

1.02 SYSTEM REQUIREMENTS

- A. Fire detection system shall continually supervise and monitor the following initiating, signaling, and monitoring circuits:
 - 1. Manual fire-pull stations.
 - 2. Smoke and heat detectors, duct detectors, CO Detectors, including detectors installed under other sections.
 - 3. Fire sprinkler flow and tamper switches. In existing installations also include PIV tamper switches.
 - 4. Alarm signaling circuits including alarm bells, horns and visual alarm units.
 - 5. Annunciators.
 - 6. Power supplies and batteries.
 - 7. Interconnection with Central and Autonomous Public Address systems, and HVAC systems where applicable.
- B. System controls shall be UL listed for power limited applications in accordance with California Electrical Code.

- C. The fire alarm devices and equipment shall be listed for installation for the fire alarm control panel to which they are being connected.
- D. Complete installation shall conform to the version of NFPA 72, California Fire Code, California Building Code (CBC), and California Electrical Code (CEC) as approved by DSA on stamped drawings.
- E. System labels and devices programming addresses shall be based on final signage and building labeling submittals. For existing facilities contractor shall obtain from Owner Authorized Representative a copy of the current site layout and building labeling designations.

1.03 CERTIFICATION

- A. Certification: Installation of fire alarm system modifications shall not begin until Shop Drawings, including State Fire Marshal listing numbers of fire alarm components, are submitted and reviewed by the Architect. Written certification by fire alarm equipment distributor or manufacturer shall be submitted to the Architect stating that system and its component parts are as approved and listed by the State Fire Marshal, and that the design conforms to requirements set forth in CBC.

1.04 PERFORMANCE

- A. System shall be fully programmable, configurable, and expandable in the field without special tools or PROM programmers and shall not require replacement of memory ICs. Installer shall provide a CD of all system installed software, site specific system programming and all information and tools required to re-program or modify the system.

1.05 SYSTEM FUNCTIONAL OPERATION

- A. When a fire alarm condition is detected by one of the system alarm-initiating devices, the following functions shall occur:
 - 1. System alarm LED shall flash.
 - 2. Local sounding device in panel shall be activated.
 - 3. The LCD display shall indicate type of device, custom label location label and point status alarm condition.
 - 4. Appropriate change of status message shall be transmitted to remote annunciator(s).
 - 5. Automatic programs assigned to alarm point shall be executed and associated indicating devices and relays activated.
 - 6. In the event of a fire alarm control panel activation, all manual and automatic electronic tone or electromechanical bell class passing signals shall be disabled.
 - 7. In the event of a fire alarm condition the Central and Autonomous Public Address System shall be overridden.
 - 8. UDACT (Universal Digital Alarm Communicator Transmitter) shall activate.
- B. Trouble and Supervisory Conditions.
 - 1. When any trouble condition is detected the following functions shall occur:
 - a. System trouble LED shall flash.
 - b. Local sounding device in panel shall be activated.
 - c. The LCD display shall indicate the type of trouble and custom label location associated with the trouble condition and its location. Unacknowledged alarm messages shall have priority over trouble messages. If such an alarm is displayed, then trouble messages shall not be displayed.
 - d. Appropriate message shall be transmitted to remote annunciators.
 - e. UDACT shall activate.

- C. When any supervisory condition occurs such as a sprinkler valve tamper, the following function shall occur:
 - 1. System supervisory LED shall flash.
 - 2. Local sounding device in panel shall be activated.
 - 3. Appropriate message shall be transmitted to remote annunciators.
 - 4. UDACT shall activate.
- D. Activation of control panel ACKNOWLEDGE switch in response to a single new alarm, trouble or supervisory condition shall silence panel sounding device and change system alarm, trouble, or supervisory LED from flashing to steady-ON. If additional new alarm, trouble, or supervisory conditions exist in the system; activation of this switch shall advance display to next alarm, trouble, or supervisory condition that exists, and shall not silence local audible device or change LED to steady until new conditions have been so acknowledged. New alarm conditions shall always be displayed before new trouble conditions. Occurrence of a new alarm, trouble, or supervisory condition shall cause panel to resound, and sequences as described above, shall repeat.
- E. Activation of the signal silence switch shall cause appropriate notification (indicating) appliances and relays to return to normal condition. Selection of notification appliance circuits and relays silenced by this switch shall be fully programmable.
- F. Activation of system reset switch shall cause electronically latched initiating devices or zones, as well as associated output devices and circuits, to return to normal condition after sixty seconds of alarm. If alarm conditions exist in system after system reset switch activation, system shall then re-sound alarm conditions as indicated hereafter.
- G. Activation of lamp test switch shall turn on LED indicators, LCD display, and local sounding device in panel, and then return to previous condition.
- H. Fire alarm indicating appliances may be silenced or extinguished, after one minute, by operating signal silence switch at the FACP or by use of key supervised alarm silence switch at remote annunciators. A subsequent zone alarm shall reactivate signals. Audible indicating appliances shall be automatically silenced after no less than 5 nor more than 10 minutes of operation. Visual indicating appliances shall be extinguished at system reset, or automatically after no less than 5 nor more than 10 minutes of operation. Fire sprinkler flow alarm bells shall not silence until the contacts in the fire sprinkler flow switch return to the normal non-alarm state. Appropriate signage must be installed on or next to the sprinkler alarm bell.
- I. All system circuits including but not limited to initiation, indicating, and equipment interfacing shall be monitored for open/short circuit and ground fault conditions, these conditions shall be indicated on the Fire Alarm Control Panel and Annunciator displays while remaining circuits continue to operate normally.
- J. All notification appliance circuits shall be silenceable for testing purposes by authorized persons. Protected pass-codes, keys, or another secure method that does not require entering into the system programming shall be used.

1.06 POWER REQUIREMENTS

- A. The fire alarm control panel and remote power supplies receive 120 VAC power, 60 Hz, through a dedicated 20 amps circuit.
- B. Modified system shall be provided with sufficient battery capacity to operate entire system upon loss of normal 120 VAC power, in a normal quiescent mode, for a period of 24 hours with 5 minutes of alarm indication at end of this period. System shall automatically transfer to standby batteries upon power failure. Battery charging and recharging operations shall be automatic. Batteries, once discharged, shall recharge at a rate to provide a minimum of 70 percent capacity in 12 hours. Replace existing batteries as indicated on the Drawings.
- C. Circuits requiring system operating power shall be 24 VDC and shall be individually protected at control panel.

SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Component Plan Submittal: Availability and listing for its application shall be verified for all system components before presentation of the submittal. Include the following information and details as applicable:
 - 1. Installer name, address, telephone number.
 - 2. List of system components, equipment and devices, including manufacturer model numbers, quantity and California State Fire Marshal listing numbers, mounting heights, and symbols to match the SYMBOL LIST on the Drawings.
 - 3. Copies of manufacturer specification sheets for equipment and devices indicated. Highlight or identify the specific components on Catalog cut sheets.
 - 4. Voltage Drop Calculations: Include the following information for the worst case:
 - a. Point-to-point or Ohms law calculations.
 - b. Zone used in calculations.
 - c. Voltage drop percent. Voltage drop shall not exceed manufacturer's requirements. If voltage drop exceeds 10 percent, indicate manufacturer listed operating voltage ranges for equipment and devices.
 - 5. Battery types, amp hours, and load calculations including the following:
 - a. Normal operation: 100 percent of applicable devices for 24 hours to equal control panel amps plus list of amps per device that draw power from the panel during standby power condition including, but not limited to, zone modules, detectors and devices as identified.
 - b. Alarm condition: 100 percent of applicable devices for 5 minutes to equal control panel amps plus list of amps per device that draw power from panel during alarm condition including, but not limited to, the following:
 - (1) Zone modules.
 - (2) Signal modules.
 - (3) Detectors.
 - (4) Signal devices.
 - (5) Annunciator.
 - (6) Other devices as identified.
 - c. Normal operation plus alarm operation load calculation shall include total amp hours required and total amp hours provided.
 - 6. Provide one copy of testing procedures.
- C. Shop Drawings: Provide Shop Drawings, in the same size as the design Drawings, Shop Drawings shall include the following:
 - 1. Provide drawing scale, elevations of all system enclosures, and actual layout of the Fire Alarm Control Panel, power supply, annunciator, and all main system components.
 - 2. Site Plan indicating PIV and all related fire sprinkler system devices and equipment to be monitored or supervised; such as water flow valves, and main equipment such as control panels, power supplies, annunciators, and components such as outdoor wall-mounted horns, sprinkler bells, pull boxes, underground pull boxes, wiring routes on buildings exterior and underground locations. In each conduit or raceway run indicate conduit sizes, and quantities and type of wires.
 - a. In existing facilities make a distinction between existing and new installation.

3. Complete battery calculations, and voltage drop calculation shall be included; these calculations shall be based on the devices maximum UL current rating.
 4. One line drawing for the entire system network indicating all system components and wiring. The one line diagram shall show but not be limited to panel to panel interconnections, conductors gauge and quantity, conduit size and type (designation) and specific function.
 5. System panel one-line drawings indicating the quantity and type (designation) of conductors entering and exiting the fire alarm terminal cabinet in each building (enclosure) for initiating, notification, or other command control functions required for complete system operation:
 - a. Individual floor/building plan view drawings indicating all device locations including end of line resistors "EOLR" in accordance with the legend provided.
 - b. Individual point addresses for all initiation and notification devices.
 - c. Device "typical" wiring diagrams. These drawings shall indicate specific termination details for all peripheral equipment and/or interface devices.
 6. Provide interfacing with equipment furnished by others including voltages, and other required coordination items. Refer to 3.01-B.
 7. Each of the pictorial diagrams included shall appear identical to the products they are intended to depict, in order to speed installation of the system, and to enhance the accuracy of the installation Work. Typical wiring diagrams or catalog sheets are not permitted.
 8. Background Drawings with device locations of DSA approved drawings are available in electronic format and may be obtained from the Owner's Authorized Representative (OAR). Contractor is solely responsible for the accuracy and completeness of shop drawings. Buildings that are not part of the contract shall be clearly identified "NOT IN CONTRACT". Shop Drawings shall be prepared in the latest version of AutoCAD with 3 – CD ROM electronic copies submitted along with full sized Shop Drawings.
 9. Other installation and coordination drawings specifically related to this section shall be included as follows:
 - a. Size A (8-1/2-inch x 11 inches) and size B (11-inch x 17-inch) shall be bound into the manual.
 - b. Larger drawings shall be folded and inserted into transparent envelopes and bound into the manual.
 10. Installation and coordination drawings for items in other sections shall be included with submittal of Shop Drawings. Submit blue line copies and one reproducible copy of installation and coordination drawings.
 11. Samples: Provide Samples of material and equipment as required by the Architect. If Samples are requested, they shall be submitted within 10 days from date of request.
- D. In addition to the above requirements, provide submittals to meet any additional requirements of DSA.
- E. Modifications or additions to existing fire alarm systems shall be compatible and of the same manufacturer as the existing system. Contractor shall be solely responsible for all engineering, plan check and any fees resulting from an installation that deviates from this requirement.
- F. Prior to Substantial Completion submit to the Architect/Engineer of Record and to Owner Authorized Representative a complete updated set of the Shop Drawings showing all changes made to the Fire Alarm System during construction. These drawings will become the System As-Built Drawing set for the Fire Alarm System Owner's Manual.

- A. Installer shall have successfully completed at least 5 projects of equal scope in the past 5 years, and have been in business of furnishing and installing fire alarm systems of this type for at least 5 years.
- B. Installer shall be a factory authorized distributor and service provider for the brand of equipment offered and shall provide documentation to the Architect upon request.
- C. Installer shall maintain a fully equipped service organization capable of furnishing repair service to the equipment and shall maintain a spare set of major parts for the system at all times.
- D. Installer shall furnish a letter from manufacturer of equipment certifying equipment has been installed according to factory standards and that system is operating properly.
- E. Certifications: Installer shall submit certification from the equipment manufacturer indicating that installer is an authorized representative of the equipment manufacturer and is trained on network applications.
- F. All materials and equipment installed shall be new.
- G. Equipment in this specification shall be furnished and installed by the Authorized Factory Distributor of the equipment. Furnish a letter from the manufacturer of all major equipment, which certifies that the installer is an authorized distributor and that the equipment has been installed according to factory intended practices. Furnish a written guarantee from the manufacturer that they will have a service representative assigned to this area for the life of the equipment.
- H. Installer shall be Underwriters Laboratory (UL) listed company under the UUJS classification, and shall certify that the installation has been made in accordance with UL requirements.
- I. The fire alarm contractor shall have a NICET II Certified Technician on staff in their facility directly involved with this project to ensure technical expertise to this project and adherence with these specifications.
- J. Contractor/Installer's electricians and fire/life safety technicians shall be certified in accordance with Labor Code sections 3099, and 3099.2, and section 209.0 of the California Code of Regulations.
- K. System startup and testing shall be performed under the direct observation of the Inspector of Record (IOR) and OAR. The Contractor at this time shall provide a legible half size reproduction of the original completed fire alarm red-line drawings (this copy will be retained by the Owner), an accurate copy of the fire alarm system points list, and a copy of the construction drawings on CD in AutoCAD format.
- L. Provide and install the most current software package available at the time of installation.
- M. At the time of Owner Acceptance of the installation, all equipment, including any and all updated software which is to include the appropriate operating system, pass-codes, electronic keys and program disks, manuals and cables employed in the installation of the system, shall be delivered to the Owners Authorized Representative (OAR).
- N. In addition, when the programming software is available in disk format, a backup copy of the most up to date revision, in disk format, shall be delivered to the OAR at the completion of the project.
- O. A software license agreement shall be made available for the responsible Owner representative to sign at the time of training.

1.09 WARRANTY

- A. The Fire Alarm Equipment Manufacturer shall provide a 3-year material warranty. Installer shall provide a 3-year labor warranty.
- B. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer for a period of 5 years after expiration of the warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The existing Fire Alarm System is manufactured by Notifier. All new components for the Fire Alarm System shall be manufactured and/or supplied Notifier. ***This manufacturer and system type is the campus/District standard and no other manufacturers / systems will be considered.***
- B. To ensure that compatibility and continuity is maintained throughout the existing school district, no other manufacturers or system suppliers will be considered.

2.02 MAIN FIRE ALARM CONTROL PANEL (MFACP)

- A. The MFACP is existing as indicated on the Drawings.
- B. The MFACP shall be upgraded, altered, modified, and reprogrammed as necessary to accommodate the additions to the campus.

2.03 FIRE ALARM CONTROL PANEL (FACP) FOR NEW STADIUM

- A. Furnish new Fire Alarm Control Panel as indicated on drawings.
- B. Operator Control:
 - 1. Acknowledge Switch: Activation of control panel acknowledge switch in response to a single new trouble or alarm condition shall silence panel sounding device and change system alarm or trouble LED from flashing to steady-ON. If additional new alarm or trouble conditions exist in system, activation of this switch shall advance display to next alarm or trouble condition that exists and shall not silence local audible device or change LED to steady until new conditions have been so acknowledged. New alarm conditions shall always be displayed before new trouble conditions. Occurrence of a new alarm or trouble condition shall cause panel to resound, and sequences as described above, shall repeat.
 - 2. Signal (Alarm) Silence Switch: Activation of the signal silence switch shall cause programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully fielded programmable within the confines of applicable standards at the job site. The FACP software shall include silence inhibit and auto-silence timers.
 - 3. Alarm Activate (Drill) Switch: Alarm activate switch shall activate notification appliance circuits. The drill function shall latch until the panel is silenced or reset.
 - 4. System Reset Switch: Activation of the System Reset switch shall cause electronically-latched initiating devices, appliances or software zone, as well as associated output devices and circuits, to return to their normal condition.
 - 5. Lamp Test Switch: Switch shall activate local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personnel.
 - 6. Hot Button Switch: Hot Button Key switch shall be provided in FACP to disable all output devices for testing or repair of system. Key switch shall silence all horn and strobes, disable PA cutouts, HVAC shutdowns, door closures, and Autonomous PA systems. Key switch shall be password protected to enable function. LED indicator shall illuminate a trouble condition while Hot Button Switch is activated and shall turn off when system is re-enabled.
- C. System Capacity and General Operation
 - 1. The control panel or each network node shall provide, or be capable of expansion to 636 minimum intelligent addressable devices in smaller systems, and 3180 intelligent, addressable devices for larger systems.
 - 2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of two amps at 30 VDC. It shall

also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notifications Appliance Circuits.

3. The control panel or each network node shall support up to eight output modules (signal or relay), each with eight circuits for a total of 64 circuits for the smaller capacity panels, and 12 output modules for a total of 96 circuits for the larger capacity panels. Programmable notification appliance circuits shall be class B.
4. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire alarm system.
5. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
6. The system shall allow the programming of any input to activate any output or group of outputs. The FACP shall support up to 20 logic equations, including “and” “or” and “not”, or timed delay equations to be used for advanced programming. Logic equations shall require the use of a PC with software utility designed for programming.
7. The FACP or each network node shall provide the following features:
 - a. Drift compensation to extend detector accuracy over life. Drift Compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
 - b. Detector Sensitivity tests, meeting requirements of NFPA 72 Chapter seven.
 - c. Maintenance alert, with two levels (maintenance alert or maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
 - d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be 0.5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also support sensitive advance detection laser detectors with an alarm level range of 0.03 percent per foot to one percent per foot. The system shall also include up to nine levels of Pre- alarm, selected by detector, to indicate impending alarms to maintenance personnel.
 - e. Circuit boards, programming, and interconnecting cables to enable the system to display or print system reports.
 - f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
 - g. PAS pre-signal testing in accordance with California Fire Code (CFC) and NFPA 72 requirements.
 - h. Rapid manual station reporting (less than three seconds) shall meet CFC and NFPA 72 requirements for activation of notification circuits within ten Seconds of initiating device activation.
 - i. Periodic detector test, conducted automatically by the software.
 - j. Self-optimizing pre-alarm for advance fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks.
 - k. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
 - l. Walk test, with a check for two detectors set to same address.
 - m. Control-by-time for non-fire operations, with holiday schedules.
 - n. Day or night automatic adjustment of detector sensitivity.

- o. RS 232 serial port to support a District supplied printer to be used for silent testing and certification of the system.

8. Network Communication:

- a. The network architecture shall be based on a Local Area Network (LAN), a firmware package that utilizes a peer-to-peer, inherently regenerative communication format and protocol. The protocol shall be based on ARCNET or equivalent non-proprietary protocol.
- b. Failure of any node shall not cause failure or communication degradation of any other node or change the network communication protocol among surviving nodes located within distance limitations. A node may be an intelligent Fire Alarm Control Panel (FACP), Network Control Station PC (NCS) or Network Control Annunciator (NCA).
- c. Each network node address shall be capable of storing Event Equations which shall be used to activate outputs on one network node from inputs on other network nodes.

D. System Display:

- 1. Utilize the 640-character display option. The design of the CPU shall provide for a configuration with the 640-character display mounted on the front of the unit in place of the standard 80-character display.
- 2. The 640-character display shall provide the controls and indicators used by the system operator: The 640-character display shall include the following operator control switches; Acknowledge, Alarm, Silence, Alarm Activate (drill), System Reset and Lamp Test.
- 3. The display shall annunciate status information and custom alphanumeric labels for intelligent detector, addressable modules, internal panel circuits, and software zones.
- 4. The 640-character display shall provide ten Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC Power and Network Communication, Fire Alarm, Pre alarm Warning, Security Alarm, Supervisory Event, System Trouble, Alarm Silence, Disabled Points, CPU failure.
- 5. The 640-character display shall use ten "soft" keys for screen navigation or to accomplish dedicated programming functions. Full programming access shall require use of a laptop and the proper programming utility. The programming utility shall be provided to the OAR who will forward it to the local maintenance area representative.
- 6. The system shall support the display of battery charging current and voltage on the LCD display.

E. Network Control Annunciator:

- 1. When a networked system is installed a network controlled annunciator (NCA) shall be provided to display system intelligent points. The NCA shall be capable of displaying information for all possible points on the network.
- 2. The NCA shall include a minimum of 640 characters, backlit by a long life, solid-state LCD display. Additionally, the network display shall include ten soft keys for screen navigation and the ability to scroll events by type. i.e. Fire Alarm, Supervisory Alarm, Trouble, etc.
- 3. The NCA shall have the ability to display up to eight events in order of priority and time of occurrence. Counters shall be provided to indicate the total number of event by type.

4. The NCA shall mount in a Notifier ABS-2DB or equal keyed box; provide a key enable or disable switch for the network node fire alarm control panels. The network display may mount in a backbox designed for this use. The network shall support the NCAs.
5. The network control annunciator shall have an event history buffer capable of storing a minimum of 1000 events in nonvolatile memory. Additionally, the NCA shall have a fire alarm history buffer capable of storing a minimum of 200 events in nonvolatile memory.
6. The NCA shall include two EIA-232 ports for UL864 listed printers and CRT's.
7. The NCA shall include control switches for system wide control of Acknowledge, Signal Silence, System Reset, Drill, and local Lamp Test. A mechanical means, by which the controls switches are locked out, such as a key, shall be provided.
8. The NCA shall include long life LEDs to display Power, Fire Alarm, Pre-Alarm, Security Alarm, System Trouble, Supervisory, Signals, Silenced, Disabled Prints, other (non-fire) Events, and CPU Failure.
9. The NCA shall include a Master Password and up to nine user Passwords. The Master password shall be required to access the programming and alter status menus. Each User password may have different levels of authorization assigned by the Master password. Passwords installed into the NCA shall be made available to the OAR who will forward them to the local maintenance area representative.
10. The NCA shall allow editing of label for points within the network, control on or off of outputs, enable or disable of network points, alter detector sensitivity, clear detector verification counters for any analog addressable detector within the network, clear any history log within the network, change the Time or Date settings, initiate a Walk Test.
11. The NCA shall include a time of day clock.
12. Each NCA shall support 80-character remote display annunciators for displaying network activity. These "Terminal Mode" displays will mimic the activity appearing on the corresponding NCA. There shall be only one annunciator or control system consisting of components manufactured by one manufacturer for the fire alarm system.

F. Signaling Line Circuits (SLC):

1. Each FACP or FACP network node shall support a minimum of one SLC for the smaller panels and ten SLC's for the larger panels. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric or thermal) and 159 intelligent modules (monitor or control) for a loop capacity of 318 devices.
2. CPU shall receive analog information from intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors including the accumulation of dust in each detector. The analog information shall also be used for automatic detectors testing and for the automatic determination of detector maintenance requirements.

G. Enclosures:

1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.030 steel with provisions for electrical conduit connections into the sides and top.
3. The supplied door shall include a key lock and shall include glass or other transparent opening for viewing of indicators. For convenience, the door may be site configured for either right or left hand hinging.

H. Power Supply:

1. An off-line switching power supply shall be available for the fire alarm control panel or network nodes.
2. Provisions shall be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
3. Over-current protection shall be provided on power outputs. The power supply shall provide an integral battery charger. Battery arrangement may be configured in the field.
4. The power supply shall continuously monitor field wires for earth ground conditions, and shall have the following LED indicators:
 - a. Ground Fault LED.
 - b. AC Power Fail LED.
 - c. NCA-2 on LED (4).
5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide power for the FACP or network node(s).
6. The main power supply shall provide a battery charger using dual rate charging technology for fast battery recharge and be capable of charging batteries up to 60 AH for the smaller panels and 200 AH for larger panels.

2.04 REMOTE POWER SUPPLIES

- A. Furnish and install new remote power supplies as indicated on the Drawings.

2.05 PERIPHERAL DEVICES AND EQUIPMENT

- A. Manual Stations: Refer to Drawings for information.
- B. Smoke Detectors: Refer to Drawings for information.
- C. Heat Detectors: Refer to Drawings for information.
- D. Duct Smoke Detectors: Refer to Drawings for information.
- E. Multi-Criteria Fire Detectors: Refer to Drawings for information.
- F. Monitor Modules: Refer to Drawings for information.
- G. Control Modules: Refer to Drawings for information.
- H. Relay Modules: Refer to Drawings for information.
- I. Isolator Modules: Refer to Drawings for information.
- J. Strobe Synchronization Modules: Refer to Drawings for information.
- K. Horns and Strobes: Refer to Drawings for information.
- L. Door Holder/Releases: Refer to Drawings for information.
- M. Bells: Refer to Drawings for information.
- N. Water-flow Switches: Refer to Drawings for information.
- O. Protective Covers: Refer to Drawings for information.
- P. Network Cables/SLC/Annunciator Data/Audio Output Cables: Refer to Drawings for information.
- Q. Universal Digital Alarm Communicator Transmitter (UDACT): Refer to Drawings for information.

2.06 VOICE EVACUTATION SYSTEM

- A. Voice Evacuation System:
 1. The Voice Evacuation Control (EVAC) Panel. The self-contained control panel shall be equipped with dual 25-watt audio amplifiers each with a single style Y (Class B) supervised 25-Vrms output circuit. The EVAC panel shall have the

ability to record a minimum of two field-programmable messages of up to 60 seconds total duration with an integral microphone or an external source via an audio input jack. The messages shall be stored digitally onto a non-volatile EEPROM. The message(s) shall be individually field programmable for three, four, six, eight, or indefinite repeat while triggered by the host FACP. Any message being delivered at the time of the trigger circuit(s) reset shall not stop in mid-sentence but shall be completed to the end of the message. A tone generator shall be provided capable of emulating a field programmable lead-in or trailing alert tone or an Audible Emergency Evacuation Signal (Temporal Pattern). The EVAC panel shall be capable of electrically supervising in both active and standby conditions, the amplifier outputs, field wiring, message generator, tone generator, microphone and primary or secondary power supplies to an internal trouble relay(s). The trouble relay(s) contacts shall be accessible via a terminal strip and be configured and connected to report internal or external trouble conditions to the host FACP via the trigger circuit or a separate monitor module. The minimum of two trigger circuits shall be individually field-configurable for triggering with a NAC circuit or a supervised dry contact. The control panel shall be equipped with LED indicator lights for Power On, System Trouble, Message Generator Trouble, Tone Generator Trouble, Microphone Trouble, Battery Trouble, Charger Trouble, Ground Fault, Output Circuit Trouble and Amplifier Supervisory. The panel shall be equipped with an internal monitor speaker for reviewing the field recorded messages. The primary power supply shall operate at 120 VAC through a dedicated 20 amp. circuit and shall be capable of charging 18 AH lead acid batteries. Provide two 12-volt batteries that will provide a secondary power source for the same or longer duration than is required by the host FACP. An auxiliary 24-volt DC power output shall be provided for use by an associated addressable control module. The EVAC control panel shall be triggered either directly by the associated FACP with a NAC circuit or by an addressable control module. Provide 3/8 inch minimum "P Touch" labeling on the window in front of the built in microphone indicating that "THE INTERNAL MICROPHONE IS TO BE USED FOR THE RECORDING OF ANNOUNCEMENTS ONLY. NOT FOR USE BY STAFF OR FIRE DEPARTMENT PERSONNEL."

2. Ceiling Mounted eight-inch EVAC Speakers shall be mounted in a Notifier Model CBB-8 back box or equal. The speaker assembly shall be supplied with a white 12-inch round metal grill. The 8-inch speaker shall have an impedance of 8 ohms, minimum 9.5-ounce magnet and an attached 25-volt audio line matching transformer with 1/8, 1/4, 1/2, 1, 2, 4 and 8 watt tap settings and DC blocking capacitor. Wattage shall be selectable by the use of a jumper or shunt. Audio levels shall be 75, 78, 81 87, 90 or 93 dba at ten feet. Input or output terminals that will accommodate 12 to 18 AWG wire shall be provided. Speakers orientated in the same direction shall be connected in phase with each other. Multiple speakers in areas such as Auditoriums or Gymnasiums shall be divided into two circuits in a checker-board pattern and connected separately to the two audio output circuits.
3. Wall Mount four-inch EVAC Speakers shall be mounted on a manufacture recommended outlet box. When mounted on a surface mount outlet box, Provide a Model No. BBS-SP201R surface mount backbox skirt. The speaker assembly

shall be supplied with a square high impact red grill. The four-inch speaker shall have an attached 25-volt audio line matching transformer with 1/4, 1/2, 1 and 2 watt tap settings and a DC blocking capacitor. Wattage shall be selectable by the use of a jumper or shunt. Audio levels shall be 80, 84, 86 or 89 dba at ten feet. Input or Output terminals that will accommodate 12 to 18 AWG wire shall be provided. Speakers orientated in the same direction shall be connected in phase with each other; but when installed facing opposite directions they shall be connected out of phase.

PART 3 - EXECUTION

3.01 GENERAL

- A. Fire alarm system shall not be used for any purpose other than fire alarm functions.
- B. Fire alarm shall be interconnected but not limited to the following systems:
 - 1. All systems required by code to be connected to the fire alarm systems shall be connected.
 - 2. Ventilation systems where required for the purpose of fan shutdown
 - 3. Central and Autonomous PA system(s).
 - 4. Water based fire sprinkler systems.
- C. Fire alarm system shall not be interconnected to any of the following:
 - 1. Sump warning systems,
 - 2. Carbon monoxide detection systems,
 - 3. Methane gas detection systems.
 - 4. Any other unrelated system.

3.02 SYSTEM INSTALLATION

- A. Install required conductors to devices indicated on Drawings. Provide required conductor terminations to devices for a complete system to function as specified and indicated on Drawings. Refer to Section 26_0519: Low-Voltage Wire (600 Volt AC), for installation and color-coding requirements.
- B. Splices are not allowed in junction boxes. Terminations shall be in terminal cabinets or on equipment terminals.
- C. Conductors shall be installed within conduits, boxes, and terminal cabinets in a totally enclosed installation. Furnish and install conductors required to connect incoming and outgoing circuits, including spare conductors, to terminal strips within terminal cabinets.
- D. Wiring within equipment and terminal cabinets shall be installed to conform to contract documentation and NFPA 72 standards and shall be terminated on terminal blocks having terminals for required connections. Wiring shall be cabled, laced, and securely fastened in place so that no weight is imposed on equipment or terminals.
- E. Install required terminal blocks within terminal cabinets. Terminal blocks shall be installed on inside back of cabinets only, not on side. Incoming wiring shall be terminated on the left side of terminal blocks; outgoing wiring shall be terminated on the right side of the terminal blocks.
- F. Conductors shall be color-coded per specification Section 26_0519: Low-Voltage Wire (600 Volt AC), and tagged with code markers at terminal cabinets, and equipment. A wire index shall be typed and installed on terminal cabinet doors. Index shall be covered with clear plastic adhesive covers. Wiring shall be identified as to building and location of devices in the index.

- G. Wiring within equipment and terminal cabinets shall be carefully strapped, and shall be formed in rectangular configuration. Wires shall be properly numbered in numerical order and shall maintain same number throughout the Project site.
- H. Complete installation shall comply with local building codes and applicable provisions of the California Electrical Code, California Fire Code and the NFPA 72 National Fire Alarm Code.
- I. Location of outlet boxes and equipment on Drawings is approximate, unless dimensions are indicated. Do not scale Drawings to determine locations and routing of conduits and outlet boxes. Location of outlet boxes and equipment shall conform to architectural features of the building and other Work already in place, and must be ascertained in the field before the start of Work.
- J. Drawings generally indicate Work to be provided, but do not indicate all bends, transitions or special fittings required to clear beams, girders or other Work already in place. Investigate conditions where conduits are to be installed, and furnish and install required fittings.
- K. Provide P-touch label of approximately 1 inch wide with red lettering for each initiating device that is hidden from view. Tags shall indicate the name and type of device: Heat Detector, or Duct Smoke Detector. Tags shall be permanently attached on access panel or t-bar grid which is used to access a hidden device.
- L. Provide and install adjacent to each annunciator a neatly typewritten copy of the Fire Alarm Operating Instructions. The instructions shall reflect the installed and programmed features of the system. Instructions that include information on non-installed or programmed features will not be acceptable. The instructions shall be placed into a suitably sized dark colored wood or metal frame with a glass document face cover. The frame shall be attached to the wall with a minimum of two screws into the wall material with appropriate anchors.
- M. Provide and install adjacent to each annunciator a neatly drawn site map showing all rooms with designations and buildings with names as programmed into the system. This map shall be sized to allow (normal vision) reading of the designations, names etc. A map so reduced in size to the point of not being readable will not be acceptable. This map shall include symbols indicating the locations of all installed fire sprinkler flow switches, riser shut off valves, post indicating valves and manual pull stations. Provide a symbol list on the map for the symbols used. The site map shall be placed into a suitably sized dark colored wood or metal frame with a glass document face cover. The frame shall be attached to the wall with a minimum of two screws into the wall material with the appropriate anchors.

3.03 SYSTEM PROGRAMMING

- A. The contractor shall program the system with the functions and features required by the District, the local authority having jurisdiction or applicable codes.
- B. The contractor shall develop the designations for the device descriptors to be used to identify the various systems devices and site locations. Prior to completion of construction, Contractor shall propose labelling descriptions for all devices and locations in the manner indicated in the attached guidelines on a separate copy of the shop drawings. Contractor shall request a meeting with OAR, IOR, and representative of NLMUSD to review, finalize and obtain approval of the proposed device, equipment and location descriptors that will be programmed into the system. The District may at time of substantial completion request minor changes to program descriptors if needed to conform to site conditions.

3.04 SYSTEM OPERATION

- A. Unless otherwise specified, but not limited to actuation of manual stations, smoke detectors, heat detectors, linear heat or smoke detectors, or water-flow switches shall cause the following operations to occur:
 - 1. Activate audible circuits.
 - 2. Actuate strobe units until the panel is reset or strobe circuit time-out.
 - 3. Duct type smoke detectors shall, in addition to the above functions, shut down the ventilation system or close associated control dampers as required.

4. Activation of fire sprinkler system low-pressure switches, post indicator valve or tamper switches shall initiate a system supervisory alarm indication.
5. UL listed central station shall be notified via – Universal Digital Alarm Communicator Transmitter (UDACT).

3.05 TESTING

- A. A 48-hour notice shall be provided to the IOR before final testing.
- B. Testing of fire detection system shall be as required by the State Fire Marshal and local authorities having jurisdiction. Installer is responsible for identifying required testing, coordinating, scheduling, and conducting tests before Substantial Completion. Tests shall include the following:
 1. Operation of all signal-initiating devices (smoke detectors, heat detectors, pull stations etc.).
 2. Operation of all indicating devices (alarm horns, alarm bells and alarm strobes).
 3. Operation of all system features under normal operation.
 4. Operation of all system supervisory features.
 5. Operation of all system features on standby power, with primary power turned off.
 6. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 7. Close sprinkler system flow valves and verify proper supervisory alarm at the FACP.
 8. Verify activation of flow switches.
 9. Open initiating device circuits and verify that trouble signal actuates.
 10. Open signaling line circuits and verify that trouble signal actuates.
 11. Open and short notification appliance circuits and verify that trouble signal actuates.
 12. Open and short (wire only) network communications and verify that trouble signals are received at network annunciators or reporting terminals.
 13. Ground initiating device circuits and verify response of trouble signals.
 14. Ground signaling line circuit and verify response of trouble signals.
 15. Ground notification appliance circuit and verify response of trouble signals.
 16. Check alert tone to alarm notification devices.
 17. Check installation, supervision, and operation of intelligent smoke detectors.
 18. Alarm conditions that the system is required to detect shall be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
 19. When the system is equipped with optional features, consult the manufacturer manual to determine proper testing procedures.
 20. Central and Autonomous PA systems for muting during the sounding of the audible notification appliances and voice evacuation announcements.
 21. Disabling electronic tone or electromechanical bell class passing signals until system reset.
- C. Upon completion of installation of fire alarm equipment, provide to the OAR a signed, written statement confirming that fire alarm equipment was installed in accordance with the Specifications, Shop Drawings, instructions and directions provided by the manufacturer.
- D. Demonstrate in presence of the IOR that circuit and wiring tests are free of shorts and grounds and that installation performs as specified herein and within manufacturer's guidelines.

- E. Software Modifications:
1. Provide the services of a factory trained and authorized technician to perform system software modification, upgrades or changes. Response time of the technician to the Project site shall not exceed 24 hours.
 2. Provide hardware, software, programming tools, and documentation necessary to modify the fire alarm network on the Project site. Modification includes: addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modification on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being provided.
- F. Complete the inspection and testing form as required by NFPA 72, and submit one copy of the completed form to the Architect and IOR.
- G. If required by local authorities, fire alarm system shall pass a City of La Mirada Fire Department test administered by Owner personnel prior to issuing certificate of substantial completion. An accurate copy of the red line as-built drawings, a valid copy of the fire alarm points list, a CD with the project background drawings in AutoCAD format, and all pass-codes required for the testing process shall be made available to District personnel prior to the test. These items shall be retained by the District.
1. All defects resulting from the District tests shall be corrected prior to substantial completion.

3.06 SERVICE MANUALS

- A. Contractor shall deliver to OAR, 3 copies of the service manuals. Each manual shall include the following:
1. Installation manuals, programming manuals and user manual if applicable for every control panel, control panel power supply, FACP input/output/relay or control module, auxiliary power supply, UDACT, remote NAC extender power supply, door holder power supplies, all installed annunciators, initiating and indicating devices and all addressable monitor, relay and control modules. Catalog cut sheets are not acceptable.
 2. A printed copy of the system configuration as programmed, including all system labeling codes, and passwords.
 3. An electronic copy on compact disk of the system configuration program
 4. Final test report.
 5. Detailed explanation of the operation of the system.
 6. Instructions for routine maintenance.
 7. Detailed wiring diagram for the connection of relays, addressable monitor, and control or relay modules as applied in the interfacing of peripheral systems or equipment to the fire alarm system. Updated shop drawings shall include all revisions made in the field via plan changes, RFIs, Field Change Directives, and any other construction change documents including interface details with ancillary systems.
 8. An electronic copy (CD) of the posted site/fire alarm map in Auto-Cad and pdf formats
 9. Provide a CD ROM electronic copy of the updated system As-Built Drawings to the OAR, prepare this copy in the latest version of AutoCAD; along with the electronic copy provide a full size bond copy. Include one CD-ROM of the up-dated As-Built Drawings into each of the Service Manuals. CD and folded drawings shall be secured and inserted into the Service Manuals via a three-hole punched protective CD case and protective envelopes for the drawings.
 10. Provide codes and passwords for fire alarm system at testing.

- 3.07 SPARE PARTS
- A. The following new spare parts shall be furnished in unopened boxes:
1. 5% spare pull stations including the associated monitor module (minimum one spare pull station per type).
 2. 5% spare smoke and heat detectors (minimum one spare smoke and heat detector per type).
 3. 5% spare audible devices (minimum one spare audible device per type).
 4. 5% spare strobe devices (minimum one spare strobe device per type).
- 3.08 SYSTEM USER AND MAINTENANCE PERSONNEL TRAINING
- A. Before Substantial Completion, provide one instruction period for the Project site based Owner operators and system users.
1. The instruction period shall be scheduled and coordinated by the Owner's Authorized Representative.
- B. All training materials and required deliverables shall be submitted to the Owner's Authorized Representative for distribution.
- 3.09 PROTECTION
- A. Protect the Work of this section until Substantial Completion.
- 3.10 CLEANUP
- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION

DIVISION 31

EARTHWORK

SECTION 31 10 00

SITE CLEARING

PART 1 – GENERAL

1.1 SUMMARY

- A. Provisions of the general and supplementary conditions and Division One apply to this section.
- B. Section Includes:
 - 1. Removal of vegetation, grass, grass roots, shrubs, tree stumps, trees, upturned stumps, weed growth, tree roots, brush, masonry, concrete, rubbish, debris and other objectionable materials, within limits of construction.
 - 2. Removal of concrete and bituminous surfaces.
 - 3. Removal of existing fences and gates
- C. Related Sections:
 - 1. Section 31 22 00: Grading
 - 2. Section 02316: Excavating, Backfilling and Compacting for Pavement.
 - 3. Section 02315: Excavating, Backfilling and Compacting.
 - 4. Section 02319: Base Course

1.2 SUBMITTALS

- A. Shop Drawings
 - 1. Submit site plan showing extent of clearing, and indicating methods proposed.

1.3 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 - 1. Standard Specifications for Public Works Construction, current edition.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION

3.01 TREE AND STUMP REMOVAL

- A. Remove trees and stumps indicated to be removed. Remove trees, together with bulk of roots, to a minimum depth of four feet below existing grade, and within a radius of approximately seven feet beyond perimeter of trunk at ground line.

- B. Fill and compact holes resulting from tree and stump removal. Fill in six inch layers, each compacted to 90% of maximum density in accordance with ASTM D 1557.
 - 1. Prior to filling holes, schedule an inspection by District Inspector. Do not proceed until approved by District Inspector.

3.02 CONCRETE AND BITUMINOUS SURFACING REMOVAL

- A. Rehabilitation of existing asphalt per District instruction - Pulverize existing material to subgrade and use as base in accordance with section 3.03 – B.

Or

- B. Break up and completely remove all existing concrete surfacing, curbs, gutters, walks and bituminous surfacing to limits indicated to be removed. All cutting shall be done to a neat and even line with proper tools or concrete cutting saw with a new, sharp blade. Minimum depth of cut shall be 1-1/2 inch, unless otherwise indicated. Remove concrete broken beyond the indicated limits to the nearest joint or score line and replace with new concrete to match existing.

3.03 FENCING

- A. Existing fencing scheduled to remain, may be removed to facilitate the work, provide such are reinstalled to their original condition at completion of the work. Reinstall in accordance with requirements of section 32 31 13: Chain Link Fences and Gates: Section and Gates.
- B. Fencing that is indicated to be removed and not reinstalled shall be completely removed, including footings. Fill and compact holes resulting from removal. Remove materials and dispose of off-site.
- C. Reinstall chain link fencing indicated to be relocated or reset in accordance with applicable requirements specified under section 32 31 13: Chain Link Fences and Gates: Section and Gates.

3.04 DISPOSAL

- A. Remove Materials and debris and dispose of off-site.

END OF SECTION

SECTION 31 20 00

EARTHWORK

PART 1 - GENERAL

- 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. Preparing and grading subgrades for slabs-on-grade, walks, pavements and landscaping
2. Excavating and backfilling for buildings and structures.
3. Drainage and moisture-control fill course for concrete slabs-on-grade.
4. Base course for concrete walks, asphalt and pavements.
5. Subsurface drainage backfill for walls and trenches.
6. Excavating and backfilling trenches for utilities and appurtenances outside building lines.

B. Related Sections:

1. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
2. Division 03 Section "Cast-in-Place Concrete" for granular course beneath the slab-on-grade.
3. Division 31 Section "Site Clearing" for site stripping, grubbing, and removal of above- and below-grade improvements and utilities.

1.3 REFERENCE SPECIFICATION

- A. Perform all work in accordance with applicable provisions of "Standard Specifications for Public Works Construction", 2018 Edition, City of Los Angeles Ordinances and Amendments, latest editions, UBC and 2019 CBC. Unless otherwise noted, mention herein of section numbers refers to sections of the Reference Specification. Where Reference Specification refers to "Agency", substitute the word "Owner". Where Reference Specification refers to "Engineer", substitute the word "Architect". Where Reference Specification is in conflict with these Specifications, these Specifications shall govern.
- B. The recommendations found in the Geotechnical Exploration Report prepared by Ninyo & Moore Geotechnical and Environmental Sciences Consultants dated September 9, 2014 apply to this Section.

1.4 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.

2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and the surface pavement in paving system.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill when sufficient approved soil material is not available from excavations
- E. Drainage Fill: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered to subgrade elevations and the re-use or disposal of materials removed.
1. Authorized Additional Excavation: Excavation below subgrade elevations as directed by Architect.
 2. Unauthorized Excavation: Excavation below subgrade elevations without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.
- L. Compaction: Any method of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum dry density obtained by the test procedure described in ASTM D 1557 for general soil types abbreviated in this Specification as 90 percent of maximum dry density".
- M. Hard Material: Weathered rock, dense consolidated deposits or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal
- N. Lift: A layer or course of soil placed on top of previously prepared or placed soil in a fill or embankment.
- O. Unsatisfactory Material: Soil or other material identified as having insufficient strength or stability to carry intended loads without excessive consolidation or loss of stability.

1.5 SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Warning Tape
 - 2. Geotextile
 - 3. Water Quality Filter Media
- B. Location of Borrow Materials.
- C. Material Test Reports
- D. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction
- B. Testing and Inspection Service: Owner will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing.
- C. Pre-excavation Conference: Before commencing earthwork, meet with representatives of the governing authorities, Owner, 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 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

1.7 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided.
 - 1. Provide a minimum 48-hours' notice to the Architect and receive written notice to proceed before interrupting any utility.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies and owner to shutoff services if lines are active.
- C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- D. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.
- E. Utility Locator Service: Notify UNDERGROUND SERVICE ALERT for area where Project is located before beginning earth moving operations.
- F. Do not commence earth moving operations until temporary erosion/sedimentation control measures, specified in Division 01 are in place.
- G. Perched Groundwater was mapped at approximately 50 feet below the ground surface.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil materials imported or excavated on the property determined to be suitable as referenced in the project Geotechnical Investigation Report; and approved by the Geotechnical Engineer.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.
 1. Refer to Geotechnical Investigation Report, for unsuitable materials and disposal methods for unsatisfactory soils.
- D. Backfill and Fill Materials: Satisfactory soil materials.
- E. Base Material: Shall conform to crushed aggregate base or crushed miscellaneous base, as specified on plan, in accordance with section 200-2.2 or 200-2.4, respectively, of the Reference Specification, and compacted to at least 95% of the maximum dry density as determined by ASTM Test Method D 1557.
- F. Engineered Fill: Base Materials and compacted fill materials
- G. Bedding Material: Shall be 1 sack slurry per soils report.
- H. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, ASTM D 448, coarse aggregate grading size 57, with 100 percent passing a 1-1/2-inch sieve and not more than 5 percent passing a No. 8 sieve
- I. Filtering Material: Evenly graded mixture of natural or crushed gravel or crushed stone and natural sand, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 50 sieve.
- J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater

than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
3. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
4. Tear Strength: 56 lbf (250 N); ASTM D 4533.
5. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.2 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.
 6. White: Steam systems
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.
 6. White: Steam Systems

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. 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.
- C. Tree protection is specified in the Section 31 10 00 "Site Clearing". Refer to landscape architectural plans for instructions.

- D. Prepare subgrade and place base materials in accordance with sections 301-1.2 and 301-2, respectively, of the Reference Specification.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Dewatering shall be done in accordance with NPDES waste discharge requirements. Contractor shall obtain all necessary Dewatering permits from state and local jurisdictions.
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. General: Excavation shall be to the contours, elevations and dimensions indicated. Keep excavations free from water and debris while construction is in progress. Notify the Owner immediately in writing where it becomes necessary to remove hard, soft, weak, or wet material to a depth greater than indicated. Unless otherwise indicated, concrete placed below grade will be formed and excavations shall allow for placement and removal of forms. Side cuts shall be cribbed and shored as required.
- B. Unclassified Excavation: Excavation is unclassified and includes excavation to required subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions as described in the referenced Geotechnical Investigations Report.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials, replace with satisfactory soil materials.
 - 2. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and rocks.
 - 3. Rock fragments greater than 4 inches in diameter shall be taken off-site or placed in accordance with the recommendations of the Geotechnical Engineer in areas designated as suitable for rock disposal.

3.5 STABILITY OF EXCAVATIONS

- A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.

- B. Unshored Temporary Excavations:
 - 1. Unshored temporary excavations may be sloped back at 1 to 1 (horizontal to vertical) or flatter up to 5 feet in height. Where sloped embankments are used, the tops of the slopes should be barricaded to prevent vehicles and storage loads within seven feet of the tops of the slopes. If the temporary construction slopes will be maintained during the rainy season, construct berms along the tops of the slopes where necessary to prevent run-off water from entering the excavation and eroding the slope faces.

3.6 EXCAVATION FOR STRUCTURES

- A. Excavation Limits: Shall be to a tolerance of plus-or-minus 0.10 foot and shall extend two (2) or more feet laterally beyond the building limits at the excavation level and two (2) feet below existing grade, or deeper to excavate existing fill. The excavation side slopes shall not exceed a slope ratio of 1.5 to 1, horizontal to vertical, up to 5 feet in height, unless they are positively retained by shoring or other approved methods. Over-excavation side slopes may be vertical, as long as they are no higher than allowed by the State of California Construction Safety Orders, in which case they shall be no steeper than 1.5 to 1. If cut below depths indicated, excavations shall be filled with concrete when the foundations or footings are placed. Revise first subparagraph below if footings and foundations are placed on engineered fill.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 - 1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.7 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.8 EXCAVATION FOR UTILITY TRENCHES

- A. Excavation made with power-driven equipment is not permitted within two feet of any known utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, use hand or light equipment excavation. Start hand or light equipment excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines and other existing work affected by the excavation work of this Section until approval for backfill is granted by the geotechnical engineer. Immediately report damage to utility lines or subsurface construction to the Owner.
- B. Where unidentified existing utilities are encountered, determine whether these are active or abandoned. Remove interfering portions of abandoned utilities and cap or plug open ends of pipe to remain. The cap or plug must seal the opening in such a manner that would permit remaining portions of the utility to be reactivated. Notify Owner for instructions on utilities which

are determined to be active. Do not proceed without instructions, except to correct an immediate hazard or emergency condition. Relocation work performed on an active utility without obtaining prior approval from Owner shall be done at the Contractor's expense and liability.

- C. In areas where compacted backfill has been placed, additional consolidation may occur after completion due to changes in moisture content and surcharge. Utility connections crossing this backfill, and improvements adjoining the building at the backfill line shall be installed taking into account this additional consolidation, or sufficient time shall be scheduled between backfilling operations and such improvements to allow this consolidation to take place. Damage to utilities or other improvements due to Contractor's negligence in regard to this paragraph shall be repaired at the Contractor's expense
- D. Protect newly backfilled areas and adjacent structures, slopes, or grades from traffic, erosion settlement, and any other damage. Repair and re-establish damaged or eroded grades and slopes and restore surface construction prior to acceptance
- E. Cutting Pavement, Curbs, and Gutters: Saw cut with neat, parallel, straight lines one foot wider than trench width on each side of trenches and one foot beyond each edge of pits. If an existing pavement joint or cracked area is within two feet outside of a designated sawcut line shown on the Drawings, removal and resurfacing shall be to that joint, and/or shall include the crack or cracked area, unless otherwise approved by Architect.
- F. Contractor shall pothole at all identifiable crossings of existing utilities prior to any trenching operations and provide Architect with a survey of the top elevations (and bottom elevations, if applicable), of possible interferences so that an evaluation of necessary adjustments to the current profile or alignment may be made. Additionally, Architect shall be given the opportunity to view possible conflicts in the field prior to providing revised designs.
- G. Provide a minimum cover from grade of 3 feet for water mains and gas mains unless otherwise indicated on plans and details. Storm drains and sewers shall be to the depths indicated. Where settlements greater than the tolerance allowed herein for grading occur in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation.
- H. Keep excavations free from water while construction is in progress.
- I. Notify the Owner immediately in writing if it becomes necessary to remove rock or hard, unstable, or otherwise unsatisfactory material to a depth greater than indicated. Excavate large rock, boulders, and other unyielding material to depth at least 6 inches below the bottom of the pipe, conduit, duct and appurtenances, unless otherwise indicated or specified. Over-excavate soft, weak, or wet excavations to an depth at least 6 inches below the bottom of the pipe, conduit, duct or appurtenances unless otherwise indicated or specified.
- J. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
- K. 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, except where sloping of sides is allowed. Sides of trenches shall not be sloped from the bottom of the trench up to the elevation of the top of the pipe. See plans for detail.
- L. At the option of the Contractor, the excavations may be overcut to depth of not less than 4 inches and refilled to required grade as specified.

- M. 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.
1. 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.
 2. 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.
 3. Dig bell holes and depressions for joints after trench has been graded. Dimension of bell holes shall be as required for properly making the particular type of joint to ensure that the bell does not bear on the bottom of the excavation.

3.9 APPROVAL OF SUBGRADE

- A. Notify Architect when excavations have reached required subgrade.
- B. If and when Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Roll subgrade below the building slabs and pavements with a pneumatic-tired roller to identify soft pockets and areas of excess yielding. Do not roll wet or saturated subgrades.
1. Completely roll subgrade in one direction, repeating rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Unforeseen additional excavation and replacement material will be paid for according to Contract provisions for Changes in Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the Architect.
1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.11 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.12 SOIL TREATMENT

- A. All chemical applications used for soil treatment are subject to the approval of the Owner.
- B. Recommended termiticide: Chlorpyrifos "Dursban TC", or "Permetrin Torpedo" or "Dagnet", or approved equal.
- C. Do not apply soil treatment solution until excavating, filling and grading operations are completed and prior to any membrane being placed beginning concrete placement or other construction activities.
- D. To ensure penetration, do not apply soil treatment to excessively wet soils or during inclement weather. Comply with handling and application instruction of soil toxicant manufacturer.
- E. Remove foreign matter which could decrease effectiveness of treatment on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under foundations.
- F. Apply soil treatment solution at rates recommended by soil toxicant manufacturer.
- G. Allow not less than 12 hours for drying after application, before beginning concrete placement or other construction activities
- H. Reapply soil treatment solution to areas disturbed by subsequent excavation or other construction activities following application.

3.13 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 1. Acceptance of construction below finish grade including, where applicable, subdrainage, damp-proofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for Record Documents.
 3. Testing and inspecting underground utilities.
 4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.14 UTILITY TRENCH BACKFILL AND COMPACTION

- A. Backfilling of exterior utility trenches shall not be undertaken until geotechnical engineer has received 24-hours notice, until required tests and inspections have been completed, and until as-built location notes have been furnished. Remove uninspected backfill in accordance with requirements of this specification. Use hand-operated, plate-type, vibratory, or other suitable hand tampers in areas not accessible to larger rollers or compactors. Avoid damaging pipes and protective pipe coatings.

- B. Place backfill material in accordance with Section 306-1.3.2 of the Reference Specifications and achieve at least 90% of the maximum density. The top 12 inches of backfill in the building or paved areas shall be compacted to 90% of maximum density.
- C. Compaction by ponding or flooding will not be permitted.
- D. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- E. Concrete backfill trenches that carry below or pass under footings and that are excavated within 18 inches of footings. Place concrete to level of bottom of footings
- F. Provide 4-inch-thick concrete base slab support for piping or conduit less than 2'-6" below surface of roadways. After installation and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway base.
- G. Place and compact initial backfill of satisfactory soil material or base material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.
 - 1. 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.

3.15 FILL

- A. Preparation: Scarify and remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
 - 1. The scarified ground shall be brought to optimum moisture, mixed as required, and compacted as specified. If the scarified zone is greater than 12 inches in depth, the excess shall be removed and placed in lifts restricted to six inches.
 - 2. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use base materials
 - 4. Under building slabs, use base materials
 - 5. Under footings and foundations, use drainage fill materials.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.16 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

- a. Stockpile or spread and dry removed wet satisfactory soil material.

3.17 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 8 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Keep rollers and other heavy equipment at least 18 inches from footings, foundations, piers and walls of buildings and accessory construction. Use mechanical and hand tampers weighing at least 90 pounds with a maximum face area of 48 inches square to compact backfill within 18 inches of construction and where access is restricted.
- C. Percentage of Maximum Dry Density Requirements: Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
 - 1. For general site fills, compact each layer of backfill or fill material at 90 percent maximum dry density.
 - 2. Under structures, building slabs, and steps, scarify and recompact top 24 inches below footing or slab and each layer of backfill or fill soil material at 90 percent maximum dry density.
 - 3. Under walkways and paving, scarify and recompact top 12 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent maximum dry density.
 - 4. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent maximum dry density.

3.18 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
 - 3. If necessary, the Contractor's selected equipment and construction procedure shall be altered, changed or modified in order to meet the specified compaction requirements. Flooding and water jetting is prohibited.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: ± 0.10 foot, unless otherwise indicated.
 - 2. Concrete Walks: ± 0.025 foot.
 - 3. Pavements:
 - a. Concrete: 0.025 foot minus, with no high spots.
 - b. Asphalt: 0.05 foot minus, with no high spots.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of $\frac{1}{2}$ inch when tested with a 10-foot straightedge.

3.19 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Division 33 Section "Storm Drainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches x 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 90 percent of maximum dry unit weight
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 90 percent of maximum dry unit weight
 - 2. Place and compact impervious fill over drainage backfill in 6-inch thick compacted layers to final subgrade.

3.20 BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place base course under pavements and walks as follows:
 - 1. Compact base courses at optimum moisture content to required grades, lines, cross sections and thickness to not less than 95 percent of ASTM D 4254 relative density.
 - 2. Shape base to required crown elevations and cross-slope grades.
 - 3. When thickness of compacted base course is 6 inches or less, place materials in a single layer.
 - 4. When thickness of compacted 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.

3.21 PAVEMENT REPAIR

- A. Repair or patch asphalt pavement as specified in Section 32 12 16 Asphalt Paving. Repair or patch concrete pavement, curbs and gutters as specified in Section 32 1313 Concrete Paving. Do not repair pavement until trench has been backfilled and compacted as herein specified. As a minimum, maintain one-way traffic on roads and streets crossed by trenches.

3.22 FIELD QUALITY CONTROL

- A. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
 - 1. Perform field in-place density tests according to ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2937 (drive cylinder method), as applicable.

- a. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 3017
 - b. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect.
- B. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- C. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
- D. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in-place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.
- E. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in-place density test for each 150 feet or less of trench, but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.23 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact at optimum moisture content to the required density.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.24 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 22 00

GRADING

PART 1 - GENERAL

1.1 SUMMARY

- A. The work of this section shall include excavation, unclassified cut, unclassified fill, removing existing unsatisfactory material, preparing areas to be filled, spreading and compacting of fill in the areas to be filled, and all other work necessary to complete the grading of the site. It shall be the Contractor's responsibility to place, spread, moisten or dry, and compact the fill in strict accordance with these specifications to the lines and grades indicated on project plans or as directed in writing by the Geotechnical Engineer. Included with this Work are the following:

1. General exterior grading, cutting and filling, including grading for building area, paving, planting areas, banks and hillsides.
2. Excavating, filling, backfilling, and compacting for Project site pavement, planting areas, buildings, and other structures.
3. Base course for walks and pavements.
4. Excavating and backfilling trenches within buildings lines.
5. Excavating and backfilling for underground mechanical and electrical utilities and appurtenances.
6. Shoring plan guidelines.

B. Related Sections: The following Sections contain requirements that relate to this Section.

1. Project Specific Geotechnical Report.

1.2 DEFINITIONS

- A. Excavation consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.
- B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- C. Borrow: Soil material obtained off site when sufficient approved soil material is not available from excavations.
- D. Base Course: The layer placed between the subgrade and surface pavement in a paving system.
- E. Permeable Backfill: Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations.
- F. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Architect. Unauthorized excavation, as well as remedial work directed by the Architect, shall be at the Contractor's expense.
- G. 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.

- H. Utilities include underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. 2013 California Building Code, Title 24, Part 2, Volume 2 of 2, Appendix J, Grading.
2. ASTM D422 - Method for Particle Size Analysis of Soils
3. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
4. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-1b (4.54 kg) and 18-inch (457-mm) Drop.
5. ASTM D2216 - Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.
6. ASTM D2922 - Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).
7. ASTM D3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).
8. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
9. ASTM D4829 - Expansion Index Test.

- B. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("GREENBOOK"), 2015 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications".

- C. Professional Observation: A soils engineer will be retained by the Owner for purposes of inspection, testing and approval of all work under this section. Perform work of this section under inspection and approval of the soils engineer. Give soils engineer not less than 48 hours advance notice of readiness for inspection.

- D. The soils engineer will have the authority over all filling, grading, and compaction operations, including interruption of work if deemed necessary due to improper work.

1.4 CONSTRUCTION MONITORING

- A. All earthwork and foundation construction should be monitored by a qualified engineer/technician under the supervision of a Geotechnical Engineer, including;

1. Observation of all site preparations;
2. Observation of shoring installation, if needed;
3. Observation of all site excavations;
4. Test and approval of all import soil;
5. Observation of placement of all compacted fills and backfills;
6. Observation of all surface and subsurface drainage systems;
7. Observation of all foundation and pile excavations;
8. Observation of subgrade preparation for paved and building areas.

- B. The Geotechnical Engineer of Record should be notified at least three (3) days in advance of the start of construction. A joint meeting between the Contractor and Geotechnical Engineer is recommended prior to the start of construction to discuss specific procedures and scheduling. The Geotechnical Engineer should be present to observe the soil conditions encountered during construction, to evaluate the applicability of the recommendations presented in the Soils Report to the soil conditions encountered, and to recommend appropriate changes in design or construction if conditions differ from those described herein. The Geotechnical Engineer of Record should inspect and approval all imported backfill material prior to its placement as backfill, approve the subgrade beneath all fills, fill placement and bottom of all foundation excavations before concrete or steel is placed.
- C. The Geotechnical Engineer shall submit compaction reports to the Construction Manager and the Civil Engineer at the completion of the work, including test results and plot plans indicating the locations from which the tested samples of fill were taken. The Geotechnical Engineer shall keep the Construction Manager informed on the progress of the grading work.

1.5 IMPORT AND EXPORT OF EARTH MATERIALS

- A. Fees: Pay as required by government authority having jurisdiction over the area.
- B. Bonds: Post as required by government authority having jurisdiction over the area.
- C. Hauling Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.6 DIG ALERT NOTIFICATION

- A. Before any excavation in or near the public right-of-way, the Contractor must contact the Underground Service Alert of Southern California (Dig Alert) at 811 for information on buried utilities and pipelines.
- B. Delineation of the proposed excavation site is mandatory. Mark the area to be excavated with water soluble or chalk based white paint on paved surfaces or with other suitable markings such as flags or stakes on unpaved areas.
- C. Call at least Two (2) full working days prior to digging.
- D. If the members (utility companies) have facilities within the work area, they will mark them prior to the start of your excavation and if not, they will let you know there is no conflict. A different color is used for each utility type (electricity is marked in red, gas in yellow, water in blue, sewer in green, telephone and cable TV in orange).
- E. The Law requires you to hand expose to the point of no conflict 24" (inches) on either side of the underground facility, so you know its exact location before using power equipment.
- F. If caught digging without a Dig Alert ticket you can be fined as much as \$50,000 per California government code 4216.

1.7 PROJECT CONDITIONS

- A. Data: Maps, boring logs, geotechnical and foundation investigation reports, and like reference data, not included in Contract Documents but made available to Contractor by Owner are for information only, and the Owner assumes no responsibility for any conclusions Contractor may draw from such information. Should questions or issues arise, contact Owner for clarification.
- B. Contractor shall determine existing conditions under which the Contractor will operate in performing the Work

- C. A geotechnical investigation report prepared by Ninyo & Moore (Report No. 209800001), dated September 22, 2016 has been prepared for this project. Prior to bidding or performing the work of this project, contractor shall obtain a copy of this report, and shall thoroughly familiarize himself/herself with its contents. Any information obtained from such report, or any information given on any drawings as to subsurface soil conditions or to elevations of existing elevations or elevations of underlying rock, is approximate only, is not guaranteed. The Contractor is required to make a visual inspection of the Project Premises and must (and is permitted to) make whatever tests the Contractor deems appropriate to determine and assess the underground condition of the soil.
- D. Information on Drawings does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.
- E. Based on exploratory borings, the site is underlain by undocumented fill and alluvium. The fill encountered in borings ranges in depth from approximately 2 to 6 feet and consisted of loose to medium dense, silty sand. Due to the unknowns regarding the original ground preparation and the compaction of the existing fill soils, there is a potential for settlement of the fill and/or shallow, loose alluvium under the new improvements. Accordingly, remedial earthwork to excavate and recompact existing fill and loose alluvium is appropriate for preparation of the field building pads.
- F. Seepage was encountered in boring B-9 at a depth of approximately 50°/« feet below the ground surface. Historical high groundwater is reportedly 7 feet below the ground surface. However, wells at the site and within approximately 500 feet of the site report groundwater levels ranging from approximately 19 to 120 feet below the ground surface. Fluctuations in the groundwater level will occur as a result of variations in seasonal precipitation, irrigation practices, and other factors.
- G. Existing utilities: Locate existing underground utilities in all areas of work prior to excavation or commencement of work. If utilities are to remain in place provide adequate means of protection during earthwork operations.
1. Should uncharted, or incorrectly charted piping or other utilities be encountered during excavation, consult Utility Owner immediately for direction. Cooperate with Owner and Utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of Utility Company.
 2. Do not interrupt existing utilities serving facilities occupied or used by Owner, or others, except when permitted in writing by Owner's Representative, and then only after acceptable temporary services have been provided.
 3. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut off of services if lines are active.
- H. Noise and Dust Abatement: Exercise all reasonable and necessary means to abate dust, dirt rising and undue noise. Perform necessary sprinkling and wetting of construction site to allay dust as required by applicable codes and ordinances.
- I. Water for Grading: Contractor shall obtain and pay for all water required for his grading operation. This may include, but is not limited to, payment of deposits to utility for construction meter, and payment of all monthly service and water charges. Construction meter shall be in place throughout construction period unless alternative arrangements are made with the Owner to provide construction water for all purposes. Contractor shall be aware of water moratoriums and restrictions, and shall immediately advise Owner of effects on construction schedules.
- J. Existing Conditions: Prior to commencing work at site, verify agreement of existing conditions with indicated conditions. Notify Owner's Representative in writing of discrepancies found. Start of work without notification constitutes acceptance of conditions, without cause for extra compensation.

PART 2 - PRODUCTS

2. SOIL MATERIALS

- A. General: All soils materials to be used throughout the site shall be approved for use by the Geotechnical testing engineer. Provide approved borrow soil materials from off site when sufficient approved soil materials are not available from excavations.
- B. The Contractor is solely responsible for verifying the earthwork quantities necessary to complete the project.
- C. For earthwork volume estimating purposes, an average shrinkage volume of 10 percent and subsidence of a 1/2-inch may be assumed for the surficial soils. These values are estimates only and exclude losses due to removal of vegetation and debris. Actual shrinkage and subsidence will depend on the types of earthmoving equipment used and should be determined during grading.
- D. Satisfactory Soil Materials: In general, the on-site earth materials should be suitable for reuse as fill, provided that environmentally impacted soils found during Ninyo & Moore's preliminary endangered assessment, if any, are first excavated and removed from the site. Fill material should also be free of trash, debris, roots, vegetation, or other deleterious materials. Fill should generally be free of rocks or lumps of material in excess of 4 inches in diameter. Rocks or hard lumps larger than approximately 4 inches in diameter should be broken into smaller pieces or should be removed from the site. Fill used as structural backfill, should be comprised of granular, non-expansive soil that conforms to the latest edition of "Greenbook" Standard Specifications for Public Works Construction (Greenbook) for structural backfill. "Non- expansive" is defined as soil having an EI of 20 or less in accordance with ASTM International (ASTM) D4829 (CBC, 2013).
- E. Import Fill Material: Imported materials should consist of clean, non-expansive granular material which conforms to the 2015 edition of Greenbook. The imported materials should meet the Caltrans (2012) criteria for non-corrosive soils (i.e., soils having a chloride concentration of 500 parts per million [ppm] or less, a soluble sulfate content of approximately 0.20 percent [2,000 ppm] or less, a pH value of 5.5 or higher and a minimum resistivity of 1,000 ohm-centimeters [ohm-cm] or higher). Materials for use as fill should be evaluated by the geotechnical consultant prior to importing. The contractor should be responsible for the uniformity of import material brought to the site.
- F. Base Course Material For Use Under Hardscape: Crushed Aggregate Base (CAB) per Section 200-2.2, 3/4" maximum of the Standard Specifications for Public Works Construction (Green Book).
- G. Engineered Fill: Satisfactory Soil Materials / Borrow Fill Material, as described above, placed in lifts no greater than 8 inches thick (loose measurements) and each lift moisture conditioned per the soils report. All engineered fill should be densified to a minimum relative compaction of 90 percent per ASTM D 1557.
- H. Bedding Material for Trenches:
 - 1. Bedding sand shall be as defined by Standard Specifications, Section 200-1.5, and shall be free of expansive material and organic matter. Bedding material for utility lines outside the property lines shall be as required by the agency having jurisdiction. On-site soils are not considered suitable for bedding of utilities.
 - 2. Sand providing a sand equivalent of at least 35. All of the sand bedding shall be compacted

to a minimum 90 percent of maximum density by mechanical means. Flooding and jetting shall not be permitted without prior written approval from the Geotechnical Engineer. Where sheeting or shoring is used densification of the bedding shall be accomplished after the sheeting or shoring has been removed from the bedding zone, unless the sheeting or shoring is to be cut off or left in place. Pipe bedding material shall be placed in horizontal layers not exceeding (8) eight inches.

I. Backfill Material for Trenches:

1. The on-site soils have been determined to be suitable for being used for backfilling purposes in trenches. Utility trenches should be backfilled with granular materials and mechanically compacted to at least 90% of the maximum dry density of the soils.

J. Permeable Base Course Material Under Synthetic Turf: Permeable base material meeting Caltrans 2015 Specification section 68-2.02F(3).

K. Base Material Around Perimeter Subdrains: 3/4-inch washed crushed rock per ASTM #67.

3. ACCESSORIES

A. The soil isolation fabric is a standard nonwoven geotextile fabric of polypropylene geotextile, "Mirafi 140N" or approved equal.

B. Detectable Warning Tape: Acid and alkali-resistant polyethylene film metallic 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 inches 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, with "Caution: Water Line Below."
- e. Red Water systems, with "Caution: Fire Water Line Below."
- f. Green: Sewer systems, with "Caution: Sewer Line Below."

4. EXCAVATION SUPPORT & PROTECTION — SHORING PLAN

A. The Contractor shall have at the Worksite, copies or suitable extracts of: Construction Safety Orders, Tunnel Safety Orders and General Industry Safety Orders issued by the State Division of Industrial Safety. The Contractor shall comply with provisions of these and all other applicable laws, ordinances, and regulations.

B. Before excavating any trench 5 feet or more in depth, the Contractor shall submit a detailed plan to the Owner showing the design of shoring, bracing, sloping, or other revisions to be made for the Workers' protection from the hazard of caving ground during the excavation of such trench. If the plan varies from the shoring system standards, the plan shall be prepared by a registered Civil Engineer. No excavation shall start until the OWNER has accepted the plan and the CONTRACTOR has obtained a permit from the State Division of Industrial Safety. A copy of the permit shall be submitted to the OWNER.

C. The Inspector will provide a competent person trench/excavation certification form to the

Contractor. It shall be completely filled out before any worker has access to trench or excavation and returned to the Inspector before the end of the first working day. The Contractor shall certify by this form the name of the competent person administering the Work, the soil classification, and the type of excavation protective system provided and/or installed.

- D. The Contractor shall completely fence all excavations to provided protection against anyone falling into the excavation and to the satisfaction of the Inspector. The fencing shall be in place at all times except when workers are present and actual construction operations are in progress.
- E. The fencing material shall be chain link fabric or welded wire fabric (6x6-W9xW9 minimum) and 6 feet high, constructed according to one of the following:
 - 1. Tensioned fencing material and have top and bottom tension wires securely fastened to driven steel posts or other equally rigid elements at a maximum spacing of 12 feet; or
 - 2. Untensioned fencing materials securely fastened to extended trench shoring elements at a maximum spacing of 8 feet and fastened to continuous top and bottom rails constructed of nominal 2 in x 4 in lumber or equally rigid material. Framed panels with suitable supporting elements fastened together to form a continuous fence may also be used.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Use Laser technology to verify construction and accurate elevations and slopes required.
- B. Protect adjacent property and existing improvements and structures as necessary to prevent undermining, caving of cuts, and miscellaneous damage.
- C. Provide cribbing, sheeting, and shoring necessary to safely retain the earth banks and protect excavations and adjoining grades from caving and other damage resulting from excavating together with suitable forms of protection against bodily injury to personnel employed on the work and the general public. Be responsible for the design, installation, and maintenance of required cribbing and shoring and shall meet the approval of the State Division of Industrial Safety and local governing agencies requirements.
- D. Utility lines and structures shown shall be protected and treated as indicated. Where work not shown is encountered, report it to the Architect before proceeding with excavation. Encase active lines in sleeves where they pass through concrete; remove inactive lines as directed, and plug the remaining ends. Bear the costs for repairs to damaged or broken utilities and any damages related thereto.
- E. Protect existing improvements and adjacent properties from storm damage and flood hazard originating on this project until final acceptance by the Owner. Prevent silt run-off from the limits of work in accordance with governmental requirements.

3.2 DEWATERING

- A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area. Any water entering an excavation shall be immediately pumped out and the exposed excavation allowed to dry.

- B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

3.3 GRADE STAKES

- A. The Contractor's Surveyor will set grade stakes. The Surveyor shall be a California registered land surveyor or licensed Civil Engineer. The Surveyor shall be hired and paid by the Contractor, and shall be subject to the approval of the Owner. Contractor shall notify the Owner at least 48 hours before staking is to be started. The Owner will determine if work is ready for staking.
- B. All work shall conform to the lines, elevations, and grades shown on the Construction Plans. Three consecutive points set on the same slope shall be used together so that any variation from a straight grade can be detected. Any such variation shall be reported to the Engineer. In the absence of such report, the Contractor shall be responsible for any error in the grade of the finished work.
- C. Protect and maintain stakes in place until their removal is approved by the Owner. Grade or location stakes lost or disturbed by Contractor, shall be reset by the Surveyor at the expense of Contractor.
- D. Grades for underground conduits will be set at the surface of the ground. The Contractor shall transfer them to the bottom of the trench.

3.4 FIELD FINISHED PERMEABLE BASE CONTOUR AND FLATNESS

- A. The permeable base contours of the field, after final compaction and grading, shall not have deviations in surface shape greater than 3/16" over a 10' span. Final contour shall be plotted on a table of laser-sighted grade elevations using a rectangular grid size of 120 yards by 60 yards with measurements every 20 yards (28 total elevation points). Grade elevations to be reviewed and approved prior to installation of the soil isolation fabric. Fine grade to the required tolerances leaving behind no tire tracks or indentations.

3.5 TEMPORARY EXCAVATION & SHORING

- A. Per section 10.1.3 of the soils report.

3.6 BUILDING PAD PREPARATION

- A. Per section 10.1.4.1 of the soils report.

3.7 HARDSCAPE PREPARATION

- A. It is recommended that the native soil below proposed crushed base material under hardscape areas, be over excavated to the recommended minimum depth of 12" (inches) below the base layer, brought to near optimum moisture content and rolled with heavy compaction equipment. Soil should be re-compacted to at least 90% of the maximum dry density obtainable by ASTM D1557 method of compaction.
- B. The exposed bottom surface soils, below over-excavation, shall be scarified to the recommended minimum depth of 8" (inches), brought to near optimum moisture content and rolled with heavy compaction equipment. Exposed soil should be compacted to at least 90% of the maximum dry density obtainable by ASTM D1557 method of compaction. Potentially expansive fine-grained silts and clays, if present, should be removed to a depth of approximately 12 inches and replaced with on-site low-expansion sandy soil.

3.8 ATHLETIC FIELDS PREPARATION

- A. In the athletic field, in the areas where the finish grade is more than 12 inches below the existing grade no over excavation will be required. In the areas where the finish grade is less than 12 inches below the existing grade, 12 inches of over excavation along with the 8 inches of scarification of the bottom of the over excavation as recommended in the soils report should be implemented. Over excavation of 12 inches plus the scarification of 8 inches of the bottom of the over excavation should apply to all areas receiving fill.

3.9 EXCAVATION, BACKFILL & COMPACTION FOR UTILITIES

- A. Field conditions may require deviations from information indicated on Drawings. Such changes in work shall be covered by a Change Order, indicating an increase or decrease in the Contract sum.
- B. Before excavation, Contractor shall contact the "Underground Service Alert of Southern California" (USASC) for information on buried utilities and pipelines.
- C. When connections are to be made to any existing pipe, conduit, or other appurtenances, the actual elevation or position of which cannot be determined without excavation, the Contractor shall excavate for, and expose, the existing improvement before laying any pipe or conduit. The Engineer shall be given the opportunity to inspect the existing pipe or conduit before connection is made. Any adjustments in line or grade which may be necessary to accomplish the intent of the plans will be made, and the Contractor will be paid for any additional work resulting from such change in line or grade.
- D. Trenches, ditches, pits, sumps, and similar items which are outside the barricaded working area shall be barricaded to conform to Cal OSHA standards.
- E. Trenches over 5'-0" in depth shall conform to the Construction Safety Orders of the California Division of Industrial Safety, see Section 2.3 Excavation Support & Protection — Shoring Plan.
- F. Safe and suitable ladders which project 2 feet above the top of the trench shall be provided for all trenches over 4 feet in depth. One ladder shall be provided for each 50 feet of open trench, or fraction thereof, and be so located that workers in the trench need not move more than 25 feet to a ladder.
- G. Where indicated and/or required to excavate in lawn areas, protect adjoining lawn areas outside of the Work area. Replace or install removed sod upon completion of backfill by installing sod level with adjacent lawns. If installation of removed sod fails, furnish sod and install to match existing lawns.
- H. All trenches should be backfilled with approved fill material compacted to relative compaction of not less than 90 percent of maximum density determined in accordance with ASTM D 1557. Backfill shall be placed in layers not exceeding 8" (inches) in thickness.
- I. Backfill over excavations to the required elevations with earth, gravel, sand, or concrete and compact as required. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. Slope adjacent grades away from excavations to minimize entry of water.
- J. Do not excavate trenches parallel to footings closer than 18" from the face of the footing or below a plane having a downward slope of 2 horizontal to one vertical, from a line 9" above bottom of footings.

- K. Unless indicated otherwise on the plans are within this specification, excavate trenches to the required depths for utilities, such as pipes, conduit and tanks, with minimum allowances of 6 inches at the bottom for bedding of unprotected piping or as required for concrete encasement of conduits as indicated on Drawings. Maximum allowances at the sides for trenching shall be 12 inches. Grade bottom of trenches to a uniform smooth surface. Remove loose soil from the excavation before installing sand bedding or concrete encasement.
- L. Where portions of existing structures, walks, paving, etc. must be removed or cut for pipe or conduit installation, replace the material with equal quality, finished to match adjacent work
- M. Provide a minimum clear dimension of 6 inches from sides of wall excavation to outer surfaces of buried pipes or conduits installed in the same trench or outside surfaces of containers and/or tanks.
- N. DO NOT place backfill until the bedding and pipe work installed has been inspected, tested and approved by the County Inspector. Remove excavated rocky material unsuitable for backfill from the site prior to final backfilling.
- O. Bedding material immediately around a utility line and to a point 6 inches above the line should consist of sand to support the line and protect it.
- P. Bedding zone shall be defined as the area containing the material specified that is supporting, surrounding, and extending to 6" (inches) above the top of pipe for storm drains. Compaction requirements in this area must meet 90% minimum.
- Q. Bedding material shall first be placed on a firm and unyielding subgrade so that the pipe is supported for the full length of the barrel. There shall be 6" (inch) minimum of bedding below the pipe barrel and 1" (inch) clearance below a projecting bell for storm drain pipe. The material in the bedding zone shall be placed and densified by mechanical compaction only.
- R. Mechanically compacted backfill shall comply with section 306-1.3.2 of the Standard Specifications for Public Works Construction.
- S. Above the bedding, up to finished subgrade at areas other than landscape areas and up to one foot below flatwork and pavements, utility trenches should be backfilled with granular materials and mechanically compacted to at least 90%.
- T. Concrete backfill trenches that carry below or pass under footings and that are excavated within 18 inches of footings. Place concrete to level of bottom of footings.
- U. Fill voids with approved backfill materials as shoring bracing and sheeting is removed.

3.10 INSPECTION & TESTING AT TRENCHES

- A. Pipe will be inspected in the field before and after laying. If any cause for rejection is discovered in a pipe after it has been laid, it shall be subject to rejection. Any corrective work shall be approved by the civil engineer of record and shall be at NO cost to the Owner.
- B. The Inspector and/or Geotechnical Engineer will inspect all subgrades and excavations prior to placing bedding & backfill materials.
- C. DO NOT place backfill until the bedding and pipe work installed has been inspected, tested and approved by the Inspector. Remove excavated rocky material unsuitable for backfill from the site prior to final backfilling.

- D. Utility backfill compaction test shall be performed in accordance with ASTM D1557, method "C".
- E. Utility backfill in place density test per ASTM D1556 (sand cone) or other test method as considered appropriate by the Geotechnical Engineer.
- F. Hydrostatic pressure tests shall be done only after backfill has been placed and final compaction has been achieved.

3.11 APPROVAL OF SUBGRADE

- A. Notify Geotechnical Engineer when excavations have reached required over-excavation subgrade.
- B. When Geotechnical Engineer determines that unforeseen unsatisfactory soil is present, continue work only after receiving direction from the Owner.
- C. Reconstruct subgrades damaged by rain, accumulated water or construction activities as directed by the Soils Engineer.

3.12 UNAUTHORIZED EXCAVATION

- A. Fill of unauthorized excavation below bottoms of foundations or wall footings will be engineered fill.
- B. Fill unauthorized excavations under other construction as directed by the Soils Engineer.
- C. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Geotechnical Engineer.

3.13 PLACEMENT OF ENGINEERED FILL

- A. Spreading and Compacting Fill Material:
 - 1. Fill and trench backfill should be compacted in uniform horizontal lifts to a relative compaction of 90 percent or more as evaluated by the latest edition of ASTM D 1557. Fill soils should be moisture-conditioned to above the optimum moisture content as evaluated by the latest edition of ASTM D 1557. The optimum lift thickness of fill will depend on the type of compaction equipment used but generally should not exceed 8 inches in loose thickness. Special care should be taken to avoid pipe damage when compacting trench backfill above pipes. Placement and compaction of the fill soils should be in general accordance with the appropriate governing agencies and good construction practices.
- B. Compaction Testing:
 - 1. The Geotechnical Engineer's representative shall observe the excavation, filling, and compacting operations and shall make density tests in the fill material so that he can state his opinion as to whether or not the fill was constructed in accordance with the specifications. If the surface is disturbed, the density tests shall be made in the compacted materials below the disturbed zone. When these tests indicate that the density or moisture content of any layer of fill or portion thereof does not meet the specified density or moisture content, the particular layer or portions shall be reworked until the specified density and moisture content have been obtained.
 - 2. Sampling and testing of materials for determination of compliance with the specified compaction requirements will be conducted by the Geotechnical Engineer's representative at any location and time as the Owner may determine.

3. The Contractor shall be responsible for excavation of the test pits and for providing and installing any shoring, ladders, or other equipment necessary to protect the testing personnel. The Contractor shall also suspend operations as necessary and at no cost to the owner for the purpose of conducting such testing.
4. Test pits shall be excavated in the backfill by the Contractor as directed by the Engineer for the purpose of testing the backfill compaction. At the option of Engineer, density tests may be taken on a lift of compacted backfill immediately before placing the next lift.
5. Any settlement noted in backfill, fill, or in structures built over the backfill or fill within the one-year warranty period will be considered to be caused by improper compaction methods and shall be corrected at the Contractor's expense. Structures damaged by settlement shall be restored to their original condition by the Contractor at the Contractor's expense.
6. When initial compaction testing performed by the Engineer indicates the required density has not been obtained, the Contractor shall re-compact or replace the backfill as necessary to meet the specified minimum density.
7. The Contractor shall be responsible for rescheduling compaction testing with the Engineer and shall bear all costs for subsequent retesting in the areas of noncompliance. Costs associated with retesting and scheduling delays shall be the sole responsibility of the Contractor. The Engineer will deduct the costs for testing of materials and work found to be unacceptable, as determined by the tests performed by the Owner and the costs for testing of material sources identified by the Contractor which are not used for the work, from moneys due or to become due to the Contractor. The amount deducted will be determined by the Engineer.

3.14 BACKFILL - GENERAL

- A. Backfill excavations promptly, but not before completing the following:
 1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
 2. Provide red line mark ups for locations of installed underground utilities that vary from the County approved version for as-built plan purposes.
 3. Testing, inspecting, and approval of underground utilities.
 4. Concrete formwork removal.
 5. Removal of trash and debris from excavation.
 6. Removal of temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.15 FIELD QUALITY CONTROL

- A. A Geotechnical Engineer, designated by the Owner, will be engaged to perform continuous inspection of the placing and compacting of all fills and backfills within the limits of grading of this project. All work shall be done in accordance with the approved plans and these specifications and as recommended and approved by the Geotechnical Engineer. Revised recommendations relating to conditions differing from the approved soils engineering and engineering geology reports shall be submitted to the owner, inspector, architect and the civil engineer. Costs for all such inspections and tests shall be paid by the Owner. The Contractor shall be responsible for notifying the Geotechnical

Engineer in advance so that he may be present to perform his services as needed.

- B. The Geotechnical Engineer shall submit compaction reports to the Construction Manager and the Architect at the completion of the work, including test results and plot plans indicating the locations from which the tested samples of fill were taken. The Geotechnical Engineer shall keep the Construction Manager informed on the progress of the grading work.
- C. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
 - 1. Perform field in-place density tests according to ASTM D1556 (sand cone method) or other test method as considered appropriate by Geotechnical Engineer.
 - a. Field in place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 3017.
 - b. When field in place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect.
 - 2. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
 - 3. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in place density test for each 150 feet or less of trench, but no fewer than two tests.
- D. When testing agency reports that subgrades, 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.
- E. Owner's inspector will inspect foundation excavations when completed and ready for forms, after forms are in place, and before first placement of concrete.

3.16 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and re establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace material to depth directed by the Architect; reshape and recompact at optimum moisture content to the required density.
- C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.17 MAINTENANCE

- A. Install and maintain all temporary erosion control devices, including gravel bags, de-silting basins, inlet barricades, vehicle wash traps, and other features called for on the Erosion Control Plans and as required per Storm Water Pollution Prevention Plan.
- B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape to required tolerances, and compact to required density prior to further construction.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION

SECTION 31 23 16

TRENCHING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Excavate trenches for utilities from outside building to municipal utilities.
- B. Excavate trenches for utilities on interior of building.
- C. Compacted bedding under fill over utilities.
- D. Backfilling and compaction.
- E. Fill for overexcavation.

1.2 REFERENCES

- A. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- B. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 pound Rammer and 18 inch Drop.
- C. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- D. ASTM D2937 - Test Method for Density of Soil in Place by the Drive-Cylinder Method.
- E. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

- A. Submit under provisions of Section 01330.
- B. Samples: Submit 10 pound sample of each type of fill to testing laboratory, in air-tight containers.
- C. Submit test reports under provisions of Section 01458.

1.4 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of Section 01770.
- B. Accurately record location of utilities remaining, rerouted utilities, new utilities by horizontal dimensions, elevations or inverts, and slope gradients.

1.5 FIELD CONDITIONS

- A. Verify that survey benchmark and intended elevations for the Work as indicated.
- B. Notify Architect of unexpected subsurface conditions and discontinue work in area affected until notified to resume work.

1.6 PROTECTION

- A. Protect trees, shrubs, lawns, and other features remaining as portion of final landscaping.
- B. Protect bench marks, fences, roads, sidewalks paving, and curbs.
- C. Underpin adjacent structures, including utilities and pipe chases, which may be damaged by excavation work.
- D. Protect above or below grade utilities which are to remain.
- E. Barricade open excavations and post warning lights. Operate lights from dusk to dawn.
- F. Protect facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by trenching operations.
- G. Repair or replace all damage.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Types specified in Section 02316

2.2 BED MATERIALS

- A. Subsoil: As specified in Section 02316.
- B. Sand: As specified in Section 02316.

2.3 EQUIPMENT

- A. Equipment: Capable of excavating subsoil, mixing and placing materials, wetting, consolidation, grading, and compaction of material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that fill materials to be reused are acceptable.
- B. Verify agreement of existing site conditions with indicated conditions.
- C. Notify Architect of discrepancies found.
- D. Beginning work of this Section constitutes acceptance of existing conditions.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Identify known below grade utilities. Stake and flag locations.
- C. Identify and flag above grade utilities.
- D. Maintain and protect existing utilities remaining which pass through work area.
- E. Notify utility company and pay all costs to remove and relocate utilities.
- F. Upon discovery of unknown utility or concealed conditions, discontinue affected work; notify Architect.

3.3 TRENCH EXCAVATION

- A. Excavate subsoil required to accommodate storm sewer, water, electric and telephone conduit, and piping to municipal or private utilities.
- B. Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of 8 inch clearance on both sides of the pipe.
- C. Excavate trenches to depth indicated or required to establish indicated slope and invert elevations.
- D. For pipe or conduit less than 4 inches in nominal size, do not excavate beyond indicated depths. Hand-excavate bottom to accurate elevations and support pipe or conduit on undisturbed soil.
- E. For pipe or conduit, 4 inches and larger, carry excavation 4 inches below required elevation and backfill with sand bedding to support pipe or conduit.
- F. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with subsoil and compact to density equal to or greater than requirements for subsequent backfill material.
- G. Hand trim excavation. Remove loose material.
- H. Excavation cut not to interfere with bearing splay of foundations.
- I. At each pipe joint dig bell hole to relieve pipe bell of loads and to ensure continuous bearing of pipe on bearing surface.
- J. Remove lumped subsoil, boulders and rock up to 1/3 cu yd measured by volume. Replace with sand bedding material and compact as specified.

3.4 STORAGE OF EXCAVATED MATERIALS

- A. Stockpile excavated materials in designated on-site area.
- B. Segregate excavated materials based upon intended use.
- C. Place, grade, and shape stockpile for proper drainage.
- D. Locate stockpile away from edge of excavations.
- E. Do not stockpile materials within drip line of trees.

3.5 UNAUTHORIZED EXCAVATION

- A. Correct unauthorized excavation at no cost to Owner.
- B. Backfill excavation to correct elevation with concrete or approved fill material compacted as specified.

3.6 STABILITY OF EXCAVATIONS

- A. Comply with local codes, ordinances, and requirements of agencies having jurisdiction.
- B. Machine slope banks to angle of repose or less.
- C. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- D. Shore and brace where sloping is not possible because of space restrictions or stability of

material excavated.

- E. Provide shoring and bracing in good serviceable condition.
- F. Extend shoring and bracing as excavation progresses.
- G. Maintain shoring and bracing in excavations regardless of time period excavation will be open.
- H. Provide permanent steel sheet piling wherever subsequent removal of piling would permit lateral movement of soil under adjacent structures. Cut off top of piling 2'-6" below finish grade and leave permanently in place.

3.7 DEWATERING

- A. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
- B. Grade top perimeter of excavations to prevent surface water from draining into excavations.
- C. Do not allow water to accumulate in excavations.
- D. Remove water to prevent softening of trench bottoms and soil changes detrimental to stability of subgrades.
- E. Provide and maintain pumps, well points, sumps, suction and discharge lines and other components necessary to convey water away from excavations.
- F. Establish and maintain temporary drainage ditches and other diversions to convey rain water and water removed from excavations to runoff areas.
- G. Do not use trench excavations as temporary ditches.

3.8 BEDDING OF TRENCHES

- A. Support pipe and conduit during placement and compaction of bedding fill.
- B. Place a minimum of 4 inches of sand bedding beneath all piping 4 inches in diameter and larger.
- C. Place a minimum of 12 inches of sand bedding above all piping.
- D. Compact sand bedding to density required.

3.9 BACKFILLING

- A. Backfill excavations as promptly as work permits, but not until the following has been completed:
 - 1. Acceptance of subgrade.
 - 2. Inspection, testing, approval and record documentation of location of underground utilities.
 - 3. Removal of shoring and bracing if not to be left in place.
 - 4. Backfill of voids in subgrade with satisfactory materials.
 - 5. Removal of trash and debris.
 - 6. Installation of bedding material.
- B. Compact subgrade to density requirements for subsequent backfill.

- C. Backfill to contours and elevations required.
- D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- E. Place and compact fill material in continuous layers not exceeding specified compacted depth for each layer.
- F. Employ a placement method that does not disturb or damage utilities in trenches.
- G. Before placing successive layers, all ruts, and other hollows more than 6 inches in depth shall be regraded and compacted.
- H. Maintain optimum moisture content of backfill materials.
- I. Backfill trenches with concrete where excavation is less than 3 feet below bottom of footing. Place concrete to level of bottom of adjacent footing. Width of concrete backfill to match width of footing and be full width of trench. Maintain minimum 6 inch encasement on sides, top, and bottom.
- J. Backfill trenches with concrete for piping or conduit where top of piping or conduit is less than 30 inches below finished elevation of paving. Minimum 6 inches of encasement on sides and top.
- K. Remove and replace or scarify and air dry subgrade or fill material that is too wet to permit compaction to required density.

3.10 COMPACTION

- A. Control soil compaction during construction providing density specified for each area classification.
- B. Place and compact fill materials in continuous layers of not more than 8 inch thick compacted depth.
- C. Provide not less than the specified percentages of density of soil material compacted at optimum moisture content, for each layer of soil material in place.
- D. When existing ground surfaces have a density less than that specified for a particular area classification, scarify existing surface to a depth of 12 inches, moisture-condition to optimum moisture content and compact to required percentage of maximum density.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Moisture content shall be uniform throughout all layers. Add necessary moisture or aerate soil material at borrow source if it is not possible to obtain uniform moisture content at soil surface at time of placement.
- G. When moisture content and condition of each soil layer is satisfactory compact soils to specified density.
- H. Compaction of free draining material such as gravel shall be by treads of crawler type tractor, surface vibrator, smooth or pneumatic roller, hand or power tampers. I. Compaction of soils by use of water jetting or puddling is not an acceptable procedure.
- I. Correct improperly compacted areas or layers as directed by Architect if soil density tests indicate inadequate compaction.

3.11 DISPOSAL OF EXCESS AND WASTE MATERIAL

- A. Remove waste materials, including unacceptable excavated material, trash, and debris, and dispose of legally off site.
- B. Remove surplus backfill materials from site and dispose of legally off site.
- C. Leave material stockpile areas completely free of excess materials.

3.12 PROTECTION OF WORK

- A. Protect finished work under provisions of Section 01600.
- B. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.
- C. Protect bottom of excavations from freezing, water saturation, and disturbance.

3.13 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01458.
- B. Allow testing service to inspect, test, and approve each subgrade and fill layer before further backfill or construction work is performed
- C. Laboratory tests and analysis of fill material will be performed in accordance with ASTM D1557 and with Section 01458. In place site tests and analysis of fill material will be performed in accordance with ASTM D1556, ASTM D2937 or ASTM D2922, and with Section 01458.
- D. In place site moisture tests will be performed in accordance with ASTM D3017.
- E. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner. Grading tolerances
- F. Top Surface of Backfill: To within not more than 0.10 foot above or below required subgrade elevation.

3.14 PLACEMENT SCHEDULE

- A. Fill to Correct Overexcavation:
 - 1. Lean concrete of minimum compressive strength as specified.
- B. Utility Trenches on Exterior of Building:
 - 1. Sand bedding to 12 inches above pipe, compact to 90 percent.
 - 2. Existing or imported subsoil fill, compact to 90 percent.

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 01 17

ASPHALT PAVEMENT REPAIR

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Bituminous Surfacing Repair: Areas removed for utility trenches, heaved by tree roots, cracked areas, protruding areas where pavement meets hard surfaces, depressed areas, holes and areas around new structures, and raveled bituminous pavement.
 - 2. Areas heaved by tree roots, cracked areas, holes and trenches, and areas around new structures.
- B. Related Sections:
 - 1. Division 01 - General Requirements.
 - 2. Section 31 22 00 - Grading.
 - 3. Section 32 12 16 – Asphalt Paving.
 - 4. Section 32 13 13 – Site Concrete Work.
 - 5. Section 32 12 36 – Seal Bituminous Surfacing.

1.2 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating areas to be repaired.
- B. Product Data: Submit manufacturer's technical data for materials and products.

1.3 QUALITY ASSURANCE.

- A. Comply with Standard Specifications for Public Works Construction, 2015 edition.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Base course materials: Section 31 22 00 – Grading.
- B. Asphalt paving materials: Section 32 12 16 – Asphalt Paving.
- C. Seal materials: Section 32 12 36 - Seal Bituminous Surfacing.
- D. Headers: Section 32 12 16 - Asphalt Paving.

2.2 BITUMINOUS MATERIALS

- A. Provide materials and products of the class, grade or type indicated, conforming to relevant provisions of Section 203 - Bituminous Materials of the latest Standard Specifications for Public Works Construction.

PART 3 - EXECUTION

3.1 PAVEMENT REMOVAL

- A. Remove bituminous and concrete pavement in accordance with applicable provisions of Section 300 – Earthwork of the Standard Specifications for Public Works Construction.
- B. Pavement heaved by roots: Remove pavement to limits of distortion and expose roots. Trim roots to provide at least 12-inch clearance to pavement.
- C. Remove protruding bituminous surfaces flush with the surrounding grade using a suitable tool or equipment so that adjacent finishes are not blackened.
- D. Remove raveled and depressed bituminous pavement to limits indicated or required.
- E. Saw cut existing improvements, trim holes and trenches in bituminous and concrete pavement to permit mechanical hand tampers to compact the fill.
- F. Remove broken concrete by saw cutting. If the required cut line is within 30 inches of a score or joint line or edge, cut and remove to the score, joint line, or edge.

3.2 EXCAVATING, BACKFILLING AND COMPACTING

- A. Conform to requirements in Section 31 2200 - Grading.
- B. Where subgrade or base is deemed to be unstable or otherwise unsuitable, excavate such materials to firm earth, and replace with a required material. Install and compact fill materials in accordance with the requirements of related Specification sections.

3.3 HEADERS

- A. Install headers along edge of bituminous surfacing abutting turf, earth, or planting area, unless indicated otherwise.
- B. Install headers so the bottom surface has continuous bearing on solid grade. Where excavation for headers is undercut, thoroughly tamp soil under the header. Compact backfill on both sides of header to the density of the adjacent undisturbed grade.
- C. Fasten headers in place with redwood or Douglas fir stakes of length necessary to extend into solid earth a minimum of 12 inches. Stakes shall be of sound material, neatly pointed, driven vertically, and securely nailed to headers. Space stakes, not to exceed 4 feet on centers with top of stakes set one inch below top of header. Provide a minimum of two 12d galvanized common nails through each stake.
- D. Remove existing headers where new surfacing is installed adjacent to existing surfacing.
- E. Install temporary headers at transverse joints of paving where continuous paving operations are not maintained.
- F. Provide additional stakes and devices as required to fasten headers.

3.4 BASE COURSE

- A. Unless otherwise indicated, base course shall be crushed aggregate base or crushed miscellaneous base 4 inches thick or equal to thickness of the existing base, whichever is greater.
- B. Fill grade and compact as specified in Section 31 22 00 - Grading.

3.5 RESURFACING

- A. Holes and Trenches: Remove loose dirt and backfill with cement-sand slurry allowing for surfacing one inch thicker than existing. Resurface flush with existing adjoining pavement installing the same type of materials and section provided in existing improvements.

- B. Other Areas: Other surface improvements damaged or removed shall be cut to a neat even line and excavated one inch below the bottom of the existing pavement. Resurface by following the original grades and installing the same type of materials provided in existing improvements.
- C. Where bituminous surfacing abuts concrete, masonry, walks or paving, tamp joint smooth, if necessary, as described above to obtain a uniformly even joint, true to line and grade. Tamp and smooth materials before asphalt cools.

3.6 REPAIRING AND RESEALING EXISTING SURFACES

- A. Preparation of Surfaces: Prior to filling cracks, clean existing bituminous surfacing of loose and foreign materials and coat with a film of asphalt emulsion.
- B. Repair of Existing Surfacing:
 - 1. Fill cracks 1/2 inch wide and less with RS-1 emulsion and silica sand or other required material. Cracks larger than 1/2 inch wide shall be filled with Type C2 Asphalt Concrete as specified. Cracks shall be filled to the level of adjacent surfacing.
 - 2. Where low areas, holes, or depressions occur in existing surfacing, repair with emulsified asphalt. Install material, strike off the emulsified asphalt with a straightedge flush with adjoining surfacing. Finish with a steel trowel, and after dehydration, compact by rolling or tamping.
- C. Testing: Flood test entire area in presence of the Project Inspector. Entire area tested shall be free of standing water or puddles.

3.7 CLEANING

- A. Remove all stains on the Project site and adjacent properties caused by or attributed to the Work of this section.
- B. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.8 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 – GENERAL

1.1 REQUIREMENT

- A. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the work as indicated in the Contract Documents and specified herein.
- B. The following types of pavement shall be covered in this Section:
 - 1. Paving for utility trenching, parking lots, artificial track and field, areas between buildings, adjacent to planting and turf areas, and as indicated on Construction Documents.
- C. Related Sections:
 - 1. Section 31 22 00: Grading.
 - 2. Section 32 12 36: Seal Bituminous Surfacing.

1.2 QUALITY ASSURANCE

- A. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("GREENBOOK"), 2015 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications".
- B. The Owner's inspector shall test the temperature of each batch of asphaltic concrete prior to placement. At the time of delivery to the work site, the temperature of mixture shall not be lower than 260 degrees F or higher than 320 degrees F, the lower limit to be approached in warm weather and the higher in cold weather. If asphaltic concrete temperature is not within these tolerances the affected batch shall be rejected. Any and all costs due to the rejected asphaltic concrete shall be the responsibility of the paving contractor.

1.3 ESTABLISHMENT OF GRADES

- A. The Contractor's Surveyor will set grade stakes. The Surveyor shall be a California registered land surveyor or licensed Civil Engineer. The Surveyor shall be hired and paid by the Contractor, and shall be subject to the approval of the Owner. Contractor shall notify the Owner at least 48 hours before staking is to be started. The Owner will determine if work is ready for staking.
- B. All work shall conform to the lines, elevations, and grades shown on the Construction Plans. Three consecutive points set on the same slope shall be used together so that any variation from a straight grade can be detected. Any such variation shall be reported to the Engineer. In the absence of such report, the Contractor shall be responsible for any error in the grade of the finished work.
- C. Protect and maintain stakes in place until their removal is approved by the Owner. Grade or location stakes lost or disturbed by Contractor, shall be reset by the Surveyor at the expense of Contractor.
- D. Areas having drainage gradients of 2 percent or more shall have elevation stakes, set with instrument, at grid intervals of 25 feet. Intermediate stakes may be set by using a tightly-drawn string line over the tops of adjacent stakes. Grade stakes must be set at all grade breaks, grade changes, etc.

- E. Areas having drainage gradients of less than 2 percent shall have elevation stakes, set with instrument, at 10 foot intervals. Grade stakes must be set at all grade breaks, grade changes, etc.

1.4 SUBMITTALS

- A. Mix Designs: The Contractor shall formulate a job-mix formula using the Hveem method in accordance with Standard Specifications Section 203-6.2 and submit it to the Engineer for approval. The resultant mixture shall have Hveem properties conforming to Standard Specifications Section 203-6.4.3.
- B. Samples:
 - 1. Prior to the delivery of specified aggregate to the site, the Contractor shall submit samples of the material for the Inspector's acceptance in accordance with Standard Specifications Section 4-1.4. Samples shall be typical of materials to be furnished from the proposed source and in conformance with the specified requirements.
 - 2. Aggregate base gradation and quality certifications shall be dated within 30 days of the submittal.
- C. Certificates
 - 1. Twenty days prior to the delivery of aggregates, asphalt materials, and paving mixes to the project site, the Contractor shall submit to the Engineer certificates and test results of compliance of such materials with these specifications.
 - 2. Submit certificates of compliance from the supplier for bituminous materials for paint binder, asphaltic concrete, and seal coat.
 - 3. Submit weigh master's certificates or certified delivery tickets for each truck load of asphaltic material delivered to the project site.
 - 4. Upon completion of the weed control treatment, and as a condition for final acceptance, furnish a written certificate stating the brand name of the sterilant and the manufacturer, and that the sterilant used had at least the minimum required concentration, and that the rate and method of application complied in every respect with the conditions and standards contained herein.

1.5 QUALITY CONTROL

- A. Asphaltic Concrete Producers Qualifications: Use only materials furnished by a bulk asphaltic concrete producer regularly engaged in production of hot mix, hot laid bituminous concrete.
- B. Applicator Qualifications: Paving machine and roller operators shall be fully trained and experienced in the installation of asphaltic concrete paving on projects of similar size and complexity.
- C. Regulatory Requirements: The quantity of volatile organic compounds (V.O.C.) used in weed killer, seal coat, primer and other materials shall not exceed the limits permitted under the current regulations of the local authorities having jurisdiction.

1.6 ENVIRONMENTAL LIMITATIONS

- A. Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
 - 1. Tack Coats: Minimum surface temperature of 60 deg F.
 - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
 - 3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Base Course Material:

1. Crushed Aggregate Base (CAB) per Section 200-2.2, 3/4" maximum of the Standard Specifications for Public Works Construction (Green Book).
2. Crushed Miscellaneous Base (CMB) per Section 200-2.4, fine sieve, of the Standard Specifications for Public Works Construction (Green Book).

B. Asphalt Surfacing Materials: Furnish asphalt surfacing meeting the following requirement, furnished from a commercial asphalt central mixing plant.

1. Paint Binder/Tack Coat: Asphalt emulsion shall be CSS-1 or CSS-1h and shall conform to the requirements of Standard Specifications Section 203-3 Emulsified Asphalt.
2. Asphalt Concrete Composition & Grading:
 - a. Synthetic Track & Playground Area surface course asphalt concrete shall conform to Standard Specification Section 203-6.4.3, Type D2, with asphalt content of 4.8% to 6.5%.
 - b. Parking lots surface course asphalt concrete shall conform to Standard Specification Section 203-6.4.3, Type C2, with asphalt content of 4.6% to 6.0%.
 - c. Base course asphalt concrete, in all areas, shall conform to Standard Specification Section 203-6.4.3, Type B, with asphalt content of 4.5% to 5.8%.
 - d. Asphalt performance grade shall be PG-64-10.
 - e. At least two courses of asphalt shall be laid when Type D2 asphalt pavement is greater than 1-1/2 inches. The surface course shall be a minimum thickness of one inch and a maximum of 1-1/2 inches.
 - f. At least two courses of asphalt shall be laid when Type C2 asphalt pavement is greater than 3 inches. The surface course shall be a minimum thickness of one inch and a maximum of two inches.

C. Weed Control:

1. The soils sterilant shall be in accordance with current EPA acceptable standard and the California Department of Pesticide Regulations for soils sterilant. Sterilant shall be selected as appropriate for the environment in which it is to be placed. Contractor shall be licensed with the State of California to apply sterilant. Sterilant shall be commercial grade for commercial application. Payment for soil sterilization will include full compensation for application and all materials and incidental work required.
2. Apply Dow Elanco Spike 80DF, or approved equal, to subgrade prior to asphalt paving. Spike 80DF weed control should be applied at the rate of seven pounds per acre. If another manufacturer is used follow their recommendations.

D. Headers and Stakes:

1. Headers: Redwood, Construction Heart Grade, size 2 x 6, unless otherwise indicated on construction drawings
2. Stakes: 2 x 4 redwood or 2 x 3 Douglas fir, Construction Grade.
3. Nails: common, galvanized, 12d minimum.

PART 3 - EXECUTION

3.1 HEADERS

- A. Install headers along edge of bituminous surfacing abutting turf, earth, or planting area, unless indicated otherwise.
- B. Install headers so the bottom surface has continuous bearing on solid grade. Where excavation for headers is undercut, thoroughly tamp soil under the header. Compact backfill on both sides of header to the density of adjacent undisturbed earth.
- C. Fasten headers in place with redwood or Douglas fir stakes of length necessary to extend into solid grade a minimum of 12 inches. Stakes shall be of sound material, neatly pointed, driven vertically, and securely nailed to headers. Space stakes, not to exceed 4 feet on centers with top of stakes set one inch below top of header. Provide a minimum of 2-12d galvanized common nails through each stake.
- D. Remove existing headers where new surfacing is installed adjacent to existing surfacing.
- E. Install temporary headers at transverse joints of paving where continuous paving operations are not maintained.
- F. Provide additional stakes and anchorage as required to fasten headers in place

3.2 SUBGRADE PREPARATION

- A. It is required that areas of asphalt pavement be underlain by a layer of aggregate base material. Thickness of base layer is as shown on the Construction Documents.
 - 1. It is recommended that the native soil below proposed crushed base material under hardscape areas, be over excavated to the recommended minimum depth of 12" (inches) below the base layer, brought to near optimum moisture content and rolled with heavy compaction equipment. Soil should be re-compacted to at least 90% of the maximum dry density obtainable by ASTM D1557 method of compaction.
 - 2. The exposed bottom surface soils, below over-excavation, shall be scarified to the recommended minimum depth of 8", brought to near optimum moisture content and rolled with heavy compaction equipment. Exposed soil should be compacted to at least 90% of the maximum dry density obtainable by ASTM D1557 method of compaction. Potentially expansive fine-grained silts and clays, if present, should be removed to a depth of approximately 12 inches and replaced with on-site low-expansion sandy soil.

3.3 APPLICATION GENERAL

- A. Finish elevations, extent of asphalt paving and locations of type of asphalt and class of base shall be as indicated and specified herein and on the Construction Documents. Bring subgrade elevations sufficiently below the finish elevations of the paving so as to accommodate the thickness of paving and base.

3.4 STERILANT APPLICATION

- A. Place herbicide below base course. Meet the applicable environmental control requirements. Apply as directed by the manufacturer's printed instructions just before application of the base course. Sterilant shall not be applied within two feet of planting areas.

3.5 APPLICATION OF BASE COURSE

- A. Install base course material, encompassing spreading and compacting, in accordance with the S.S.P.W.C. Section 301-2, Untreated Base.

- B. The permeable base contours of the field, after final compaction and grading, shall not have deviations in surface shape greater than 3/16" over a 10' span. Final contour shall be plotted on a table of laser-sighted grade elevations using a rectangular grid size of 120 yards by 60 yards with measurements every 20 yards (28 total elevation points). Grade elevations to be reviewed and approved prior to installation of the soil isolation fabric. Fine grade to the required tolerances leaving behind no tire tracks or indentations.
- C. After preparing the subgrade as specified in 3.5.A, all traffic on the subgrade shall be avoided. Should it be necessary to haul over the prepared subgrade, the Contractor shall drag and roll the traveled way as frequently as may be necessary to remove ruts, cuts, and breaks in the surface. All cuts, ruts, and breaks in the surface of the subgrade that are not removed by the above operations shall be raked and hand tamped. All equipment used for transporting materials over the prepared subgrade shall be equipped with pneumatic tires.
- D. Continued use of sections of prepared subgrade for hauling, so as to cut up or deform it from the true cross-section, will not be permitted. The Contractor shall protect the prepared subgrade from all traffic.
- E. Maintain the surface in its finished condition until the succeeding layer is placed.

3.6 PLACING ASPHALT CONCRETE SURFACING:

- A. Asphalt binder (tack coat) shall be applied to all existing pavement surfaces to be overlaid and/or joined per section 302-5.4 of the Standard Specifications. Asphalt binder (tack coat) shall be applied to existing surfaces to be surfaced and between layers of asphalt concrete, except when eliminated by the Engineer. A layer of asphalt binder (tack coat) shall be applied to all vertical-cut faces and between subsequent AC lifts.
- B. Asphalt Concrete Pavement:
 - 1. All work shall be in accordance with Section 302-5 of the Standard Specifications, except as noted herein. Asphalt concrete work shall include full-depth patching and variable thick asphalt concrete transition areas. The Contractor shall, on a daily basis, provide the Inspector with copies of certificates of weight for all materials delivered to the job site and/or incorporated in the work. At no time shall the coarse aggregate that has segregated from the mix be scattered across the paved mat.
 - 2. Asphalt concrete shall not be placed on any surface, which contains ponded water or excessive moisture in the opinion of the Engineer. If paving operations are in progress and rain or fog forces a shut down, loaded trucks in transit shall return to the plant, and no compensation will be allowed therefore. The Contractor shall furnish and use canvas tarpaulins to cover all loads of asphalt from the time that the mixture is loaded until it is discharged from the delivery vehicle, unless otherwise directed in writing by the Engineer.
 - 3. The Inspector will examine the base before the paving has begun. The Contractor will correct any deficiencies before the paving is started.
 - 4. Asphalt concrete of the class indicated in Section 2. B.2 shall be laid in courses conforming to S.S.P.W.C. Table 302-5.5(A) unless otherwise stated herein.
 - 5. At least two courses of asphalt shall be laid when Type D2 asphalt pavement is greater than 1-1/2 inches. The surface course shall be a minimum thickness of one inch and a maximum of 1-1/2 inches.
 - 6. At least two courses shall be laid when Type C2 asphalt pavement is greater than 3 inches. The surface course shall be a minimum thickness of one inch and a maximum of two inches.
 - 7. Successive courses may be laid upon previously laid courses as soon as the previous course has cooled sufficiently to show no perceivable displacement under equipment or loaded material delivery trucks and a tack coat has been applied.
 - 8. Wherever AC pavement does not terminate against a curb, gutter, or another pavement, the Contractor shall provide and install a redwood or pressure treated Douglas fir header at the line of termination.

9. Smoothness of asphalt shall conform to section 302-5.6.2 of the Standard Specifications.
10. Density shall conform to the below requirements:
 - a. In-place density of the Asphalt Concrete will be based on test results from a nuclear gauge and core samples taken in accordance with CTM 375, "Determining the in Place Density and Relative Compaction of Asphalt Concrete Pavement" except as modified below. The Inspector will determine when core sample testing shall be completed.
 - b. Asphalt Concrete shall be compacted to not less than 95.0 percent for a single test and not less than an average in place density of 96.0 percent relative compaction of the Laboratory Test Maximum Density as determined by, Caltrans Testing Method (CTM) 375 except as modified by these specifications.
 - c. The materials testing laboratory, paid for by the contractor, will obtain random samples of the hot mix asphalt material from behind the paving machine in accordance with Caltrans Testing Method (CTM) 125, "Methods for Sampling Highway Materials and Products in Roadway Structural Sections", to determine the Laboratory Test Maximum Density of the asphalt mixture in accordance with CTM 308.
 - d. Asphalt Concrete compaction shall be accepted based upon passing tests taken from the nuclear gauge. In the event that the nuclear gauge testing presents failing results, then core samples will be the determination for the in place density and acceptance or rejection of the compaction.
 - e. When core testing is to be performed to determine the relative compaction after nuclear gauge testing has not produced passing tests, the materials testing laboratory will obtain four 4" diameter core specimens (or four 6" diameter core specimens) for determination of relative density of the completed pavement. The four cores shall represent the sample frequency requirements specified in CTM 375.
11. Pavement at all longitudinal joints shall have a Field Density of 95%, as described in 302-5.6.2 of the Standard Specifications. When the test results of the field cores are less than 95% Relative Compaction, the Contractor shall remove a 1 foot wide section on each side of the longitudinal joint. The Contractor shall replace the removed pavement with an asphalt mix that meets the job specification at no additional cost to the Owner.

3.7 FLOOD TESTING

- A. Flood Test: Before acceptance, all pavements shall be water tested to ensure proper drainage as directed by the Inspector. The Contractor shall provide water for this purpose. The flooding shall be done by water tank truck. Depressions where the water ponds to a depth of more than 1/8-inch shall be filled or the slope corrected to provide proper drainage. The edges of the fill shall be feathered and smoothed so that the joint between the fill and the original surface is invisible. No standing water shall remain 1-hour after test. Full compensation for complying with this requirement shall be considered as included in the Contract Unit Price for Asphalt Paving.

3.8 SEAL COAT

- A. All new asphalt pavement, which receives a seal coat, shall cure 30 days before application of seal coat. See Project Specification Section 32 12 36: Seal Bituminous Surfacing.

3.9 FIELD QUALITY CONTROL

- A. Replace or repair deficient and damaged asphalt paving.
- B. All paving shall drain properly before being accepted. Upon completion, the pavement shall be true to grade and cross section. When a 10 foot straightedge is laid on the finished surface parallel to the centerline of the roadway, the surface shall not vary from the edge of the straightedge more than 1/8 inch, except at intersections or at changes of grade. Any areas that are not within this tolerance shall be brought to grade immediately following the initial rolling. There shall be no variation greater than 1/4 inch plus or minus from a 10 foot straight edge, except at grade changes. The paving material in the area to be repaired shall be removed, by an approved method, to provide a minimum laying depth of 1 inch, or 2 times the maximum size aggregate, whichever is greater, of the new pavement at the join line. Repairs shall not be made to pavement surface by feather-edging at the join lines. All expenses for pavement repair up shall be borne by the Contractor at no cost to the Owner.

3.10 PROTECTION

- A. Protect the work of this section until Substantial Completion.

3.11 CLEAN UP

- A. Clean all debris and unused materials from the paving operation. Clean all surfaces that have been spattered or defaced as a result of the paving operation. Asphalt or asphalt stains which are noticeable upon surfaces of concrete, or materials which will be exposed to view, shall be promptly and completely removed. Cleaning shall be done in a manner that will not result in any discharge of contaminated materials into any catch basin. All expenses for clean up shall be borne by the Contractor at no cost to the Owner.

END OF SECTION

SECTION 32 12 36

SEAL BITUMINOUS SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Surface sealer over new asphalt paved surfaces. This excludes the synthetic track as that does not require a bituminous surface seal.

1.2 REFERENCES

- A. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("Green Book"), 2015 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications".

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product information and application procedures for bituminous surfacing.

1.4 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement: Standard Specifications Section 203-9, "SEALCOAT — ASPHALT BASED".
- B. Obtain materials from same source throughout.
- C. Schedule a pre-construction conference at jobsite in advance of beginning of Work. In existing areas to be seal coated and restriped, document existing striping to be duplicated before commencing seal coating work.
- D. Review and resolve conflicts involving requirements of specifications. Record discussions and furnish copies to all attendees.
- E. Beginning of Work means Contractor accepts all conditions.
- F. Agitate bulk materials during transport.

1.5 REGULATORY REQUIREMENTS

- A. Comply with local air quality management district regulations for emissions maximums.
- B. Maintain control of vehicular and pedestrian traffic during seal coating operations as required for other construction activities and in accordance with local traffic authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Seal Coat: The materials for sealcoat shall conform to Section 203-9 — "Sealcoat Asphalt Based" of the Standard Specifications. Before incorporation in the Work, the Contractor shall submit a 2 Liter (2-quart) sample of undiluted seal coat at no cost to the Owner.

1. Seal Coat: Provide one of the following surface seals:

<u>Product Name</u>	<u>Manufacturer</u>
GuardTop	Vulcan Materials Company
Over Kote	Diversified Asphalt Products
Park Top	Western Colloid Products
Sure Seal	Asphalt Coating Engineering
MasterSeal	SealMaster Pavement Products & Equipment

2. Crack Sealing: Crack sealant shall be CalSeal Modified Asphalt joint sealant as manufactured by Henry Inc, Crafcro Polyflex Type 3 or equal.

PART 3 - EXECUTION

3.1 REPAIRING AND SEALCOATING OF SURFACES

- A. Preparation of Surfaces:

1. Before placing the sealcoat, the pavement surface shall be cleaned by sweeping, flushing or other means necessary to removal all loose particles of paving, all dirt, and all other extraneous material. This shall include vegetation in pavement cracks and between pavement and curb/gutter. Prior to removal an approved herbicide, which leaves behind a visible blue marker dye, shall be sprayed where vegetation exists. Surface contaminates, grease or oil spots shall be cleaned to allow for proper adhesion.
2. Prior to applying sealcoat material, cracks wider then 1/8 inch shall be cleaned, treated with weed killer, and filled with an asphalt-based crack filler (large cracks may require several applications). For best quality, it is recommended that all broken asphalt be removed and patched with new asphalt. It is also suggested that extreme low spots be filled with new asphalt. New asphalt must cure 30 days before application of sealcoat to meet manufacturer seal coat warranty.
3. Immediately before commencing the sealcoat operations, all surface metal utility covers (including survey monuments) shall be protected by thoroughly covering the surface with an appropriate adhesive and oiled or plastic paper. No adhesive material shall be permitted to cover, seal or fill the joint between the frame and cover of the structure. A vertical tab shall be placed on each cover for locating after the seal application is complete. The tab shall extend at least 3" above the existing pavement surface. Covers are to be uncovered and cleaned of asphalt emulsion material by the end of the same work day. Inspector shall inspect surfaces before the installation of seal coat.

4. For best results, the asphalt, just prior to being sealed, should be sprayed with a mist of water in an amount that will leave the surface damp but with no puddles or visible water. This procedure is critical when ambient temperature is hot with bright sunlight or when the pavement is excessively aged or porous.
5. A prime or tack coat may be necessary on surfaces that have weathered excessively or are dusted. The primer should be diluted with three parts clean, potable water and one part SS-1h emulsion and shall be applied at the rate of 0.05 gallon per square yard.
6. Install barricades as required to divert traffic from operations. Install temporary "no parking" signs and similar notices.

B. Application:

1. Sealcoat may be mixed with water to obtain desired consistency for job requirements to a maximum of 20% of the total volume. Care should be taken not to over dilute. Material after dilution shall be mixed with a mechanical agitator to maintain consistency and ease of application. Note that as the pavement increases in roughness, the amount of dilution should be decreased.
2. Sealcoat shall only be applied when the atmospheric temperature is greater than 55 degrees F and if rain is not forecast for the period of 24 hours after application.
3. The sealcoat material shall be applied in two applications. Unless otherwise specified, the total quantity applied (before dilution) shall be 50 gallons per 1,000 square feet.
4. Sealcoat material shall be applied using a truck-mounted tank or wheeled container in continuous parallel lines and spread by means of brooms or rubber-faced squeegees either by hand or machine and in such a manner as to eliminate all ridges, lap marks, and air pockets.
5. Hand tools shall be available in order to remove spillage. Ridges or bumps in the finished surface will not be permitted. Sealcoat material shall be homogeneous prior to spreading, with no visible separation of solids and liquids.
6. When the first coat has completely dried to the touch, apply the second coat. While misting is not normally required before second coat, surface should be clean with no foreign materials on it.

C. Drying Time:

1. Sealcoat should be allowed to dry 24 — 48 hours before permitting traffic. When asphalt is cold or in shade, or air temperature is below 75 degrees F, based on general weather, humidity and temperature conditions, drying time may need to be extended.

3.2

CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.
- B. Striping for parking or traffic flow should be done only after the sealcoat has thoroughly dried. It is recommended that a high quality water based traffic line paint be used for best results.

3.3

PROTECTION

- A. Protect the work of this section until substantial completion.

END OF SECTION

SECTION 32 12 93

SYNTHETIC TURF

PART 1 - GENERAL

1.1 SUMMARY

- A. CMAS Procurement: The Owner has purchased synthetic track surfacing and all associated line striping direct under separate contract. Beynon and its installation are not part of the bid. This section is for clarification and in coordination with the general contractor's scope of work and project schedules.
 - 1. It shall be the responsibility of the synthetic turf manufacturer to provide all labor, materials, equipment and tools necessary for the complete installation of the synthetic track surfacing system as indicated on the plans and as specified herein. The installation of all materials shall be performed in strict accordance with the manufacturer's installation instructions and in accordance with all approved shop drawings.
 - 2. Perimeter edge and drainage details required for the system shall be as detailed and recommended by the Manufacturer, and as approved by the Owner. Supply and installation of these details will be under the scope of work of the general contractor based on project plans and are not part of the synthetic track surfacing manufacturer / installer's scope.
 - 3. The system shall consist of, but not necessarily be limited to, the following:
 - a. Synthetic turf fabric and infill.
 - b. Field striping and graphic markings.
 - c. FieldTurf Revolution CoolPlay or approved equal.

1.2 REFERENCE STANDARDS

- A. FM Factory Mutual
 - 1. P7825 - Approval Guide; Factory Mutual Research Corporation; current edition
- B. ASTM – American Society for Testing and Materials.
 - 1. D1577 - Standard Test Method for Linear Density of Textile Fiber
 - 2. D5848 - Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Covering
 - 3. D1338 - Standard Test Method for Tuft Bind of Pile Yarn Floor Covering
 - 4. D1682 - Standard Method of Test for Breaking Load and Elongation of Textile Fabrics
 - 5. D5034 - Standard Test Method of Breaking Strength and Elongation of Textile Fabrics (Grab Test)
 - 6. F1015 - Standard Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
 - 7. D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
 - 8. D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
 - 9. F355 - Standard Test Method for Shock-Absorbing Properties of Playing Surfaces.
 - 10. F2117 – Standard Test Method for Vertical Rebound Characteristics of Sports Surface Systems: Acoustical Measurements (Soccer)
 - 11. BS7044, Section 2.2 Methods for Determination of Person/Surface Interaction Method 1: Determination of Traction (Rotational Resistance)
 - 12. F1551-03 Suffix: DIN 18-035, Part 6: Water Permeability of Synthetic Turf Systems
 - 13. ASTM F355-10, Procedure A: Testing Services Inc test number TSI 1202

1.3 SUBMITTALS

- A. Substitutions: Other products are acceptable if in compliance with all requirements of these

specifications. Submit alternate products to Architect for approval prior to bidding in accordance Section 01 25 13, Product Substitution Procedures.

1. Provide substantiation that proposed system does not violate any other manufacturer's patents, patents allowed or patents pending.
 2. Provide a sample copy of insured, non-prorated warranty and insurance policy information.
- B. Comply with Section 01 33 00, Submittals Procedures. Submit for approval prior to fabrication.
- C. Shop Drawings:
1. Indicate field layout; field marking plan and details for the specified sports; i.e., NCAA Football; roll/seaming layout; methods of attachment, field openings and perimeter conditions.
 2. Show installation methods and construction indicating field verified conditions, clearances, measurements, terminations, drainage.
 3. Provide joint submission with related trades when requested by Architect.
- D. Product Data:
1. Submit manufacturer's catalog cuts, material safety data sheets (MSDS), brochures, specifications; preparation and installation instructions and recommendations; storage, handling requirements and recommendations.
 2. Submit fiber manufacturer's name, type of fiber and composition of fiber.
 3. Submit data in sufficient detail to indicate compliance with the contract documents.
 4. Submit manufacturer's instructions for installation.
 5. Submit manufacturer's instructions for maintenance for the proper care and preventative maintenance of the synthetic turf system, including painting and markings.
- E. Samples: Submit samples, 9 x 12 inches, illustrating details of finished product in amounts as required by General Requirements, or as requested by Architect.
- F. Product Certification:
1. Submit manufacturer's certification that products and materials comply with requirements of the specifications.
 2. Submit test results indicating compliance with Reference Standards.
- G. Project Record Documents: Record actual locations of seams, drains and other pertinent information in accordance with Specifications, General Requirements.
- H. List of existing installations: Submit list including respective Owner's representative and telephone number.
- I. Warranties: Submit warranty and ensure that forms have been completed in Owner's name and registered with approved manufacturer.
- J. Submit Bills of Lading/Material Delivery Receipts for synthetic turf infill materials. Bills of lading shall bear the name of the project/delivery address, quantity of materials delivered, source/location of origin of infill materials and/or manufacturer, and date of delivery.
- K. Testing Certification: Submit certified copies of independent (third-party) laboratory reports on ASTM testing:
1. Pile Height, Face Weight & Total Fabric Weight, ASTM D5848.
 2. Primary & Secondary Backing Weights, ASTM D5848.
 3. Tuft Bind, ASTM D1335.
 4. Grab Tear Strength, ASTM D1682 or D5034.
 5. Water Permeability, ASTM D4491

1.4 QUALITY ASSURANCE

- A. Comply with Section 01 43 00, Quality Assurance.

- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section. The turf contractor and/or the turf manufacturer:
1. Shall be experienced in the manufacture and installation of infilled spined and/or ridged monofilament grass system for a minimum of three years. This includes use of a spined and/or ridged monofilament fiber, backing, the backing coating, and the installation method.
 2. The manufacturer shall own and operate its own manufacturing plant. Manufacturing the fiber, tufting of the field fibers into the backing materials and coating of the turf system must be done in-house by the turf manufacturer.
 3. The manufacturer must have ISO 9001, ISO 14001 and OHSAS 18001 certifications demonstrating its manufacturing efficiency with regards to quality, environment and safety management systems.
 4. The manufacturer must be a FIFA Preferred Producer and a FIFA Licensee
 5. The manufacturer must be licensed by all of the following major international governing bodies: FIFA, International Rugby Board (IRB), International Hockey Federation (FIH), Australian Football League (AFL).
 6. Shall have 500 fields in play for at least two years with a spined and/or ridged monofilament fiber. Fields shall be 65,000 ft² or more
 7. Shall have a minimum of 500 fields that are at least 8 years old, which is equal to the respective warranty period
 8. Shall have a minimum of 750 installations in California.
 9. Shall have a minimum of 1 FIFA 2-Star recommended field in North America.
 10. Shall have a minimum of 5 NFL game and/or practice fields in play for the previous year.
 11. Shall have minimum 25 NCAA Division 1 game and/or practice fields installed for (football or soccer)
 12. Shall have a minimum of 1000 installations in North America, each of 65,000 ft² or more. Fields shall be 65,000 ft² or more of the specified infill material and a spined and/or ridged monofilament fiber.
 13. Shall provide third party certification confirming minimum requirement of 9 lbs tuft bind.
 14. Shall provide third-party laboratory testing proving heat reduction qualities of the same infill used in the proposed turf system
- C. Installer: Company shall specialize in performing the work of this section. The Contractor shall provide competent workmen skilled in this specific type of synthetic grass installation.
1. The designated Supervisory Personnel on the project shall be certified, in writing by the turf manufacturer, as competent in the installation of specified monofilament material, including sewing seams and proper installation of the infill mixture.
 2. Installer shall be certified by the manufacturer and licensed.
 3. The installer supervisor shall have a minimum of 5 years experience as either a construction manager or a supervisor of synthetic turf installations
- D. Pre-Installation Conference: Conduct conference at project site at time to be determined by Architect. Review methods and procedures related to installation including, but not limited to, the following:
1. Inspect and discuss existing conditions and preparatory work performed under other contracts.
 2. In addition to the Contractor and the installer, arrange for the attendance of installers affected by the Work, The Owner's representative, and the Architect.
- E. The Contractor shall verify special conditions required for the installation of the system.
- F. The Contractor shall notify the Architect of any discrepancies.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prevent contact with materials that may cause dysfunction.
- B. Deliver and store components with labels intact and legible.

- C. Store materials/components in a safe place, under cover, and elevated above grade.
- D. Protect from damage during delivery, storage, handling and installation. Protect from damage by other trades.
- E. Inspect all delivered materials and products to ensure they are undamaged and in good condition.
- F. Comply with manufacturer's recommendations.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the Work with installation of work of related trades as the Work proceeds.
- B. Sequence the Work in order to prevent deterioration of installed system.

1.7 WARRANTY AND GUARANTEE

- A. The Contractor shall provide a warranty to the Owner that covers defects in materials and workmanship of the turf for a period of eight (8) years from the date of substantial completion. The turf manufacturer must verify that their representative has inspected the installation and that the work conforms to the manufacturer's requirements. The manufacturer's warranty shall include general wear and damage caused from UV degradation. The warranty shall specifically exclude vandalism, and acts of God beyond the control of the Owner or the manufacturer. The warranty shall be fully third party insured; pre paid for the entire 8 year term and be non-prorated. The Contractor shall provide a warranty to the Owner that covers defects in the installation workmanship, and further warrant that the installation was done in accordance with both the manufacturer's recommendations and any written directives of the manufacturer's representative. Prior to final payment for the synthetic turf, the Contractor shall submit to owner notification in writing that the field is officially added to the annual policy coverage, guaranteeing the warranty to the Owner. The insurance policy must be underwritten by an "AM Best" A rated carrier and must reflect the following values:
 - 1. Pre-Paid 8-year insured warranty.
 - 2. Insured Warranty Coverage must be provided in the form of 1 single policy
 - 3. Maximum per claim coverage amount of \$32,000,000.
 - 4. Minimum of thirty-two million dollar (\$32,000,000) annual aggregate
 - 5. Must cover full 100% replacement value of total square footage installed, minimum of \$7.00 per sq ft. (in case of complete product failure, which will include removal and disposal of the existing surface)
 - 6. Policies that include self insurance or self retention clauses shall not be considered.
 - 7. Policy cannot include any form of deductible amount.
 - 8. Sample policy must be provided at time of bid to prove that policy is in force. A letter from an agent or a sample Certificate of Insurance will not be acceptable.
- C. The artificial grass system must maintain a G-max of less than 200 for the life of the Warranty as per ASTM F1936.

1.8 MAINTENANCE SERVICE

- A. Contractor shall train the Owner's facility maintenance staff in the use of the turf manufacturer's recommended maintenance equipment.

- B. Manufacturer must provide maintenance guidelines and a maintenance video to the facility maintenance staff.

PART 2 - PRODUCTS

1.9 ACCEPTABLE MANUFACTURER

- A. Approved manufacturers are as follows:

1. FieldTurf USA Inc.
175 N. Industrial Blvd
Calhoun, GA 30701
P: 760-635-2504
or approved equal.

Model: FieldTurf Revolution CoolPlay or approved equal.

1.10 MATERIALS AND PRODUCTS

- A. Artificial grass system materials shall consist of the following:
1. Carpet made of "spined and/or ridged" monofilament polyethylene fibers tufted into a fibrous, non-perforated, porous backing.
 2. Infill: Controlled mixture of graded sand and cryogenic rubber crumb that partially covers the carpet. A top infill layer of granulated cork is mandatory.
 3. Glue, thread, paint, seaming fabric and other materials used to install and mark the artificial grass monofilament.
- B. The installed artificial grass monofilament shall have the following properties:

Standard	Property	Specification
ASTM D1577	Fiber Denier	10,800
	HALS UV Stabilizer	10,000ppm
	Inner Face Support Ridges	≥6
	Outer Face Support Ridges	≥10
ASTM D5823	Pile Height	2 1/2"
ASTM D5793	Stitch Gauge	3/4"
ASTM D5848	Pile Weight	40oz/square yard
ASTM D5848	Primary Backing	7+oz/square yard
ASTM D5848	Secondary Backing	14+oz/square yard
ASTM D5848	Total Weight	61+oz/square yard
ASTM D1335	Tuft Bind (Without Infill)	8+ lbs
ASTM D5034	Grab Tear (Width)	200 lbs/force
ASTM D5034	Grab Tear (Length)	200 lbs/force
ASTM D4491	Carpet Permeability	>40 inches/hour
ASTM F1936	Impact Attenuation (Gmax)	<200
	Infill Material Depth	1.75 inches
	Sand Infill Component	6.2lbs/square foot
	SBR Rubber Infill Component	2.6lbs/square foot
	Granulated Cork Component	0.2lbs/square foot
	Total Product Weight	1357oz/square yard

- C. Carpet shall consist of spined and/or ridged monofilament fibers tufted into a primary backing with a secondary backing.
- D. Carpet Rolls shall be 15' wide rolls.
1. Rolls shall be long enough to go from field sideline to sideline.

2. Where the playing field is for football, the perimeter white line shall be tufted into the individual sideline rolls.
- E. Backing:
1. Primary backing shall be a double-layered polypropylene fabric
 2. Secondary backing shall consist of an application of porous, heat-activated urethane to permanently lock the fiber tufts in place.
 3. Perforated (with punched holes), backed carpet are unacceptable.
- F. Fiber shall be 10,800 denier, low friction, and UV-resistant fiber measuring not less than 2 ½ inches high.
1. Systems with less than a 2 ½ inch fibers are unacceptable.
- G. Infill materials shall be approved by the manufacturer.
1. Infill shall consist of a resilient layered granular system, comprising selected and graded sand and cryogenically hammer-milled SBR rubber crumb with a top layer of granulated cork.
 2. Artificial Grass products without cryogenically processed SBR rubber and a top layer of granulated cork will not be acceptable.
 3. The sand component of the infill must represent a minimum of 51% or more of the total infill, by weight.
 4. Granulated cork must be pre-washed by the cork supplier prior to arrival at the field(s)
 5. Granulated cork must have a bulk density of 0.19 g/cm³ +/- 15%
- H. The sand infill will comply within the following characteristics:
- Average Particle size between 20 and 30 mesh [calculated based on summing the midpoint of sieve pan fractions times the % retained on given screen fractions]
 - Average Particle shape > 0.4 on the Krumbein scale
 - Particle structure predominantly single grain
 - Produce < 0.4%, -50M in API crush test at 80psig
- I. Non-tufted or inlaid lines and markings shall be painted with paint approved by the synthetic turf manufacturer.
- J. Thread for sewing seams of turf shall be as recommended by the synthetic turf manufacturer.
- K. Glue and seaming fabric for inlaying lines and markings shall be as recommended by the synthetic turf manufacturer.

1.11 QUALITY CONTROL IN MANUFACTURING

- A. The manufacturer shall own and operate its own manufacturing plant. Manufacturing the fiber, tufting of the field fibers into the backing materials and coating of the turf system must be done in-house by the turf manufacturer. Outsourcing of any of these major processes is unacceptable.
- B. The manufacturer shall have full-time certified in-house inspectors at their manufacturing plant that are experts with industry standards.
- C. Primary backing shall be inspected by the manufacturer's full-time certified in-house inspectors before tufting begins.
- D. The manufacturer's full-time in-house certified inspectors shall verify "pick count", yarn density in relation to the backing, to ensure the accurate amount of face yarn per square inch.
- E. The manufacturer's full-time, in-house, certified inspectors shall perform turf inspections at all levels of production including during the tufting process and at the final stages before the turf is loaded onto the truck for delivery.

- F. The manufacturer shall have its own, in-house laboratory where samples of turf are retained and analyzed, based on standard industry tests, performed by full-time, in-house, certified inspectors.
- G. The manufacturer must have ISO 9001, ISO 14001 and OHSAS 18001 certifications demonstrating its manufacturing efficiency with regards to quality, environment and safety management systems.

2.4 QUALITY CONTROL IN FIBER MANUFACTURING

Synthetic turf fiber must perform in a uniform manner or manufacturer quality control issues in the extrusion processes will be suspected. Linear Low Density Polyethylene Polymer ("LLDPE") and batch additives obtained from a reputable manufacturer are required to manufacture superior quality monofilament yarn. The master batch formula must include a UV stabilizer package added to its polymer base.

The LLDPE used to make the artificial grass fiber needs to be a "C6" LLDPE which contains 6 carbon atoms and 12 hydrogen atoms; A C6-based LLDPE produces strong and resilient artificial grass fibers over prolonged periods and thus should provide the basis for long term performance of the system.

Adequate UV protection is essential to the long-term durability of any artificial grass fiber. Typically, stabilizer packages for polyethylene fibers have three components that protect the fibers from degradation: (1) primary antioxidants; (2) secondary antioxidants; and (3) UV stabilizers (i.e., hindered amine light stabilizers ("HALS")). HALS are a particularly important aspect of the stabilizer package. A typical HALS concentration is 10,000 ppm. More developed HALS molecules are methyl stabilized to prevent from degradation.

Streaking refers to color variation in a field due to different degrees of fiber relaxation. Fiber in one row stands up, while fiber in an adjacent row lies flat. The inconsistent relaxation causes differences in the reflection of light off of the fiber, and results in the field having a streaked or striped appearance. Adequate UV protection minimizes the appearance of streaking and other visual flaws during the warranty period.

Each finished fiber should have at least 6 inner face support ridges and 10 outer face support ridges

2.5 FIELD GROOMER & SWEEPER

Supply field groomer as part of the work.

1. Field Groomer shall include a towing attachment compatible with a field utility vehicle.
2. Field Groomer shall be as recommended by turf manufacturer.
3. Field Sweeper shall include a towing attachment compatible with a field utility vehicle.
4. Field Sweeper shall be as recommended by turf manufacturer.

PART 3 - EXECUTION

1.12 EXAMINATION

- A. Verify that all sub-base leveling is complete prior to installation.
- B. Installer shall examine the surface to receive the synthetic turf and accept the sub-base planarity in writing prior to the beginning of installation.
 1. Acceptance is dependent upon the Owner's test results indicating compaction and planarity are in compliance with manufacturer's specifications.
 2. The surface shall be accepted by Installer as "clean" as installation commences and shall be maintained in that condition throughout the process.
- C. Compaction of the aggregate base shall be 95%, in accordance with ASTM D1557 (Modified Proctor procedure); and the surface tolerance shall not exceed 0-1/4 inch over 10 feet and 0-1/2" from design grade.

- D. Correct conditions detrimental to timely and proper completion of Work.
- E. Do not proceed until unsatisfactory conditions are corrected.
- F. Beginning of installation means acceptance of existing conditions.

1.13 PREPARATION

- A. Prior to the beginning of installation, inspect the sub-base for tolerance to grade.
- B. Sub-base acceptance shall be subject to receipt of test results (by others) for compaction and planarity that sub-base is in compliance with manufacturer's specifications and recommendations.
- C. Dimensions of the field and locations for markings shall be measured by a registered surveyor to verify conformity to the specifications and applicable standards. A record of the finished field as-built measurements shall be made.
- D. When requested by Architect, installed sub-base shall be tested for porosity prior to the installation of the monofilament turf. A sub base that drains poorly is an unacceptable substrate

1.14 INSTALLATION - GENERAL

- A. The installation shall be performed in full compliance with approved Shop Drawings.
- B. Only trained technicians, skilled in the installation of athletic caliber synthetic turf systems working under the direct supervision of the approved installer supervisors, shall undertake any cutting, sewing, gluing, shearing, top-dressing or brushing operations.
- C. The designated Supervisory personnel on the project must be certified, in writing by the turf manufacturer, as competent in the installation of this material, including sewing seams and proper installation of the Infill mixture.
- D. Designs, markings, layouts, and materials shall conform to all currently applicable National Collegiate Athletic Association rules, NFHS rules, and/or other rules or standards that may apply to this type of synthetic grass installation. Designs, markings and layouts shall first be approved by the Architect or Owner in the form of final shop drawings. All markings will be in full compliance with final shop drawings.

1.15 INSTALLATION

- A. Install at location(s) indicated, to comply with final shop drawings, manufacturers'/installer's instructions.
- B. The Contractor shall strictly adhere to specified procedures. Any variance from these requirements shall be provided in writing, by the manufacturer's on-site representative, and submitted to the Architect and/or Owner, verifying that the changes do not in any way affect the Warranty. Infill materials shall be approved by the manufacturer and installed in accordance with the manufacturer's standard procedures.
- C. Carpet rolls shall be installed directly over the properly prepared aggregate base. Extreme care shall be taken to avoid disturbing the aggregate base, both in regard to compaction and planarity.
 - 1. Repair and properly compact any disturbed areas of the aggregate base as recommended by manufacturer
- D. Full width rolls shall be laid out across the field.
 - 1. Turf shall be of sufficient length to permit full cross-field installation from sideline to sideline.
 - 2. No cross seams will be allowed in the main playing area between the sidelines.
 - 3. Each roll shall be attached to the next roll utilizing standard state-of-the- art sewing procedures.
 - 4. When all of the rolls of the playing surface have been installed, the sideline areas shall be installed at right angles to the playing surface.

- E. Artificial turf panel seams shall be sewn along the selvedge edging flap of the turf roll. Seams secured by other means including gluing are unacceptable. Installation shall be 99% sewn.
 - 1. Minimum gluing will only be permitted to repair problem areas, corner completions, and to cut in any logos or inlaid lines as required by the specifications.
 - 2. Seams shall be flat, tight, and permanent with no separation or fraying.
 - 3. In the case of all lines and logos, turf carpet/field fibers must be sheared to the backing (do not cut the backing) and adhered using hot melt adhesives.
- F. Infill Materials:
 - 1. Infill materials shall be applied in numerous thin lifts. The turf shall be brushed as the mixture is applied. The infill material shall be installed to a depth determined by the manufacturer.
 - 2. Three-layered infill shall be installed in a systematic order.
 - 3. Infill materials shall be installed to fill the voids between the fibers and allow the fibers to remain vertical and non-directional. The Infill installation consists of a base layer of sand followed by a homogenous mixture of the sand and the cryogenically processed rubber. A final application of specifically sized granulated cork completes the system. The Infill shall be installed to the depth of 1 3/4". Infill density shall consist of no more than 6.2 pounds of sand, 2.6 pounds of rubber, and 0.2lbs or cork per square foot. The Infill shall be placed so that there is a void of 3/4" to the top of the fibers.
- G. Non-tufted or inlaid lines and markings shall be painted in accordance with turf and paint manufacturers' recommendations. Number of applications will be dependent upon installation and field conditions.
- H. Synthetic turf shall be attached to the perimeter edge detail in accordance with the manufacturer's standard procedures.
- I. Upon completion of installation, the finished field shall be inspected by the installation crew and an installation supervisor.

1.16 FIELD MARKINGS

- A. Field markings shall be installed in accordance with approved shop drawings. If football is designated as the primary sport, all five yard lines will be tufted-in.
- B. Balance of sports markings will be inlaid or painted in accordance with the Drawings.
- C. Center field logo shall be either painted or inlaid according to artwork indicated on Drawings and in accordance with manufacturer's standard palette of turf colors.
- D. End-zone letters and logos shall be either painted or inlaid according to artwork and fonts indicated on the Drawings, and in accordance with manufacturer's standard palette of turf colors.

1.17 RECYCLING

- A. Manufacturer must commit to a "take back" program once the useful life of the turf surface has lapsed. Upon removal of the turf surface, at least 75% of the turf surface must be recycled.

1.18 FIELD MAINTENANCE

- A. Perform regularly scheduled periodic maintenance twice per year. The maintenance will include but not be limited to a complete inspection and repair including all materials and cleaners of all areas of the field including: Fiber fibrillation analysis, Seam analysis, Perimeter anchoring, Excessive wear analysis, UV fade inspection, Infill – consistency in depth, Infill – migration analysis, Glued inlay analysis, Base stability analysis, Painted marking inspection, Debris removal, Brushing, Aerating, Grooming, Removal of weeds and moss, Removal of stains, Keeping the infill level.
- B. The inspection and maintenance will be performed by a manufacturer's Authorized Maintainer, if the

person is not the same as the previous visit, then credentials will be submitted for approval before the visit.

- C. Approximate number of times is 2 times per year for 8 years through the warranty period.
- D. The maintenance activities will include and not be limited to the most current manufacturer's Maintenance Guidelines at the time the maintenance is being undertaken, including all manufacturer's recommended maintenance products.

1.19 ADJUSTMENT AND CLEANING

- A. Do not permit traffic over unprotected surface.
- B. Contractor shall provide the labor, supplies, and equipment as necessary for final cleaning of surfaces and installed items.
- C. All usable remnants of new material shall become the property of the Owner.
- D. The Contractor shall keep the area clean throughout the project and clear of debris.
- E. Surfaces, recesses, enclosures, and related spaces shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

1.20 PROTECTION

- A. Protect installation throughout construction process until date of final completion.

END OF SECTION

SECTION 32 13 13

SITE CONCRETE WORK

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall furnish all materials for concrete in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished concrete, in accordance with the requirements of the Contract Documents.
- 8. The following types of concrete shall be covered in this Section:
 - 1. Portland cement concrete pavement, cement walks, flatwork, curbs, gutters, retaining curbs, swales, trash pick-up areas, ramps, mowing strips, fence post footings, sliding gate concrete, catch basins, pipe bedding and encasements, transition structures, flagpoles and light standard bases and footings, splash blocks and equipment pads.
 - 2. Portland cement concrete paving shall be stable, firm and slip resistant and shall comply with CBC sections 11B-302 and 11B-403.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Comply with the reference specifications of the GENERAL REQUIREMENTS.
- B. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("GREENBOOK"), 2015 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications".
- C. Comply with the current provisions of the following Codes and Standards.
 - 1. Federal Specifications:
 - a. UU-B-790A (Int.Amd. 1) Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant).
 - 2. Standards:
 - a. ACI 214 Recommended Practice for Evaluation of Strength Test Results of Concrete.
 - b. ACI 301 Specifications for Structural Concrete for Buildings.
 - c. ACI 315 Details and Detailing of Concrete Reinforcement.
 - d. ACI 318 Building Code Requirements for Reinforced Concrete.
 - e. ACI 347 Recommended Practice for Concrete Formwork.
 - f. ACI 350 Recommended Practice for Sanitary Structure.

- g. ASTM C 31 Practices for Making and Curing Concrete Test Specimens in the Field.
- h. ASTM C 33 Specification for Concrete Aggregates.
- i. ASTM C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- j. ASTM C 40 Test Method for Organic Impurities in Fine Aggregates for Concrete.
- k. ASTM C 42 Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- l. ASTM C 78 Specification for Flexural Strength.
- m. ASTM C 88 Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate.
- n. ASTM C 94 Specification for Ready-Mixed Concrete.
- o. ASTM C 114 Method for Chemical Analysis of Hydraulic Cement.
- p. ASTM C 131 Test Method for Resistance to Degradation of Small-Sized Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- q. ASTM C 136 Method for Sieve Analysis of Fine and Coarse Aggregate.
- r. ASTM C 143 Test Method for Slump of Portland Cement Concrete.
- s. ASTM C 150 Specification for Portland Cement.
- t. ASTM C 156 Test Method for Water Retention by Concrete Curing Materials.
- u. ASTM C 157 Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
- v. ASTM C 172 Specification for Sampling Fresh Concrete.
- w. ASTM C 192 Method of Making and Curing Concrete Test Specimens in the Laboratory.
- x. ASTM C 260 Specification for Air-Entraining Admixtures for Concrete.
- y. ASTM C 289 Test Method for Potential Reactivity of Aggregates (Chemical Method).
- z. ASTM C 311 Method for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.
- aa. ASTM C 494 Specification for Chemical Admixtures for Concrete.
- bb. ASTM C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
- cc. ASTM D 1751 Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

- dd. ASTM E 119 Method for Fire Tests of Building Construction and Materials.

1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with general requirements.
- B. The following submittals and specific information shall be provided.
1. Mix Designs: Prior to beginning the Work, the Contractor shall submit to the Engineer, for review, and approval, preliminary concrete mix designs for each class and type of concrete specified herein. The mix designs shall be designed by an independent testing laboratory acceptable to the Engineer. All costs related to such mix design shall be borne by the Contractor.
 - a. Each concrete mix submittal shall contain the following information:
 - 1) Slump on which the design is based.
 - 2) Total gallons of water per cubic yard.
 - 3) Brand, type, composition and quantity of cement.
 - 4) Brand type, composition and quantity of fly ash.
 - 5) Specific Gravity and gradation of each aggregate.
 - 6) Ratio of fine to total aggregate per cubic yard.
 - 7) Weight (surface dry) of each aggregate per cubic yard.
 - 8) Brand, type, and ASTM designation, active chemical ingredients and quantity of each admixture.
 - 9) Copy of the Building and Safety Research Report Approval for each concrete admixture.
 - 10) Air content.
 - 11) Compressive strength based on 7 day and 28 day compression tests, including standard deviation calculations, corroborative data (if applicable), and required average comprehensive strength per ACI 318, Section 5.
 - 12) Time of initial set.
 - 13) Certification stamp and signature by a Civil or Structural engineer registered in state of California.
 - 14) Certificate of Compliance for Cement.
 2. Certified Delivery Tickets: Where ready-mix concrete is used, the Contractor shall provide certified weighmaster delivery tickets at the time of delivery of each load of concrete. Each certificate shall show the public weighmaster's signature, and the total quantities, by weight of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate and added at the batching plant as well as the amount of water allowed to be added at the site for the specific design mix. Each certificate shall, in addition, state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to when the batch was dispatched, when it left the plant, when it arrived at the job, the time that unloading began, and the time that unloading was finished.
 3. When a water reducing admixture is to be used, the Contractor shall furnish mix designs for concrete both with and without the admixture.
 4. The Contractor shall furnish a Certificate of Compliance signed by the supplier identifying the type of fly ash and stating that the fly ash complies with ASTM C

618 and these Specifications, together with all supporting test data prior to the use of the fly ash the sample represents. The supporting data shall also contain test results confirming that the fly ash in combination with the cement and water to be used meets all strength requirements and is compatible with air- entraining agents and other admixtures.

5. The Contractor shall submit to the Engineer for review the design mix for fly ash concrete together with the design mix for Portland cement (non-fly ash) concrete as specified in this Section.

1.4 QUALITY ASSURANCE

- A. Testing for Portland Cement Concrete shall be sampled and tested in accordance with the ASTM and California Tests listed in the Standard Specifications for Public Works Construction, Latest Edition, Section 201-1.1.5.
- B. Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, or not less than once for each 50 cubic yards of concrete, or not less than once for each 2,000 square feet of surface area for slabs. Additional samples for seven-day compressive strength tests shall be taken for each class of concrete at the beginning of the concrete work or whenever the mix or aggregate is changed.
- C. The cost of all laboratory tests on cement, aggregates, and concrete, will be borne by the Contractor.
- D. Concrete for testing shall be supplied by the Contractor at no cost to the Owner, and the Contractor shall provide assistance and facilities to the Inspector in obtaining samples, and disposal and cleanup of excess material.
- E. Curbs and gutters shall be staked by a Land Surveyor licensed to practice in the State of California.
- F. Job Mock-Up
 1. General
 - a. Make samples on-site; revise as required; obtain Architect's approval, 10 days prior to casting finished work.
 - b. Finished work to match approved samples.
 - c. Approved sample may be incorporated into the work. Retain samples until completion of all concrete work.
 - d. Include typical tooled joint control in sample.
 2. Broom Finished Concrete; Exterior Flatwork: Provide sample, 20 s.f. minimum area.
 3. "Sacked" Vertical Surface; Exterior Wall: Provide sample, 5 sf. minimum *area*.
- G. Construction Tolerances: The Contractor shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the specifications, permissible deviations will be in accordance with ACI 347.
- H. Construction tolerances shall not violate dimensions, grades, slopes required by CBC for accessibility requirements. Adjust work accordingly to comply with requirements.
- I. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10 feet: 1/4-inch;
Variation from the level or from the grades shown.	In 10 feet: 1/4-inch;
Variation from the plumb	In 10 feet: 1/4-inch;
Variation in the thickness of slabs and walls.	Minus 1/8-inch; Plus 1/4-inch
Variation in the locations and sizes of slabs And wall openings.	Plus or minus 1/8-inch

PART 2 – PRODUCTS

2.1 CONSTRUCTION MATERIALS

- A. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.
- B. All materials furnished for the work shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.
- C. Storage of materials shall conform to the requirements of Section 205 of ACI 301.
- D. Form Materials: Plywood, metal, metal-framed plywood, or other acceptable panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Conform to Section 303-5.2 of the Standard Specifications.
 - 1. Use flexible or curved forms for curves of a 100-foot or less radius.
- E. Reinforcing Materials: As follows:
 - 1. Steel Reinforcing Bars: ASTM A 615 deformed grade 40 billet steel, plain finish, unless otherwise specified on Construction Document. Fabrication, sampling and jobsite handling shall conform to the requirements in ASTM Designation: D 3963, except the 2 samples shall be 30 inches long.
 - 2. Dowels:
 - a. Dowel bars shall be plain round smooth conforming to the requirements in ASTM Designation: A 615/A 615M, Grade 40 except that the two samples required in ASTM Designation: D 3963/D 3963M shall be 18 inches long. Dowel bars shall be free from burrs or other deformations detrimental to free movement of the bars in the concrete
 - b. Dowel bars shall be lubricated with a bond breaker over the entire bar. A bond breaker application of petroleum paraffin based lubricant or white-pigmented curing compound shall be used to coat the dowel bars completely prior to placement. Oil and asphalt-based bond breakers shall not be used. Paraffin based lubricant shall be Dayton Superior DSC BB-Coat or Valvoline Tectyl 506 or an approved equal. Paraffin based lubricant shall be factory applied. White pigmented curing compound shall conform to the requirements of ASTM Designation: C 309, Type 2, Class A, and shall contain 22 percent minimum nonvolatile vehicles consisting of at least 50 percent paraffin wax. Curing compound

shall be applied in 2 separate applications, the last application not more than 8 hours prior to placement of the dowel bars. Each application of curing compound shall be applied at the approximate rate of one gallon per 15 square yards.

3. Epoxy for bonding tie bars and dowel bars to portland cement concrete shall be a two-component, epoxy-resin, conforming to the requirements of ASTM Designation: C 881, Type V, Grade 3 (Non-Sagging), Class B or C. The class used shall be dependent on the internal temperature of the hardened concrete at the time the epoxy is to be applied. Class B shall be used when the internal temperature is from 40 °F to 60 °F. Class C shall be used when the internal temperature is above 60 °F, but not higher than recommended by the manufacturer. A copy of the manufacturer's recommended installation procedure shall be provided to the Engineer at least 7 days prior to the start of work. Epoxy shall be applied in conformance with the manufacturer's recommendations.
 - a. Simpson Strong Tie Set-XP Epoxy (or approved equal) ICC-ES ESR- 2508.

F. Concrete Materials: As follows:

1. Cement shall be standard brand portland cement conforming to ASTM C 150 for Type II. Portland cement shall contain not more than 0.60 percent alkalis. The term "alkalis" referred to herein is defined as the sum of the percentage of sodium oxide and 0.658 times the percentage of potassium oxide ($\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$). These oxides shall be determined in accordance with ASTM C 114. A single brand of cement shall be used throughout the work, and prior to its use, the brand shall be acceptable to the Engineer. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports for each shipment of cement to be used shall be submitted to the Inspector.
2. Concurrent with strength design criteria, concrete shall also be proportioned to provide the requisite durability to satisfy the exposure conditions imposed by either environment and/or service. Durability, in this context, refers to the ability of the concrete to resist deterioration from the environment or service in which it is placed. Concrete proportioned in accordance with ACI 318, chapter 4, Durability Requirements, will meet this criteria.
3. Combined Aggregate: 1" maximum coarse aggregate size conforming to Grading C of Standard Specifications Section 201-1.3.2(A). Aggregates shall be obtained from pits acceptable to the Inspector, shall be non-reactive, and shall conform to ASTM C 33.
4. Water: Shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies.
5. "Pea gravel" mix is not acceptable, unless specifically approved in writing by the Civil Engineer of Record prior to construction.

G. Admixtures:

1. The Engineer may require the use of admixtures or the Contractor may propose to use admixtures to control the set, effect water reduction, and increase workability. In either case, the addition of an admixture shall be at the Contractor's expense. The use and continued use of an admixture shall be approved by the Engineer. Admixtures specified herein, other than calcium chloride, shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used. Admixtures shall contain no free chloride ions, be non-toxic after 30 days, and shall be compatible with and made by the same manufacturer as the air

entraining admixture.

2. These admixtures shall not be used in greater doses than those recommended by the manufacturer or permitted by the Engineer. The permitted dosage of the admixture shall not exceed that which will result in an increase in the driving shrinkage of the concrete in excess of 20 percent when used in precast or prestressed concrete, or 10 percent when used in any other structural concrete. The strength of concrete containing the admixture in the amount of proposed shall, at the age of 48 hours and longer be not less than that of similar concrete without the admixture. The admixture shall not adversely affect the specified air content, unless permitted by the Engineer.
3. Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F, a set retarding admixture such as [Sika Chemical Corporation's Plastiment], [Master Builder's Pozzoloth 300R], or equal shall be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees F, a set accelerating admixture such as [Sika Chemical Corporation's Plastocrete 161FL], [Master Builder's Pozzoloth SOC], or equal shall be used.
4. Low range water reducer shall conform to ASTM C 494, Type A. It shall be either a hydroxylated carboxylic acid type or a hydroxylated polymer type. The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.
5. High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G.
 - a. If the high range water reducing agent is added to the concrete at the batch plant, it shall be second generation type, [Daracem 100, as manufactured by W.R. Grace & Co.]; [Pozzoloth 430R, as manufactured by Masterbuilders]; or equal. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified.
 - b. If the high range water reducer is added to the concrete at the job site, it shall be used in conjunction with a low range water reducer and shall be [Pozzoloth 400N and Pozzoloth MBL82, as manufactured by Masterbuilders]; [WRDA 19 and WRDA 79, as manufactured by W.R. Grace & Co.]; or equal. Concrete shall have a slump of 3-inches + 1/2-inch prior to adding the high range water reducing admixture at the job site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system.
6. Air-entraining agent meeting the requirements of ASTM C 260, shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 4 percent; provided that, when the mean daily temperature in the vicinity of the worksite falls below 40 degrees F for more than one day, the total air content provided shall be 5 to 6 percent. The Owner reserves the right, at any time, to sample and test the air-entraining agent received on the job by the Contractor. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement.
7. Calcium Chloride: Except as otherwise provided herein, calcium chloride will not be permitted to be used in concrete.
8. Fly ash/pozzolan shall conform to ASTM C618 and the following supplementary requirements:
 - a. Class F fly ash
 - o Loss on ignition, maximum 4 percent

- o S03 content, maximum 3 percent
 - o Moisture content, maximum 1 percent
 - b. Class F fly ash, as a percent by weight of total cementitious material, shall not exceed 15 percent
 - c. When Sulfate Resistant or Special Exposure Concrete is specified, test results shall be submitted to the Engineer as specified in Section 2-5.3 of the Standard Specifications. The test result shall show that the fly ash to be used is effective in contributing to sulfate resistance in conformance with ASTM C618, Table 3 (optional physical requirements) as tested in accordance with ASTM C 1012. The data submitted shall be less than 6 months old.
- H. Curing Materials:
 - 1. Concrete curing compound shall conform to the requirements of ASTM C309 Type 1-D (clear or translucent with fugitive dye), Class B (Resin Type Only), except the loss of water shall not exceed 0.15 kilograms per square meter in 24 hours nor 0.45 kilograms per square meter in 72 hours when tested in accordance with ASTM C 156. The Contractor shall provide, when requested by the Engineer, certified copies of vendor's test report showing compliance with ASTM C 309 and these specifications. The testing and the report shall be supplied without cost to the Agency. All compounds shall be furnished by the Contractor in sealed original containers labeled in accordance with ASTM C 309 and with the date of manufacture.
 - 2. Polyethylene sheet for use as concrete curing blanket shall be white and conform to ASTM C 171. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.
 - 3. Polyethylene-coated burlap for use as concrete curing blanket shall conform to ASTM C 171. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 grams per square centimeter of surface.
- I. Expansion Joint Filler Material
 - 1. Curb & Gutter: Nonextruding and Resilient Filler: Celotex "Flexcell", or approved equal, 1/4-inch thick material conforming to ASTM D 1751.
 - 2. Concrete Walk and Slab: Joint filler material shall be preformed expansion joint filler conforming to the requirements of ASTM D994. A Certificate of Compliance for the joint filler material shall be furnished to the Engineer. The certificate shall be accompanied with a certified test report of the results of the required test performed on the joint filler material within the previous 12 months prior to proposed use. The certificate and accompanying test report shall be provided for each lot of joint filler material prior to use on the project.
 - 3. Silicone Joint Sealant: Premium-grade, high-performance, moisture-cured, single-component, polyurethane-based, non-sag elastomeric sealant. Meets Federal specification TT-S-00230C. Meets ASTM C-920, Type S, Class 25 or 35; Grade NS, Use T or NT, Shore A Hardness (21 day) 35-45. A Certificate of Compliance for the silicone sealant shall be furnished to the Engineer. The Certificate shall also be accompanied with a certified test report of the results of the required tests performed on the sealant material within the previous 12 months prior to proposed use. The Certificate and accompanying test report shall be provided for each lot of silicone joint sealant prior to use on the project.
 - a. Sika Corporation, Sikaflex-1A.
 - b. Tremco, Inc., Dymonic.
 - c. Tremco, Inc., Vulkem 116.

- d. Bostik Construction Products Div., Chem-Calk 900.
- J. Concrete Sealer: For natural concrete only, HLQ-125 as manufactured by SINAK Corp., San Diego, CA (619/231-1771), HLQ-125 as manufactured by SINAK Corp., San Diego, CA (619/231-1771), or equivalent product of another manufacturer in accordance with the "or equal" provision of the Contract Documents, penetrating sealer that interacts with mineral compounds and siliceous materials in portland cement concrete to produce more dense, non-dusting surface.
- K. Related Materials: As follows:
1. Damp-proofing agent shall be an asphalt emulsion, Sonneborn Hydrocide 660, or approved equal.
 2. Epoxy adhesives shall be the following products for the applications specified:
 - a. For bonding freshly-mixed, plastic concrete to hardened concrete, Sikadur Hi-Mod Epoxy Adhesive, as manufactured by Sika Chemical Corporation, or approved equal.
 - b. For bonding hardened concrete or masonry to steel, Sikadur Hi-Mod Gel or approved equal.
- L. Curbs / Curb & Gutter & Flatwork Mix Design: At a minimum, concrete for curbs and curbs & gutters and flatwork shall conform to the Standard Specifications for Public Works Construction, Section 201-1.1.2, mix class 520-C-2500.
1. Compressive Strength: minimum of 2,500 psi at 28 days compressive strength.
 2. Slump Limit: 4 inches at point of placement.
 3. Cement per cu yard (sacks): 5.5 (minimum).
 4. Air Content: 4% +/- 1% percent
- M. Swale Mix Design: At a minimum, concrete for swales shall conform to the Standard Specifications for Public Works Construction, Section 201-1.1.2, mix class 560-C-3250:
1. Compressive Strength: minimum of 3,250 psi at 28 days compressive strength.
 2. Slump Limit: 4 inches at point of placement.
 3. Cement per cu yard (sacks): 6.0 (minimum).
 4. Air Content: 4% +/- 1% percent.
- N. Slurry Mix Design:
1. Compressive Strength: 100 psi at min. 28 days compr. strength.
 2. Slump Limit: 5 inches at point of placement.
 3. Cement per cu yard (sacks): 1.0
 4. Aggregate Gradation: "E" per S.S.P.W.C. table 201-1.3.2(A).
 5. Air Content: 4% +/- 1% percent.

PART 3 - EXECUTION

3.1 PREPARATION OF SURFACES FOR CONCRETING

- A. General: Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
8. Subgrade Preparation:
1. It is recommended that the native soil below proposed crushed base material under hardscape areas, be over excavated to the recommended minimum depth of 12" (inches) below the base layer, brought to near optimum moisture content and rolled with heavy compaction equipment. Soil should be re-compacted to at least 90% of the maximum dry density obtainable by ASTM D1557 method of compaction.
 2. The exposed bottom surface soils, below over-excavation, shall be scarified to the recommended minimum depth of 8" (inches), brought to near optimum moisture content and rolled with heavy compaction equipment. Exposed soil should be compacted to at least 90% of the maximum dry density obtainable by ASTM D1557 method of compaction. Potentially expansive fine-grained silts and clays, if present, should be removed to a depth of approximately 12 inches and replaced with on-site low-expansion sandy soil.
- C. The compacted surface shall be firm, hard and unyielding. The term "firm, hard and unyielding" as used in S. S.P.W.C. Section 301-1.3 shall mean that when the heaviest construction and hauling equipment used on the project drives over the subgrade, no permanent deformation shall occur either before or during pavement construction. On areas where the underlying material appears to be wet or soft, or where it deflects under wheel loads, the Contractor shall employ excavation and work techniques which do not worsen the subgrade condition.
- D. The above subgrade preparation recommendations are based on the assumption that soils encountered during field exploration are representative of soils throughout the site. However, there can be unforeseen and unanticipated variations in soils between points of subsurface exploration. For this reason, the actual scarification or over-excavation depths will have to be determined on the basis of in-grading observations and testing performed by representatives of the project geotechnical consultant.
- E. A California Licensed Surveyor (LS) must provide grade stakes and elevations for the Geotechnical Engineer to verify that the over-excavation depths, shown on the construction drawings for concrete pavement structural sections, have been achieved prior to re-compaction.
- F. Joints in Concrete: Concrete surfaces upon or against which concrete is to be placed, where the placement of the old concrete has been stopped or interrupted so that, as determined by the Engineer, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, and foreign material. Such cleaning shall be accomplished by sandblasting followed by thorough washing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.
- G. Embedded Items: No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and Accepted by the Inspector at least 24 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
- H. All inserts or other embedded items shall conform to the requirements herein.

- I. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown or by shop drawings and shall be acceptable to the Inspector before any concrete is placed. Accuracy of placement is the responsibility of the Contractor.
- J. Where concrete is to be cast against old concrete, (greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by sand-blasting, exposing the aggregate. In concrete shear-walls, suspended slabs and roof slabs, the interface surface at construction joints shall be roughened to a full amplitude of one quarter inch. The hardened surface shall be cleaned of all latent foreign material and washed clean, prior to the application of an epoxy bonding agent.
- K. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited underwater nor shall the Contractor allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the Engineer.
- L. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2-inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- M. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.
- N. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.
- O. Cleaning: The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.2 HANDLING, TRANSPORTING, AND PLACING

- A. General: Placing of concrete shall conform to the applicable requirements of ACI 301 and the requirements of this Section.
- B. The total elapsed time between the addition of water at the batch plant and the completion of the discharge of the P.C.C. from the mixer shall not exceed 90 minutes. All P.C.C. remaining in the mixer after said 90-minute time limit shall be rejected and removed from the project site.
- C. Non-Conforming Work or Materials: Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced by and at the expense of the Contractor.
- D. Whenever batch trucks or other paving equipment cause rutting of the subgrade or subbase in concrete placement areas, inspectors shall immediately stop construction. Construction shall not be allowed to resume until distorted subgrade or subbase is repaired. Contractors and inspectors should locate by proof rolling, any questionable unstable areas in advance to avoid distortion under equipment. Wet, unstable areas must be dried out or replaced before starting placement of asphalt. Locating wet or soft areas in advance can be accomplished by testing finished subgrade or subbase with a loaded truck. Construction of concrete pavement should not proceed unless testing gives a

reasonable indication that distortions will not occur during construction of overlying pavement. When repair, aeration, and recompaction are required to correct damage from Contractor's operation, all necessary repair will be done at Contractor's expense. However, if the Engineer determines that additional depth of aeration and recompaction are needed, that should be paid by change order.

- E. All pull boxes, meter boxes, valve covers and manholes shall be adjusted to proposed finish grade prior to placement of the P.C.C.
- F. Dowel Placement:
 - 1. Dowel bars shall be centered on the joint within a tolerance of +2 inches in the longitudinal direction directly over the contact joint or sawcut for the transverse weakened plane joints, as shown on the plans. Prior to placement of dowel bars, the Contractor shall submit to the Engineer a written procedure to identify the transverse weakened plane joint locations relative to the middle of the dowel bars and the procedure for consolidating concrete around the dowel bars.
 - 2. Dowel bars shall be placed at longitudinal joints as shown on the plans. Dowel bars shall be placed as shown on the plans by using mechanical insertion. When dowel bars are placed by mechanical insertion, the concrete over the dowel bars shall be reworked and refinished so that there is no evidence on the surface of the completed pavement that there has been any insertion performed. When drill and bonding of dowel bars is performed at contact joints, a grout retention ring shall be used.
- G. Concrete shall not be placed until the forms and reinforcement have been inspected, all preparations for the placement have been completed, and the preparations have been checked by the project inspector, all subject to the observation of the engineer or architect.
- H. Casting New Concrete Against Old: An approved epoxy adhesive bonding agent shall be applied to the old surfaces according to the manufacturer's written recommendations. This provision shall not apply to joints where waterstop is installed.
- I. Conveyor Belts and Chutes: All ends of chutes, hopper gates, and all other points of concrete discharge throughout the CONTRACTOR'S conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the INSPECTOR. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.
- J. Placement in Slabs: Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the pour. As the work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.
- K. Temperature of Concrete: The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 40 degrees F in moderate weather, and not less than 50 degrees F in weather during which the mean daily temperature drops below 40 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the CONTRACTOR shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The CONTRACTOR shall be entitled to no additional compensation

on account of the foregoing requirements.

- L. Cold Weather Placement: Earth foundations shall be free from frost or ice when concrete is placed upon or against them. Fly ash concrete shall not be placed when the air temperature falls below 50 degrees F.
- M. A transverse construction joint shall be constructed, including dowel bars, at the end of each day's work or where concrete placement is interrupted for more than 30 minutes, to coincide with the next contraction joint location. If sufficient concrete has not been mixed to form a slab to match the next contraction joint, when an interruption occurs, the excess concrete shall be removed and disposed of back to the last preceding joint. The cost of removing and disposing of excess concrete shall be at the Contractor's expense. Excess material shall become the property of the Contractor and shall be disposed of. A metal or wooden bulkhead (header) shall be used to form the joint. The bulkhead shall be designed to accommodate the installation of dowel bars.
- N. Float Finish: Begin floating when bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surfaces to true planes within a tolerance of 1/4 inch in 10 feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. The finished surface shall be free from humps, sags, blemishes or other irregularities Cut down high spots and fill low spots. Refloat surface immediately to a uniform granular texture.
- O. Broom Finish Type:
 - 1. Surfaces Sloped Less than 6%: Provide a medium salt (medium broom) finish by drawing a soft bristle broom across concrete surface, perpendicular to line of traffic, to provide a uniform fine line texture.
 - 2. Surfaces Sloped greater than 6%: Provide a slip resistant (heavy broom finish) by striating surface 1/16 inch to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
- P. Joints:
 - 1. Joints: Joints in concrete curb, gutter, and walk shall be designated as expansion joints and control joints. Joints for concrete flatwork shall be provided every five feet or less. Expansion joints for swales, curbs / curb & gutter shall be placed at no greater than 15 feet on center or as indicated on construction drawings
 - a. Expansion Joints: Provide 1/2" wide premolded joint filler, material meeting Section 2.011 herein. Construct expansion joints per detail 3 on sheet C2.01
 - 1) Provide expansion joints, with elastomeric sealer, between concrete walk and curb, concrete walk and buildings, & concrete walk and retaining walls and at locations noted on the construction documents
 - b. Control Joints:
 - 1) In site concrete provide control joint per detail 3 on sheet C2.01.
 - 2) Where integral curb and gutter is adjacent to site concrete pavement, the joint shall be aligned with the pavement joints where practical
- Q. Protection: In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control film. Apply according to manufacturer's instructions after screeding and bull floating, but before floating.

3.3 LIGHT STANDARD BASES, FLAGPOLE BASES, POST BASES AND SIMILAR SITE STRUCTURES

- A. Forms: Suitable material and type, size, shape, quality and strength to insure construction as designed, true to line and sufficiently rigid to resist deflection during placing of concrete. Clean forms of all dirt, mortar and foreign matter before use.
- B. Reinforcement: Place accurately and hold in position, using metal chairs, spacers, metal hangers, supporting wires and other devices of sufficient strength to resist crushing under full load. Clean reinforcing steel of mortar, oil, dirt, loose mill scale loose or thick rust and coatings.
- C. Coordinate installation of conduits, cast in place items and other inserts.
- D. Finish: Grind or sack as required as determined by the Architect to produce a smooth, straight, plumb and acceptable finish without burrs or form marks. For horizontal surfaces: provide float finish.
- E. Curing: Cure surfaces utilizing one of the following methods:
 - 1. Spraying: Spray water over slab areas and maintain wet for 7 days.
 - 2. Spread polyethylene film over slab areas, lapping edges and sides, minimum 6 inches and sealing with pressure sensitive tape; cover with plywood or otherwise protect film from damage; maintain in place for 7 days.
 - 3. Apply liquid curing compound at rate of 200 square feet per gallon, using power sprayer equipped with agitator. Do not apply liquid curing compound to surfaces scheduled to receive paving units or finish of any kind.

3.4 TAMPING AND VIBRATING

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high speed power vibrators (8000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.
- B. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.5 CURING

- A. Comply with 2013 California Building Code, Title 24, Part 2, Volume 2, Section 1905A.11.
 - 1. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least seven days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.
- B. Curing Methods: Perform curing of concrete by curing as herein specified.
 - 1. Provide moisture-curing by the following methods:
 - a. Keep concrete surface continuously wet by covering with water.
 - b. Continuous water-fog spray.
 - c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4 inch lap over adjacent absorptive covers.
 - 2. Provide curing and sealing compound to exposed exterior slabs, walks, and curbs, as follows:
 - a. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Re-coat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - b. Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid, floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to Architect.
- C. Concrete slabs and paving shall be properly cured and protected against damage and defacement of nature during construction operations. If weather is hot or surface has dried out, spray surface with fine mist of water starting not later than two hours after final troweling. Surface of finish shall be kept continuously wet for at least ten days. Wetting is considered emergency work and shall be performed on weekends and holidays if necessary.
- D. Concrete Sealer Application: Apply specified concrete sealer in continuous operation in accordance with manufacturer's instructions and recommendations.
 - 1. Prior to starting application, protect adjoining Work, including sealant bond surfaces, from spillage or blow-over of concrete sealer.
 - a. Cover adjoining and nearby surfaces of aluminum and glass where there is the possibility of the concrete sealer being deposited on surfaces.
 - b. Cover live plants and grass.
 - c. Immediately clean concrete sealer from adjoining surfaces, complying with manufacturer's cleaning recommendations.
 - 2. Apply concrete sealer under temperature conditions according to manufacturer's instructions.
 - 3. Apply concrete sealer in light, even coats using garden sprayer, airless sprayer

or paint brush.

4. Apply concrete sealer at rate to suit porosity of portland cement concrete but not less than no more than coverage rates recommended by manufacturer for effective sealing of surface.
- E. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the CONTRACTOR'S expense. Exclude traffic from concrete paving for at least 7 days after placement.
- F. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep concrete paving not more than 2 days prior to date scheduled for Substantial Completion inspections.

3.6 PUMPING OF CONCRETE

- A. General: If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- B. Pumping Equipment: The pumping equipment must have 2 cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the CONTRACTOR may have a standby pump on the site during pumping.
- C. The minimum diameter of the hose (conduits) shall be 4-inches.
- D. Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced.
- E. Aluminum conduits for conveying the concrete will not be permitted.
- F. Proportioning: Minimum compressive strength, cement content, and maximum size of aggregates shall be as specified herein.
- G. Gradation of coarse aggregates shall conform to ASTM C 33 and shall be as close to the middle range as possible.
- H. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 10 percent passing the number 100 screen. The fineness modulus of sand used shall not be over 3.00.
1. Water and slump requirements shall conform to the requirements of this Section.
- J. Cement and admixtures shall conform to the requirements of this Section.
- K. Field Control: Concrete samples for slump per ASTM C 143 and test cylinders per ASTM C 31 and C 39.

3.7 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be

smoothed will not be permitted. No repairs shall be made until after inspection by the ENGINEER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced.

1. All repairs and replacements herein specified shall be promptly executed by the CONTRACTOR at its own expense.
- B. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 1/2-inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32-inch depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for repair purposes shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas white portland cement as is required to make the color of the patch match the color of the surrounding concrete.
- C. Holes left by tie-rod cones shall be reamed so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with non-shrink grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with non-shrink grout.
- D. All repairs shall be built up and shaped in such a manner that the completed work will conform to the requirements of this Section, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.
- E. Prior to filling any structure with water, all cracks that may have developed shall be repaired to the satisfaction of the ENGINEER. This repair method shall be done on the water bearing face of members. Prior to backfilling, faces of members in contact with fill, which are not covered with a waterproofing membrane, shall also have cracks repaired as specified herein.
- F. The finished surface shall be free from humps, sags, blemishes or other irregularities.

3.8 FIELD QUALITY CONTROL

- A. Correction of Mix Design for Failed Concrete Tests: If the compressive cylinder strength test for in place PCC yields test results below the specified 28-day PCC compressive strength and the Engineer determines a corrective change is necessary, the Contractor shall, at its own expense, make corrective changes in the mix proportions. The Engineer shall approve the changes in the mix proportions or PCC placement procedures, before any additional PCC is placed on the job.
- B. Flood Tests: Before final acceptance, and after concrete has thoroughly cured, all concrete pavement, including swales and curb & gutter, shall be water tested to ensure proper drainage as directed by the Inspector. The Contractor shall provide water for this purpose. The flooding shall be done by water tank truck. Concrete work where water ponds and does not run off in a reasonable amount of time (1-hour), shall be removed to the nearest score or joint line and replaced to provide proper drainage. Full compensation for complying with this requirement shall be considered as included in the Contract Unit Price for cement concrete pavement.

3.9 OFF-SITE CONCRETE WORK

- A. Concrete driveway aprons, street sidewalks, curbs and gutters, etc., indicated to be constructed outside of property lines shall conform to the standards and specifications of the public agency having jurisdiction and shall be subject to inspection by its representative. The CONTRACTOR shall obtain and pay for necessary permits and inspection fees. The Owner shall reimburse the Contractor for said permits and all necessary inspection fees.

3.10 CARE AND REPAIR OF CONCRETE

- A. General: The CONTRACTOR shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the CONTRACTOR'S expense.
- B. The contractor shall barricade and protect placed Portland Cement Concrete from all damage, marks, mars and/or graffiti. Any Portland Cement Concrete damaged, defaced, discolored or defective shall be replaced at the contractor's expense.

3.11 CONCRETE FINISHING

A. Float Finish: Begin floating when bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-drive floats, or by hand-floating if area is small or inaccessible to power units. Finish surfaces to true planes within a tolerance of 1/4 inch in 10 feet as determined by a 10 foot long straight edge placed anywhere on the surface in any direction. Cut down high spots and fill low spots. Refloat surface immediately to a uniform granular texture.

1. Burlap finish: Drag a seamless strip of burlap across concrete, perpendicular to line of traffic, to provide a uniform gritty texture finish.
2. Medium-to-fine-textured broom finish: Draw a soft bristle broom across concrete surface perpendicular to line of traffic to provide a uniform fine line texture finish.
3. Medium-to-coarse-textured broom finish: Provide a coarse finish b striating surface 1/16 inch to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
4. Do not use troweling machines withing 12 inches of electrical junction and outlet boxes which are set to finish flush with concrete slabs. Float and trowel such areas by hand with wood floats and steel trowels, taking care to see that concrete is finished flush with box cover and matches adjacent surfaces.
5. Provide concrete floor surface static coefficient of friction 0.6 at walkways and 0.8 at ramps to be at least slip resistant.

END OF SECTION

SECTION 32 14 80

ATHLETIC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY:

A. Principal work of this Section:

1. Supply all work and materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with furnishing, delivery, and installation of Athletic equipment, complete, as shown on the Drawings and/or as specified herein.
2. The principal items of work included in this section are:
 - a. Football Goal Posts
 - b. Soccer Goal Nets and Corner Flags
 - c. Long Jump / Triple Jump Sandpits
 - d. Takeoff Boards
 - e. Pole Vault Box
 - f. Discus and Shot Put Thrower's Rings
 - g. Steeplechase Hurdles
 - h. Sprint Hurdles (CFOI)

B. Related Work Specified elsewhere:

1. Excavation, Backfilling & Compaction for Pavement & structures – refer to soils report.
2. Timing Equipment- Division 26 – Electrical.
3. Section 32 18 39 Synthetic Track Surfacing

C. Manufacturers, as a basis of design:

1. Sportsfield Specialties, Alex Fletcher Western Regional Manager, (607)746-1436 – email afletcher@sportsfield.com.
2. Approved Equal.

1.2 QUALITY ASSURANCE AND REQUIREMENTS

- A. The work of this Section shall be coordinated with all underground utilities and trades responsible for their installation and with all related work in other sections.
- B. Applicable Codes & Ordinances: Comply with the requirements of the following standards as applicable:
 1. National Federation of High School Associations (NFHS) Rules and Regulations.
 2. California Building Code – 2008 Edition.
 3. State of California Building Codes & ordinances.
 4. Consumer Product Safety Commission.
 5. American Society for Testing and Materials.
 6. Underwriter's Laboratories.

- D. Protection: Erect and maintain barricades, warning signs and lights, and provide guards as necessary or required to protect all persons on the site.
- E. All work to be performed shall be done with professional quality and to the satisfaction of the District's Representative; all materials shall be new and of the brand and quality specified in the Specifications and/or Drawings; and all workmanship shall be of the best, and not simply ordinary, quality and shall be performed by skilled workmen.
- F. Manufacturer's Directions: Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturers used in this Contract furnish directions covering points not shown in the drawings and specifications.
- G. The Contractor shall not willfully install the work as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in equipment usage or area dimensions exist that might not have been considered in the design. Such obstructions or differences shall be brought to the attention of the District's Representative. In the event this notification is not performed, the Contractor shall assume full responsibility for any revision necessary.
- H. Contractor Qualifications: As specified in Section 32 18 39 – Synthetic Track Surfacing

1.3 SUBMITTALS

- A. Procedures: In accordance with Division 1.
- B. Submit manufacturer's product literature for approval prior to placing orders and/or fabrication:
 - 1. Manufacturer's specifications, installation instructions and details for manufactured items. Indicate methods of assembly, dimensions, weight and material, holes, lugs, inserts, finishes and other pertinent data.
 - 2. Provide color chart where applicable.
- C. Owner's manuals: Prior to Final Acceptance, submit owner's manuals including manufacturer's product literature for each item specified.
 - 1. Include the following:
 - a. Operating instructions, where relevant.
 - b. Equipment specifications.
 - c. List of components and accessories.
 - d. Manufacturer's installation instructions and details.
 - e. Spare parts list.
 - f. Maintenance recommendations.
 - g. Manufacturer's warranties (see paragraph 1.05 below).
- D. Do not fabricate prior to review and acceptance of samples by District Representative.
- E. Submit manufacturer's letters that installation has been inspected and approved - see Paragraph 1.06 below.

1.4 SITE OBSERVATION SCHEDULE:

- A. The Contractor shall be responsible for notifying the District in advance for required observation meetings and inspections.

1. Provide a minimum of 48 hour notice to the District requesting meeting unless otherwise noted.
- B. Before any work commences, a conference shall be held with the Landscape Architect, District Representative and Contractor regarding general requirements of this work.
 1. Provide a minimum 7 day notice to the District requesting conference.
- C. Inspections required:
 1. Initial Conference: Before any work commences, a conference shall be held with the District's Representative, Manufacturer's Representative, and Contractor regarding installation requirements. Provide 7-day minimum advance notice.
 2. Layout. The District's Representative reserves the right to make minor adjustments to location from position(s) shown on the Drawings prior to installation at no extra cost.
 3. After holes are excavated for footings, and subgrade prepared, but prior to pouring concrete. Inspection is required by Soils Engineer. Provide 7-day minimum advance notice.
 4. After placement of steel for footings, but prior to pouring concrete. Inspection is required by Structural Engineer.
 5. Final Inspection by Manufacturer's representatives. Provide 7-day minimum advance notice.
- C. Other Items specified in this Section: Observations required:
 1. Layout. The District reserves the right to make minor adjustments from positions on the Drawings prior to installation at no extra cost.
 2. After delivery to job site, but prior to installation.

1.5 WARRANTIES

- A. Provide manufacturer's written warranties for each item specified to the District, including proof of date of purchase and/or installation, make and model number, and personnel to contact in event of a warranty claim.
- B. Provide operating & maintenance manuals in accordance with Section 01730 including spare parts list in detail.

1.6 INSPECTION BY MANUFACTURER'S REPRESENTATIVE

- A. Contact the equipment manufacturer to arrange an inspection of the final installation by the manufacturer's authorized representative. The District Representative shall also be invited to attend the inspection.
- B. Contractor shall repair and/or replace any items found defective. Arrange for re-inspection if so required by the District and/or manufacturer.
- C. Submit manufacturer's letters stating that installation has been inspected and found in compliance with specified requirements, and including the following:
 1. Date of Inspection
 2. Name, address & telephone number of Inspector

3. Name, address & telephone number of Contractor

PART 2 – PRODUCTS

2.1 GENERAL

- A. All equipment shall comply with the current edition of the National Federation of High School Associations (NFHS) Rules and Regulations.

2.2 FOOTBALL GOAL POSTS

- A. Prefabricated Schedule 40 aluminum football goal posts with adjustable uprights & powder coated finish. 20'-0" uprights, 23'-4" clear between uprights, with 8'-0" gooseneck, color: white.
1. Goal posts shall be removable for storage. Provide with manufacturers ground-sleeves, min. 8" diameter Sch. 40 steel tube.
 2. Provide with upright wind flags.
 3. Manufactured by SportsEdge, Sportsfield Specialties, or equal.
- B. Provide aluminum access frames for adapting ground sleeves and footings to artificial turf installations.

2.3 SOCCER GOALS AND CORNER FLAGS

- A. Soccer Goals Shall be Aluminum Frame with tire rollers, saddle anchor bags, and semi-permanent ground anchors.
1. Netting shall be 3 mm white net.
 2. Powder Coat White finish.
 3. Installed with cast in place concrete footings as recommended by the manufacturer.
 4. Model 2B2001 as manufactured by Kwikgoal.
- B. Corner Flags shall be removable, installed in permanent ground sleeves\.
1. Manufactured by SportsEdge, Sportsfield Specialties, or equal.

2.4 LONG JUMP / TRIPLE JUMP SANDPITS

- A. Modular Prefabricated aluminum sandpit forms with ledge for covers and integral sandcatcher system, size as shown on the drawings.
1. Provide sandcatcher system as manufactured by Sportsfield Specialties, or equal.
 2. Provide rubber coated sand catcher covers as supplied by the sandpit form manufacturer, quantity as required to cover all sandcatcher areas.
 3. Provide modular extruded aluminum plank sandpit covers sufficient to completely cover the sandpits.
 - a. Provide 7mm synthetic track surfacing on all sandpit covers.
- B. Sand pit forms, sand catcher covers, and sandpit covers shall be of a single source manufacturer.

- C. Provide athletic sand and drainage course backfill in compliance with NHFS rules.

2.6 TAKEOFF BOARDS

- A. Prefabricated adjustable aluminum take-off board system consisting of an aluminum tray assembly and replaceable foul and take-off boards.
 - 1. Provide takeoff boards with 13mm synthetic track surfacing system, field applied to match new synthetic track surfacing.
 - 3. Provide blanking lid for installation when takeoff board is not in use.
Takeoff systems, foul boards, takeoff boards & blanking lids shall be of a single source manufacturer.

2.7 POLE VAULT BOXES

- A. Cast aluminum alloy pole vault boxes with white powder coat finish.
 - 1. Gill Athletics # 505, or equal.
- B. Provide aluminum vault box lid compatible with the vault box model.
 - 1. Provide vault box lids with 13mm synthetic track surfacing system, field applied to match new synthetic track surfacing.
 - 2. Vault box lid shall be flush with runway material.
 - 2. Gill Athletics # 50201, or equal.

2.8 DISCUS THROW RING

TRDAA - Discus Throw Ring by Sportsfield Specialties:

- 1. Rolled 2" x 2" x 1/4" (0.25") Aluminum Angle
- 2. Inside Diameter: 98-1/2"
- 3. 3/4" (0.75") Recessed Concrete Finishing Screed Line
- 4. Two (2) Piece Bolt Together Construction
- 5. Provided with assembly hardware
- 6. Meets or exceeds NFHS rules and regulations

2.9 SHOT PUT THROW RING TRSPHAA by Sportsfield Specialties

- 1. Rolled 2" x 2" x 1/4" (0.25") Aluminum Angle
- 2. Inside Diameter: 84"
- 3. 3/4" (0.75") Recessed Concrete Finishing Screed Line
- 4. Two (2) Piece Bolt Together Construction
- 5. Assembly Hardware
- 6. Meets or exceeds NFHS rules and regulations

2.10 SHOT PUT TOE BOARD SPTBCARHS by Sportsfield Specialties

- 1. 3-1/4"H (4" Above Recessed Concrete Pad) x 4-1/2"W x NFHS Compliant Length and Shape
- 2. Cast Aluminum Construction
- 3. Super Durable White Powder Coated Finish
- 4. Black Viny Sector Lines
- 5. Includes 3/8"-16 x 2"L Hex Head Bolt, Flat Washer, Lock Washer, and Two-Way

- Expansion Anchor Hardware
 - 6. Meets or exceeds NFHS rules and regulations
- 2.11 STEEPLECHASE PORTABLE HURDLE SET SCHS by Sportsfield Specialties
- 1. Contractor Furnished Owner Installed – Provide one set of four Steeplechase Hurdles as follows:
 - a. One (1) 5" x 5" x 16'-5"L and Three (3) 5" x 5" x 13'-5"L Painted Synthetic Track Material Covered Steeple Chase Event Stationary Hurdles that are Height Adjustable for Both Men's (36"H) and Women's (30"H) Steeplechase Events, Set of Four (4) with Removable and Retractable Wheel Kit for Portability and Transport Purposes, 4" x 4" Welded Construction Powder Coated White Aluminum Support Structure
 - 2. Synthetic rubber track surfacing covered aluminum beam.
- 2.12 SPRINT HURDLES HRHS-41" by Sportsfield Specialties
- 1. Contractor Furnished Owner Installed – Provide set of 90 Sprint Hurdles (9 sets of 10).
 - 2. Dimensions: 41"W x 27-9/16"D x Variable Height
 - 3. Height Adjustable: 30", 33", 36", 39" and 42"
 - 4. Meets NFHS Tip Over Requirements at Each Height
 - 5. Gateboard: 41" x 2-3/4" x 11/16" Polycarbonate Construction
 - a. Color: White
 - b. UV Stabilized
 - 6. Rocker Legs: Rolled 1.7" x 1.2" x 0.154" Wall Aluminum Rectangular Tube with Radiused Corners
 - a. Fixed Internal Counterweights
 - 7. Front Cross Support: 1" O.D. x 0.065" Wall Aluminum Round Tube
 - 8. Weighted Rear Cross Support: 1" O.D. x 0.065" Wall Aluminum Round Tube with Internal 13/16" (0.8125) O.D. Cold Rolled Steel Round Stock
 - 9. Gate Tubes: 1-7/8" x 1-3/8" x 20.5"L Aluminum Tube
 - a. Powder Coated Finish, Various Standard Colors Available
 - 10. Meets or Exceeds all NFHS Rules and Requirements

PART 3 – EXECUTION

3.1 SITE REVIEW

- A. Examine site for conditions that will adversely affect execution, permanence, and quality of work.
 - 1. Verify that grading has been completed and the work of this section can properly proceed.
 - 1. Exercise extreme care in excavating and working near existing structures, utilities, underground piping and conduits. Contractor is responsible for damages which are caused by his operations or neglect. Check existing utility drawings for locations.
- B. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions prior to proceeding with work under this Section.
- C. Notify the District's Representative in writing, describing unacceptable conditions.
- D. Do not proceed with work until unacceptable site conditions are corrected.

3.2 SUBGRADE PREPARATION

- A. Subgrade below bottoms of footings and slabs shall be prepared as specified in the soils report.

3.3 INSTALLATION

- A. Install all items in accordance with manufacturer's printed instructions and as detailed.
- B. Repair damaged surfaces to acceptance of the District Representative. Remove all temporary labels and tags. Clean items to remove dirt and stains.

END OF SECTION

SECTION 32 16 13

CONCRETE CURBS AND FLATWORK AT TRACK

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all labor, materials, equipment, facilities, transportation, and services to complete all concrete and related work as shown on the Drawings and/or specified herein.

- B. Scope of work

The general extent of the concrete work is shown on the Drawings and may include, but is not necessarily limited to the following:

1. Concrete curbs
2. Expansion and Score Joints
3. Reinforcement

1.2 SUBMITTALS

- A. Submit "cut-sheets," mill certificates, or certificates of compliance for all products proposed for use on the project.

1.3 QUALITY ASSURANCE

- A. Concrete

1. All formwork, joint patterns, base material, reinforcement and other miscellaneous items shall be reviewed and accepted by the District Representative prior to pouring concrete
2. The District Representative shall at all times have access to any off-site batch plant or quarry supplying materials for subject project and trucks en route to the project site. The District Representative may at any time request slump tests and secure samples for further testing.
3. Concrete Testing Service: The District may retain a testing lab to perform material evaluation tests; the District will pay for all costs associated with on or off site testing.
4. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified:
 - a. Uniform Building Code, current edition
 - b. ACI 318 "Building Code Requirements for Reinforced Concrete"
 - c. ACI 614 "Recommended Practice for Measuring, Mixing, and Placing Concrete"
 - d. Concrete Reinforcing Steel Institute, "Manual for Standard Practice"
 - e. ACI 302 "Standard for Concrete Finishing"
 - f. ACI 305 "Hot Weather Concrete"
 - g. ACI 306 "Cold Weather Concrete"

1.4 DELIVERY AND STORAGE

- A. Deliver concrete reinforcement to job site properly tagged and ready to set. Store above ground surface on platforms, skids, or other supports. Coordinate delivery and storage of all other materials as appropriate.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement shall be Type II cement conforming to ASTM C-150.
- B. Water used for mixing shall be potable.
- C. It shall be the contractor's responsibility to design the concrete mixes to provide the minimum requirements listed below. Minimum ultimate compression strength of concrete at 28 days is as follows:
 - 1. Compressive strength: 2500 PSI
 - 2. Slump Range: 2" to 4"
 - 3. Air Content: 3% to 5%
 - 4. Aggregate Size: 1" maximum

2.2 OTHER MATERIALS

- A. New form lumber shall be required for all track and field concrete form work, the practice of utilizing used lumber is prohibited even within the scope of this project. Formwork materials shall be surfaced lumber, plywood, metal, metal-framed plywood faced or other acceptable materials, to provide continuous, straight, smooth, exposed surfaces. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection. Plywood for forming shall be ACX or better.
- B. Score Joints: One half-inch (1/2") radius tooled joint to a depth of one inch.
- C. Reinforcing bars: Comply with ASTM A-615. Grade 60 #4 rebar.
- D. Provide supports for reinforcement to position the bars at mid depth of the concrete. Plastic and/or steel chairs, and dobies are acceptable.

PART 3 - EXECUTION

- A. Subgrade Preparation
The Subgrade should be uniform in composition and compacted. Base course or cushion sand may needed or used to bring the elevation of the subgrade up to the desired level before the placement of concrete. All organic material should be removed from the subgrade before base course or cushion sand is placed.
- B. Forms and Screeds
New form lumber shall be required for all track and field concrete form work, the practice of utilizing used lumber is prohibited even within the scope of this project. Set forms to the required grades and lines, rigidly braced and secured. A form should be placed as deep as the pavement edge. Install a sufficient quantity of forms to allow continuous progress of work.
- C. Weather Conditions
Place concrete only when the air temperature is above 35 degrees F and conform to the standards set forth in ACI-306. Retardant may be required when the temperature exceeds 85 degrees F and conform to the standards set forth in ACI-305.
- D. Placement
Concrete shall be a minimum of 4" thickness. Rebar shall be accurately Placed at mid-depth, supported adequately by chairs, terminating 2" away from edges and joints. Rebar should be lapped 18" and tied securely tied so that there is no displacement. Rebar shall be clean and free of rust as not to interfere with bonding of the concrete.

- E. Finishing
Concrete shall be spread, consolidated, screeded, bull-floated, edged, and Finished in accordance with ACI Standard 302. The final finish texture should be in accordance with the synthetic surface installer's recommendations, but must have at least a medium broom finish.
- F. Tolerance
The concrete surface should be finished so that the tolerance should not vary more than 1/4" inch in 10' when measured with a 10' straightedge in all directions vertically and horizontally. Finish surfaces shall drain properly with no areas of standing water. The top of all curb work shall not vary more than 1/8" laterally. There also shall be no elevation variance greater than 1/8" between any 2 locations over the entire project.
- G. Curing
Immediately after brooming, the concrete be kept continuously moist for 7 days by covering with burlap or polyethylene film. Curing compounds shall never be used. Curing time should be in accordance with the synthetic surface installers recommendations, but in no case less than 28 days.
- H. Final tolerance verification
Immediately upon completion of all concrete curbs and before any base or paving construction takes place, a final tolerance verification shall be performed. This shall consist of site survey conducted by the owners Land Survey Engineers consisting of elevation shots every 10' at the trackside edge of both inside and outside curb. Additional planarity verification shall consist of string line, digital hand level and 10 ft strait edge checks at random over entire area. Contractor shall immediately remediate any areas found not to meet specification. The track specialty contractor must accept in writing that the concrete curbs all meet the requirements for the track surface installation. The District Representative (AFCl) has the final word on all matters relating to compliance with the plans and specifications as well as remediation techniques acceptable under the unique circumstances.

PART 4 – CLEANUP

- A. Remove excess material, concrete spills, and all other excess materials from all project areas prior to Final Acceptance.

END OF SECTION

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 REFERENCE:

- A. Requirements in Addenda, Alternates, Conditions, and Division 1 collectively apply to this work.
- B. Related Sections:
 - 1. Section 32 1216: Asphalt Paving.
 - 2. Section 32 1236: Seal Bituminous Surfacing.

1.2 DESCRIPTION:

- A. Principal Work Items Are:
 - 1. Painted lines, lettering, and symbols at parking areas.
 - 2. Painted stripes at exterior stairs.
 - 3. Painted lines for sport courts.
 - 4. Curb marking and red curbs.

1.3 JOB CONDITIONS

- A. Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.
- B. Sequencing, Scheduling: Coordinate with paving work. Verify that paint type is compatible with asphalt paving surfaces seal coats.
- C. Protection: Do not apply pavement markings for seven days after application of asphalt surface seal coat. After application, protect from traffic until thoroughly dry.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Traffic Paint:
 - 1. Type: Water base, roadway traffic lane marking type; colors as selected.
 - 2. Acceptable Manufacturers:
 - a. Dunn-Edwards, Vin-L-Stripe No. W-801, vinyl-epoxy as a standard of quality.
 - b. J.E. Bauer latex base Formula No. 1030A9 White, No. 1056A9 Yellow, No. 1865A9 Blue, No. 1118A9 Green, and No. 1854A9 Red.
 - c. Sinclair No. 160 Vinyl Traffic Line Paint, water base.
 - d. Pervo Paint Company.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Layout: Accurately measure and layout work. Use stencils for all work; snap lines for straight work.
- B. Prior to application of paint, allow the pavement to properly cure. Clean and prepare in accordance with paint manufacturer's written recommendations.
- C.

- D. Provide mechanical equipment to install paint in a uniform, straight or curved pattern, without holidays and other defects.
- E. Do not permit traffic until paint has completely cured.
- F. Provide two installations/applications of pavement marking; once for initial use and once after final seal coat.
- G. Install 2 coats in thickness recommended by manufacturer.

3.2 APPLICATION:

A. Painted Lines, Lettering, and Symbols At Parking Areas:

1. Parking Stall Lines: 4 inches wide, color white.
2. Wheelchair accessible parking stalls, stripes and letters: As indicated. Loading and unloading access aisles shall be marked by a 4" wide border painted blue. Within the blue border, hatched lines a maximum of 36" on center shall be painted white. CBC Figure 11B-502. 3.3.
3. Color: White, for all work except blue at wheelchair accessible parking stalls borders and red at Fire Lanes.
4. Specific areas designated as fire lanes must be marked with red curbs using OSHA safety red paint. "FIRE LANE — NO PARKING" shall be painted on the top of curb in 3" white lettering at a spacing of 30' on center or portion thereof.
5. Parking spaces for persons with disabilities shall be marked according to CBC Section 11B-502.
6. Tactile warning lines shall be in conformance to CBC Section 11B-247.
7. Traffic Directional Arrows: Paint directional traffic flow arrows in all aisles, and at parking lot entrances and exits.

B. Stripes At Exterior Stairs:

1. Stripes: 2" wide, located 2" from, and parallel to, nosing.
2. Required Locations: All treads, all top landings, all intermediate landings.

END OF SECTION

SECTION 32 18 39

SYNTHETIC TRACK SURFACING

PART I - GENERAL

1.1 SCOPE OF WORK:

CMAS Procurement: The Owner has purchased synthetic track surfacing and all associated line striping direct under separate contract. Beynon and its installation are not part of the bid. This section is for clarification and in coordination with the general contractor's scope of work and project schedules.

- A. It shall be the responsibility of the synthetic track surfacing manufacturer to provide all labor, materials, equipment and tools necessary for the complete installation of the synthetic track surfacing system as indicated on the plans and as specified herein. The installation of all materials shall be performed in strict accordance with the manufacturer's installation instructions and in accordance with all approved shop drawings.
- B. Perimeter edge details required for the system shall be as detailed and recommended by the Manufacturer, and as approved by the Owner. Supply and installation of these details will be under the scope of work of the general contractor based on project plans and are not part of the synthetic track surfacing manufacturer / installer's scope.
- C. The system shall consist of, but not necessarily be limited to, the following:
 - 1. An acceptable subbase including asphalt paving, base rock, concrete curbs and a drainage system to drain the impermeable track surfacing system constructed by the General Contractor per the contract drawings.
 - 2. Beynon BSS 300 Track Surfacing System.

1.2 GENERAL CONTRACTOR QUALIFICATIONS FOR INSTALLING THE DRAINAGE BASE

- A. Installers of the subsurface base system and AC paving for the track shall be required to comply with and supply proof/references to the Owner 10 days post award for the following information:
 - 1. General Contractor installing the base system must have a Class A California Engineering Contractor's License.
 - 2. General Contractor and / or AC paving contractor must have prior direct experience in paving a base for synthetic running track to required tolerances and must have paved a minimum of 5 tracks in California during the past 3 years, with a minimum size of 60,000 SF per track and field event areas.

PART 2 - PRODUCTS

2.1 Beynon BSS 300 Track Surfacing System

Beynon and its installation have been purchased direct via separate CMAS contract.

Contacts for Beynon Sports are Mason Farnsworth and Jeb Burgess; (559) 237-2590

- A. Track surfacing will commence after the completed installation of the FieldTurf synthetic turf and any other trades that need access the track and/or D areas.
- B. Installation of track surfacing including mobilization, prep work, seal layer, force reduction layer, wearing layer and clean up, will require 20 working days.
- C. Track striping will require 4 additional working days by a separate crew.

2.2 TRACK MARKINGS

- A. Standard NFHS and CIF line markings on track oval and event areas are included as well as lettering of school name or nickname on one straight. Minor modifications to the above will be reviewed with owner and will be free of charge. Large logos or extra lettering may be subject to additional charges.

2.3 CLEANING RECOMMENDATIONS

- A. The general contractor shall protect installed track asphalt base from subsequent construction operations during the 28 curing time.
- B. Do not permit traffic over unprotected asphalt prior to track surfacing.
- C. General Contractor shall provide the labor, supplies, and equipment as necessary for final cleaning of asphalt base and installed items prior to track surfacing installation.

PART 3 - EXECUTION

3.1 PROJECT CLOSEOUT

- A. Beynon will train the Owner's facility maintenance staff in the maintenance and care of the new track surfacing.

END OF SECTION

SECTION 32 31 19

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. PVC Chain link perimeter fences.
 - 2. Manually operated swing and sliding gates, including new gate in existing chain link fence.
 - 3. Provide all labor, equipment and materials required for the procurement, fabrication and installation of chain link fences and gates including excavation, reinforcement, concrete materials, chain link fabric, posts and rails, tension wire, swing gates, hardware, and fittings as indicated on the Contract Drawings and as specified herein.
- B. Related work: Division 03 for concrete post footings and for installation of gate track set in concrete.

1.2 SUBMITTALS

- A. Data: Manufacturer product data for fabric, posts and accessories [and wind break].
- B. Shop drawings: Show fence layout, footings size and reinforcement, gate details, and typical elevations.
- C. Samples:
 - 1. Twenty-four-inch square samples of PVC coated chain link fabric.
 - 2. Full-size sample of each type of gate hardware.

1.3 QUALITY ASSURANCE

- A. The applicable provisions of the Chain Link Fence Manufacturers Institute (CLFMI) Product Manual govern the work of this Section.
- B. This requirement does not limit manufacture of the fencing components to CLFMI members.

1.4 HANDLING

- A. Handle and store components to avoid damaging the finish.
- B. Store off the ground in a protected location.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Framework: As detailed on drawings.
- B. Tubular members:
 - 1. Type II: ASTM F 1083, Group IC, having a minimum yield strength of 50,000 psi and an external zinc coating complying with Type B, zinc with polymer film, 0.90 oz./square-foot minimum, or Type D, zinc pigmented, 81 percent nominal coating with 0.30 mils minimum thickness.
- C. Finish: Coat with fusion bonded PVC, of the color selected by the Architect. Apply PVC over cleaned and pre-treated surfaces to a minimum thickness of 10 mils DFT.
- D. Chain link fabric: Complying with CLFMI standards and the following with a Class 1 zinc coating weight classification.
 - 1. One-piece width, 2-inch mesh, 9-gage fencing.

2. Nine-gage elsewhere.
 3. Knuckled edge at both selvages.
 4. Fusion-bonded PVC coating 7 to 12 mils thick, of the color selected by the Architect, complying with ASTM F 668, Class 2B.
- E. Accessories, general: Galvanized and coated with PVC matching the chain link fabric, complying with ASTM A 153, except that the coating weight may comply with the requirements of CFLMI standards for coating thickness.
1. Tension wire: 7-gage high strength steel wire.
 2. Stretcher bars: One-piece length equal to full height of fabric with a minimum cross section of 3/16-inch by 3/4-inch. Provide one stretcher bar for each gate and end post, and 2 for each corner and pull post.
 3. Stretcher bar bands: Heavy pressed steel to secure stretcher bars to intermediate, corner and gate posts.
 4. Post tops: Steel or malleable iron designed as a weathertight closure cap. Design caps with opening to permit passage of the top rail, when rail is provided.
- F. Wire ties: For tying fabric to line posts, use 11-gage steel wire clips spaced 14-inch o.c. For tying fabric to tension wire use 11-gage hog rings.
- 2.2 GATES Manual doors, doorways and manual gates intended for user passage shall comply with section 11B-404.2
- A. Fabricate gate frames of welded steel tubes in compliance with ASTM F 900. Provide additional horizontal and diagonal members to ensure that gates stay square and operate properly, and for attachment of fabric, hardware and accessories.
- B. Weld gate frames:
1. Use same fabric as for fencing, installed with stretcher bars at vertical edges.
 2. Tie fabric to top and bottom edges. Attach stretcher bars to gate frame at not more than 15 inches o.c.
 3. Attach hardware with rivets or by other means that will provide security against removal and breakage.
- C. Provide manufacturer standard galvanized heavy-duty hardware.
1. For swinging gate provide the following:
 - a. Hinges: One pair of steel hinges, non-lift-off type offset to permit 180-degree gate opening.
 - b. Latch: Designed to provide operation from either side of gates and equipped with padlock eye.
 - c. Keeper: Designed to automatically engage and hold the leaf open until manually released.
- 2.3 GROUNDING MATERIALS
- A. Connectors and Grounding Rods: Listed and labeled for complying with UL 467.
- B. Connectors for Below-Grade Use: Exothermic welded type.
- C. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions and measurements affecting the work of this Section at site.
- B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

- A. General: Comply with ASTM F 567 and the following.

- B. Posts: Provide corner, end, and intermediate posts. Erect posts plumb and level, in straight alignment, and set in concrete footings. Support and brace until concrete sets.
 - C. Post cap: Provide on each post.
 - D. Tension wire: Install before stretching fabric and tie to each post with ties or clips.
 - E. Fence fabric:
 - 1. Install within 2-inch of grade or paving on security side of fencing and on inside of tennis courts and anchor to framework so that fabric remains in tension after pulling force is released.
 - 2. Pull taut and tie to posts, rails, and tension wire.
 - F. Stretcher bars: Thread through fabric and secure to posts with steel bands.
 - G. Gates: Install plumb, level, square, free of rack and secure for full opening without interference. Adjust hardware for smooth operation.
- 3.3 BRACING
- A. Brace gates, corner, end, and pull posts to the nearest post with a horizontal brace used as a compression member and a diagonal truss rod and truss tightener used as a tension member.
- 3.4 TOUCHUP
- A. Touchup damaged PVC coating with matching air-drying materials, when the results are acceptable to the Architect; otherwise remove and replace damaged components.

END OF SECTION

SECTION 32 84 10

SYNTHETIC TURF COOL-DOWN SYSTEM

PART 1 - GENERAL

1.1 SCOPE:

A. Principal work of this Section:

1. Supply all work and materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with furnishing, delivery, and installation of Landscape Irrigation System, complete, as shown on the Drawings and/or as specified herein.
2. Work noted as "N.I.C.", "existing", or "by others" is not a part of this Section.
3. Definitions, guarantees, submittals, cleanup, as-builts and all other applicable requirements of Division 1 apply to the work of this section.
4. The principal items of work included in this section, but not exclusively, are:
 - a. Complete synthetic turf field cooling spray system including trenching and backfilling for all pipes and valves, providing all mains, laterals, and risers, fittings, gear driven heads, quick couplers, special function manual control timing device, low voltage electric wiring, and all necessary specialties and accessories.
 - b. Connection to an existing back flow protected main line leading from the nearby existing booster pump.
 - c. Providing all sleeves beneath walkways, roads, and driveways where required whether shown on the drawings or not.
 - d. Clearing, testing, and adjusting of the system.
 - e. Guarantees.

1.2 REQUIREMENTS

- A. The work of this Section shall be coordinated with all underground utilities and trades responsible for their installation and with all related work in other sections.

1.3 QUALITY ASSURANCE

- A. Permits & Fees: Obtain and pay for all permits and inspections required by outside agencies.
- B. Ordinances and Regulations: Local, municipal, and state laws, and rules and regulations governing or relating to any portion of this work are hereby incorporated into and made part of these specifications, and their provisions shall be carried out by the Contractor. Anything contained in the specifications shall not be construed to conflict with any of these rules and regulations or requirements of the same. However, when the

specifications and drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by these rules and regulations, the provisions of the specifications and drawings shall take precedence.

- C. Underwriters Laboratories: Electrical wiring, controls, motors, and devices shall be U.L. listed, and so labeled.
- D. Installer Qualifications (for solvent and rubber gasket joints): Each person shall be trained by the manufacturer's representative in techniques for making correct joints prior to performing work on the site.
- E. Manufacturer's Directions: Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturers used in this Contract furnish directions covering points not shown in the drawings and specifications.
- G. Work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications.

1.4 SUBMITTALS

- A. Provide the following submittals for review and approval: Provide a minimum of four copies unless otherwise directed.
 - 1. Materials Lists (see paragraph 1.5 below)
 - 2. Record Drawings (see paragraph 1.6 below)
 - 3. Controller Charts (see paragraph 1.8 below)
 - 4. Operating & Maintenance Manuals (see paragraph 1.9)
 - 5. Check List (see paragraph 1.10 below)
 - 6. Guarantee (see paragraph 1.11 below)
 - 7. Maintenance Tools (see paragraph 2.16 below)

1.5 MATERIALS LISTS

- A. Prior to installation of any work, prepare a detailed list of each material proposed for use in the project and submit to Architect for approval. Prepare typewritten material list using the following format. Double space between each item.

ITEM NO.	DESCRIPTION	MANUFACTURER	MODEL NO.

1.	Pressure	Pac. Western	Class 315 PVC supply lines
2.	Gear Head	Hunter I-90	
3.	Etc.	Etc.	Etc.

- B. If equipment is as specified, no manufacturer descriptive catalogs are necessary in submittal.

1.6 RECORD DRAWINGS (AS BUILTS)

- A. Maintain up to date complete "as-built" record set of drawings which shall show every change from the original drawings and exact as-built locations, sizes, and kinds of equipment.

1. Maintain information daily. Keep drawings at the site at all times and available for review by the Architect and or District's Representative.
 2. Record all required information on a set of prints of the Drawings. Do not use these prints for any other purpose.
 3. Record all changes which are made from the Contract Drawings, including changes in the pressure and non-pressure lines.
- B. These drawings shall also serve as work progress sheets and shall be the basis for measurement and payment for work completed.
- C. Record dimensioned locations and depths for each of the following:
- D. Locate all dimensions from two permanent points (buildings, monuments, sidewalks, curbs or pavements).
- E. When record drawings have been approved by the Architect, transfer all information to a clean set of base drawings using permanent ink.
1. Make dimensions accurately at the same scale used on original drawings, or larger. If photo reduction is required to facilitate controller chart housing, notes or dimensions must be a minimum 1/4 inch in size.
- F. Reproducible prints will be furnished by the Architect at cost for printing and handling.
- G. Use appropriate white-out fluid for removing original lines and dimensions where changes are made. Completed reproducible shall be equal in quality and legibility to the original drawings.
- H. Submit "as-built" drawing to the Landscape Architect for approval prior to making controller charts.

1.7 SUBSTITUTIONS

- A. Substitutions of any product, material, or equipment without the prior written approval of the Landscape Architect and or District's Representative will not be permitted.
- B. Refer to Division 1 requirements for substitution approval procedure.

1.8 CONTROLLER CHARTS

- A. Do not prepare charts until record drawings have been approved by the Landscape Architect and or District's Representative.
- B. Provide one controller chart.
1. Chart may be a reproduction of the Record Drawing, if the scale permits fitting the controller door. If photo reduction prints are required, keep reduction to maximum size possible to retain full legibility.
 2. Chart shall be blackline print of the actual as built system.

- C. Identify the area of coverage of each valve-in-head gear head using a distinctly different pastel color, drawn over the entire area of coverage.
- D. Following approval of charts by Landscape Architect and or District's Representative the chart shall be hermetically sealed between two layers of 20 mil thick plastic sheet.
- E. The chart must be completed and approved prior to final review of irrigation system.

1.9 OPERATING AND MAINTENANCE MANUALS

- A. Provide individually bound manuals detailing operation and maintenance requirements for the irrigation system.
- B. Provide four copies of each manual.
- C. Provide the following in each manual:
 - 1. Index sheet, stating Irrigation Contractor's name, address, telephone number and name of person to contact.
 - 2. Duration of the guarantee period.
 - 3. Equipment list providing the following for each item:
 - a. Manufacturer's name
 - b. Make and model number
 - c. Name and address of local manufacturer's representative
 - d. Spare parts list in detail
 - e. Detailed operating and maintenance instructions for major equipment.

1.10 CHECK LIST

- A. Provide a signed and dated checklist and deliver to the Architect and or District's Representative prior to final review of the work.
- B. Use the following format:
 - 1. Plumbing permits: if none required, so note.
 - 2. Material approvals: approved by and date.
 - 3. Pressure line tests: by whom and date.
 - 4. Record drawings: received by and date.
 - 5. Controller charts: received by and date.
 - 6. Maintenance Equipment furnished: received by and date.
 - 7. Operation and maintenance manuals: received by and date.
 - 8. System and equipment operation instructions received by and date.
 - 9. Manufacturer's warranties if required: received by and date.
 - 10. Written guarantee: received by and date.

1.11 GUARANTEE

- A. Guarantee the irrigation system to provide service as designed and installed for a period of one year from date of acceptance by Landscape Architect and or District's Representative.
- B. Correct all problems which develop in the system due to faulty materials or workmanship during the guarantee period.

- C. Repair or replace such work as directed by the Landscape Architect and or District's Representative.
- D. Make repairs and replacements promptly when notified.
- E. The District reserves the right to make temporary repairs during the guarantee period as necessary to keep systems in operating condition without voiding the Contractor's guarantee, nor relieving the Contractor of his responsibilities.
- F. All repairs and replacements shall match original installation in every way.
- G. Provide a written guarantee for each segment of the project, using the following format to be retyped on the Contractor's letterhead:

"GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

We hereby guarantee that the sprinkler irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse or neglect excepted. We agree to repair or replace any defects in material or workmanship which may develop during the period of one year from the date of acceptance and also to repair or replace any damage resulting from the repairing or replacing of such defects at no cost to the Owner. We shall make such repairs or replacements within a reasonable time, as determined by the Owner, after receipt of written notice. In the event of our failure to make such repairs or replacements within a reasonable time after receipt of written notice from the Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT: _____

CONTRACTOR: _____ PHONE NO: _____

ADDRESS: _____ BY: _____

_____ TITLE: _____

DATE OF ACCEPTANCE: _____ BY: _____ "

1.12 PRODUCT HANDLING

A. Storage:

1. Store materials at a location as directed by the District's Representative.
2. Store materials in an orderly manner. Avoid interference with other construction activities.

B. Protection:

1. Protect all materials to prevent intrusion of dirt and moisture. Do not store PVC material in direct sunlight.
2. Protect the installed work and materials of other trades.

PART 2 - PRODUCTS

2.1 GENERAL PIPING

- A. Lines 2-1/2 inch and larger downstream of backflow preventer: class 315 PVC solvent weld type, or (as a Contractor option) rubber gasket type, unless otherwise noted on the drawings.
- B. Lines 2 inches and smaller downstream of backflow preventer: schedule 40 PVC.

2.2 PLASTIC PIPE:

- A. Identification Markings: Identify all pipe with the following indelible markings:
 - 1. Manufacturer's name
 - 2. Nominal pipe size
 - 3. Schedule or class
 - 4. Pressure rating p.s.i.
 - 5. NSF seal of approval
 - 6. Date of extrusion
- B. Pipe (solvent weld type): manufactured from virgin poly-vinyl chloride in accordance with ASTM D-1784 or ASTM D-2241, cell classification 12454B; hydrostatic design stress rating not less than 2000 p.s.i.
- C. Rubber Gasket PVC Pipe, Couplings and Fittings:
 - 1. Pipe: ASTM D-1784, Type 1, Grade 1, 2000 pound design stress, class 200.
 - 2. Couplers and Fittings: Sch 80 injection threaded outlets shall be required, with stainless steel bands and support gussets. All tees and ells supported with an angle brace as a part of fitting. Similar in all respects to those manufactured by Flo-Seal.
- D. Fittings (solvent weld type): Schedule 80 injection molded PVC. Comply with ASTM D-1784, cell classification 13454B.
 - 1. Threads (where required): Injection molded type.
 - 2. Tees and Ells: side gated.
- A. Threaded Nipples: Standard weight, Schedule 80 PVC with molded threads.
- B. Fittings (2" through 4") slip type may be used, but must be similar in all respects to those manufactured by Cal Am Manufacturing Company and installed in accordance with their recommendations.

2.3 JOINT CEMENT AND PRIMER

- A. Non-pressure plastic pipe and fittings (lateral lines) shall be cemented using a 100% active solvent, blue in color.
- B. Pressure plastic pipe and fittings (main line) shall be coated with a primer and then with a 100% active solvent.

- C. Both primer and solvent shall be similar in all respects to that manufactured by Christy's, or approved equal.

2.4 ELECTRICAL WIRING AND SERVICE

A. High Voltage:

- 1. All connections between electrical services and equipment shall be in rigid galvanized electrical conduit, with conduit and wiring size as required.

B. Low Voltage:

- 1. Connections between controller and remote control valves shall be made with direct burial AWG-UF, 600 volt wire, insulation thickness 3/64 inch, utilizing low density, high molecular weight polyethylene insulation.
- 2. Splices, where permitted, shall be waterproofed using Rain Bird, Pen-Tite Connectors or fusible heat shrink tubing, and housed in a plastic box.
- 3. Wire sizing shall be according to Manufacturer's recommendations, in no case less than #14, unless a shielded cable is used in which case #18 wire may be used.
- 4. Ground (common) wire shall be white in color. All others shall be a different color.

2.5 BACKFLOW PREVENTER

- A. Existing backflow preventer.

2.6 COACHE'S SWITCH TIMER

- A. Type: Special purpose mechanically adjusted timing device capable of on-demand start, timed operation of each valve-in-head head, Green Product Sales Top Entry Controller Assembly ICA6 Series or approved equal. Assembly shall be as specified on the Drawings and shall be capable of operating the number of stations.

B. Features:

- 1. Individual manual start button for each station including a station active run light.
- 2. The controller shall be mounted within a stainless steel, vandal resistant enclosure and pedestal. Metal conduit shall run from the 117 volt supply to the controller housing. All power within the housing shall be properly phased. A pre-wired terminal strip shall be provided clearly indicating the proper points of connection of all appropriate wiring.
- 3. Fuse and chassis ground all controller components.
- 5. Provide heavy duty exterior grade padlock and (4) keys for each stainless steel cabinet.

2.7 GATE VALVES

- A. 3" and larger: 125 psi, iron body, bronze mounted, bolted bonnet, non-rising stem, double disc, parallel seat, hub end for PVC, nut operated. AWWA specifications, Walworth 719F

or Kennedy 573X, or equal.

2.8 QUICK COUPLING VALVES

- A. Two piece type brass body, 150 pound class, with 1 inch female threads opening at base, permitting operation with a special connecting device (coupler).
 - 1. Coupler Threads: Lug type.
 - 2. Hinge Cover: Provide with rubber-like vinyl cover.

2.9 GEAR DRIVEN TURF HEADS

- A. Heads shall be similar in all respects to types noted in legend on drawing.

2.10 THRUST BLOCKS

- A. Thrust Blocks: 3000 psi concrete at 28 days.

2.11 OPERATING AND MAINTENANCE TOOLS

- A. Deliver the following items to the District when work is completed and prior to final acceptance of work:
 - 1. Six wrenches for disassembly and adjustment of sprinkler head.
 - 2. Two keys coach's timer enclosure.
 - 3. Three couplers and matching hose swivels with globe valves.
 - 4. Six keys for opening valve boxes.

PART 3 - EXECUTION

3.1 UTILITY SERVICES

- A. Contractor shall connect to water service at location shown on the drawing and make any minor changes in location necessary due to actual site conditions as a part of this contract.

3.2 REMOVALS, SALVAGE AND MODIFICATIONS

- A. Prior to starting work, confer with District's Representatives to discover potential problem areas and locations of points of joining between the removal work and existing system to remain in service. Also identify locations of shut-off valves for all emergencies. Immediately reconnect existing service beyond the site irrigation system, should removal or modifications affect the service.
- B. No shut-downs shall be made without prior approval of the District. Requests for shut-downs shall include date, time and the period of time for shut-down. Requests shall be made a minimum of three (3) working days prior to the requested shut-down.
- C. Replace or repair, to the satisfaction of the District's Representative, all existing paving or

landscaping disturbed during the course of this work. New paving and landscaping shall be of the same type, strength, texture, and finish and be equal in every way to the material removed. Repair work shall be done at no additional cost to the District. All existing irrigation systems serving adjacent planted areas shall remain operational throughout all capping and abandoning of existing irrigation mainlines.

- D. All sprinkler heads, valves, and equipment within the limits of work shall be salvaged and signed over to the District. Piping shall not be abandoned in place. Piping removed shall be legally disposed of off the site.
- E. All connections made from the new work to the existing system shall be recorded on the Record Drawings. All other utility lines, site drainage lines, etc. found and which are to be saved shall also be recorded.

3.3 SITE REVIEW

- A. Before any work commences, a conference shall be held with the Landscape Architect and or District's Representative and Contractor regarding general requirements of this work.
- B. Contractor's Responsibility:
 - 1. Notify the Landscape Architect and or District's Representative for the following reviews, with 48 hour minimum notice except as noted:
 - a. Main line installation and testing
 - b. System layout
 - c. Controller location
 - d. Control wire installation
 - e. Coverage tests prior to planting
 - f. Final inspection - minimum 7 day notice required.
 - 1. Provide up-to-date as built drawings at each review.
- C. Examine site for conditions that will adversely affect execution, permanence, and quality of work.
 - 1. Verify that grading has been completed and the work of this section can properly proceed.
 - 2. Exercise extreme care in excavating and working near existing structures, utilities, underground piping and conduits, and over waterproofing membrane. Contractor is responsible for damages which are caused by his operations or neglect. Check existing utility drawings for locations.
 - 3. Determine locations of points of connections to all piping installed by others, and determine that pressure supply is available for work of this Section.
- D. Notify the Landscape Architect and or District's Representative in writing, describing unacceptable conditions. Do not proceed with work until unacceptable site conditions are corrected or existing utilities are located.

3.4 LAYOUT

- A. All piping or equipment shown diagrammatically on the drawing under paved shall be located under unpaved areas whenever possible.
- B. Lay out each sprinkler head and make any minor adjustments required due to differences between actual site conditions and the Drawings. Minor adjustments shall be maintained within the original design intent.
- C. Lay out each system using staking method as approved by Landscape Architect and or District's Representative. Maintain and protect approved staking layout.

3.5 TRENCHING

- A. Excavate trenches to required depths. Follow approved layout for each system.
- B. Trench bottom shall be flat to insure piping is supported continuously on an even grade.
- C. Where lines occur under paved areas, consider dimension to be below the subgrade.
- D. Provide minimum coverage as follows:
 - 1. Lines 3 inch and smaller: 18 inches.
 - 2. Main Lines 4 inches and larger: 24 inches
 - 3. All Lines under synthetic turf: 30 inches.
 - 4. Control Wires: 18 inches.

3.6 LINE CLEARANCES

- A. Provide not less than 4 inches clearance (horizontal and vertical) between each line and not less than 6 inches clearance between lines of other trades, unless otherwise noted.
- B. Do not install parallel lines directly over any other line.

3.7 BACKFILLING

- A. Buried pipe in trenches shall be center loaded only until all required tests are performed.
- B. Initial Backfill: Clean, fine granular material as approved by the Landscape Architect and or District's Representative. No foreign matter or stones larger than 1/2 inch will be permitted.
- C. Compact trench backfill to a dry density equal to adjacent undisturbed soil. Restore to adjacent grade, free of dips, depressions, humps or other irregularities.
 - 1. Where acceptable soils exist, the Landscape Architect and or District's Representative may authorize flooding in lieu of tamping.
 - 2. Compaction by truck or other vehicle is not permitted.

3.8 INSTALLATION

- A. All plastic pipe and fittings shall be installed in complete accord with manufacturer

instructions.

- B. Routing of sprinkler lines as indicated on the Drawings is diagrammatic. Install lines and assemblies to conform to details on the plan.
- C. Installation of Piping:
 - 1. Provide concrete thrust blocks at each change in direction and at all terminal points for all rubber gasket piping and/or all piping larger than 3 inches. Block in accordance with pipe manufacturer's instructions and as detailed on the drawings.
 - 2. Plastic Pipe with Threaded Fittings: Assemble using teflon tape applied to male threads only.
 - 3. All PVC pipe and fitting shall be thoroughly cleaned of dirt, dust and moisture prior to installation. Installation and solvent welding methods shall be as recommended by the pipe & fitting manufacturer.
 - 4. Tape all open ends of pipe to prevent entry of any foreign matter into the system.
 - 5. On PVC to metal connections, the Contractor shall work the metal connections first. Use teflon tape on all threaded PVC to metal joints.
- D. Install all specified assemblies in accordance with the Drawings. In absence of detail drawings or specifications pertaining to specific items required to complete the work, perform such work in accordance with best standard practice, as approved by the Landscape Architect.
- E. All major equipment shall be verified for exact location with the District's Representative before installation.
 - 1. Quick Coupling Valves: Unless otherwise indicated, locate valves within 12 inches of a walkway.
- F. Sprinkler Heads: All sprinklers shall be installed flush with finish grade unless otherwise noted.
 - 1. Spacing of heads shall not exceed the maximum shown on the drawings.

3.9 EXISTING PAVEMENTS

- A. Piping under existing pavements may be installed by jacking, boring, or by hydraulic driving, except as otherwise specified or directed.
- B. Secure District's permission prior to cutting or breaking existing pavements.
- C. Make completely clean cuts using power saws, at approved locations only.
- D. Replace and restore all surfaces to original condition, including grade and landscaping. Restoration work shall match the original work in every respect, including type, strength, texture and finish.

3.10 NEW PAVED AREAS

- A. Coordinate installation of piping and wires under paved areas with General Contractor.
- B. The installing contractor may (but is not required to) install sleeves for future installation of water lines and wires.
- C. If the only piping installed is over 20 feet long, pressure testing is required for that section at the time of installation. Upon completion of piping installation, the entire system must be tested.
- D. If wires under paved areas cannot be continuous, all splices must be enclosed in an approved box.

3.11 LOW VOLTAGE WIRING

- A. Place wiring in the same trench and along the same routing as the main lines unless otherwise approved.
 - 1. Install wiring prior to main line whenever possible.
 - 2. When more than one wire is placed in a trench, tape wires together at maximum intervals of 12 feet.
- B. Provide a 12 inch expansion loop at each connection and at each change in direction.
- C. Use a continuous wire between controller and remote control valves.
 - 1. Except as otherwise approved, do not splice wire at any point.
 - 2. All approved splices shall be enclosed in an acceptable box.
- D. Each controller shall be provided with separate ground (common) wire, white in color.

3.12 SYSTEM FLUSHING

- A. After all sprinkler pipes and risers are in place and connected, and prior to installation of sprinkler heads, thoroughly flush all lines with a full head of water.
- B. Do not install sprinkler heads until lines have been flushed to the satisfaction of the Landscape Architect and or District's Representative.

3.13 SYSTEM ADJUSTMENT

- A. Heads: Adjust for alignment and coverage.

3.14 PRESSURE TESTS

- A. Provide all equipment necessary to test systems, including force pump.
- B. Perform all hydrostatic tests in presence of the District's Representative.
- C. Test all main lines under hydrostatic pressure of 150 p.s.i. for a period of 2 hours, unless otherwise required and approved. Pressure drop over test period shall be zero p.s.i.

- D. Do not backfill over any line more than is necessary for testing, until it has been inspected, tested and approved.
- E. Do not install remote control valves, quick couplers or any other valve assembly until testing is completed and approved.

3.15 OPERATING INSTRUCTIONS

- A. Train the District's maintenance personnel in proper operation of all major equipment. Arrange for training by manufacturer's representatives for controller operation.
- B. Provide this training at the District's convenience.
- C. Submit written evidence that training has been successfully completed.

3.16 CLEANUP

- A. Upon completion of the work, restore ground to required elevations and remove excess materials, debris, and equipment from the site to the satisfaction of the District's Representative.

END OF SECTION

SYNTHETIC SPORTS TURF BASE

SECTION 32 95 00

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Synthetic turf drain bed, perforated pipe sub-drains, and synthetic turf system edge anchorage.

1.2 QUALITY ASSURANCE

- A. Contractor qualifications:
 - 1. Installers of the synthetic turf base system shall:
 - a. Possess a Class A California Engineering Contractor's License.
 - b. Have prior direct experience in preparing a drainage base for synthetic turf sports fields and must have installed a minimum of 10 such base systems in California during the past 3 years.
- B. Changes & Substitutions:
 - 1. The contractor shall strictly adhere to the procedures outlined under this Section. Any variance from these requirements will only be accepted by the College upon acceptance in writing by the synthetic turf contractor onsite representative, verifying that the changes do not in any way affect the synthetic turf warranty.
- C. Synthetic Turf Warranty Requirements:
 - 1. Completed Work of this section shall comply with the following:
 - a. Compaction of sub-grade: minimum 95% Modified Proctor density.
 - b. Planarity of sub-grade: tolerance of one inch (1") in ten feet (10').
 - c. Compaction of aggregate base: 92%-95% Modified Proctor density.
 - d. Surface tolerance of aggregate base: not to exceed 1/4 inch over 10 feet and 1/2" from design grade.
- D. Coordination:
 - 1. Coordinate locations of connections to storm drainage system with piping installed by others.
 - 2. Coordinate work with installation of underground piping beneath synthetic turf and with installation of field appurtenances such as cool-down heads, electrical outlets in synthetic turf and other items required by Contract Documents.

1.3 FIELD QUALITY CONTROL & ACCEPTANCE OF WORK

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
 - 1. Tests shall include compaction testing of sub-grade, finish grade and each lift of synthetic turf base, measured at a minimum of 8 locations randomly spaced across the surface of each field.
 - 2. The Independent Testing Agency shall also test aggregate base material upon delivery to the job site to verify that material meets the specified gradation & permeability requirements. Every 10th load to be tested on site.
 - 3. Testing agency will test compaction of soils & base materials in place according to ASTM D 1556, ASTM D 1557, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.

- B. Independent testing agency results verifying compliance with compaction & permeability requirements shall be supplied to the synthetic turf contractor prior to the commencement of synthetic turf installation.
- C. Contractor shall submit Synthetic turf installer's written acceptance of planarity & compaction of synthetic turf base to the College prior to start of the synthetic turf installation.
- D. Materials and Work not conforming to specified requirements shall be promptly removed, replaced and reinstalled as part of the work of this section.

1.4 SUBMITTALS

- A. Contractor Qualifications.
- B. Product Data: Submittals required:
 - 1. Aggregate base material including sieve size analysis & source.
 - 2. Impermeable Fabric Membrane.
 - 3. Perforated Pipe Sub-drainage pipe & fittings.
- C. Samples: Submittals required:
 - 1. Impermeable Fabric Membrane.

PART 2 - PRODUCTS

2.1 IMPERMEABLE FABRIC MEMBRANE

- A. Impermeable fabric membrane.
 - 1. Hercushield 2400, or approved equal
In-Line Plastics, LC.
8615 Golden Spike Lane
Houston, Texas 77086
Phone: (800) 364-7686 or (281) 272-1660

2.2 PERFORATED PIPE SUBDRAINS

- A. Initial piping, rectangular section:
 - 1. Basis of Design: 1" x 12" ADS AdvanEDGE rectangular perforated pipe, or equal.
 - a. Complying with ASTM D7001.
 - b. Pipe and fittings made of polyethylene with minimum cell classification of ASTM D3350 class 424420C.
 - c. Nominal pipe size 1" x 12".
 - d. Outside dimensions approximately 1 1/2" x 13".
 - e. Water Inlet Area approximately 15 sq.in per lineal foot of pipe.
 - f. Supply with integral external geotextile wrap provided by pipe manufacturer.
 - 2. Fittings compatible with pipe, as recommended by pipe manufacturer.
- B. Collector piping, round section:
 - 1. As specified in Storm Utility Drainage Piping.

2.3 CRUSHED AGGREGATE STRUCTURAL BASE

- A. Material to be open graded, fractured friction course that provides adequate mechanical stability and compaction for athletic field applications.
- B. Installed drainage properties to exceed 14" per hour of vertical water passage.
- C. Material to be clean washed with minimal fines as described in gradation table below.

- D. Material to be 100% fractured with at least one mechanical fracture per particle greater than 1/4" sieve size.
- E. Comply with the gradation criteria for the California Department of Transportation 3/4" Permeable Class II (Section 68):

Mesh Size	<u>% Passing</u>
1"	100
3/4"	90-100
3/8"	40-100
#4	25-40
#8	18-33
#30	5-15
#50	0-7
#200	0-3

- 1. Acceptable local sources:
 - a. Vulcan Materials Company, Western Division, Carroll Canyon: "Turf Perm 40% 3/4"CR, 20% 1/2"CR, 20% 3/8"CR, 20% FS-30"
 - b. FST Sand & Gravel, Corona, California tel.(951) 277-8440 "Class II Permeable Base"
 - c. Other sources complying with specified requirements.
- 2. Soft limestones and shale materials are not acceptable.
- 3. Questionable materials shall be tested at the Contractor's expense using a sulfate soundness test (ASTM C-88) and LA Abrasion Test (ASTM C-131).

Test Method	<u>Criteria</u>
Sulfate Soundness (ASTM C-88)	Not to exceed 12% Loss
LA Abrasion (ASTM C-131)	Not to exceed 40

2.4 PERIMETER CURBING AND TURF FABRIC ATTACHMENT

- A. Freeform trench-dug concrete curb wall.
 - 1. Curb finish where exposed.
 - 2. Concrete as specified in Division 3, requirements for footings.
- B. Fabric nailer board.
 - 1. Recycled plastic polymer landscape board, 2 x 4 nominal.
- C. Fence footings where required.

PART 3 - EXECUTION

3.1 PREPARATORY WORK

- A. Examination of Site:
 - 1. Examine site for conditions that will adversely affect execution, permanence, and quality of work.
 - 2. Verify that underground utility & irrigation piping below sub-grade of synthetic turf base has been completed and the work of this section can properly proceed.
 - 3. The Contractor shall be responsible to close and cover, in a manner acceptable to the Owner, any existing basins, which the Owner determines to be detrimental to the function of the new artificial turf field.

3.2 EXCAVATION & SUB-GRADE PREPARATION

- A. Sub-grade of base material shall be sloped of at a minimum grade of 0.5% towards perforated pipe subdrains as shown on the drawings.
- B. Trench sub-grade locally as required to achieve design slopes on sub-drain collector pipes.
- C. Compaction:
 - 1. After sub-grade has been properly graded, contoured and sloped as required, compact soil materials to not less than the following percentages of maximum dry unit weight according to Modified Proctor procedure, ASTM D 1557:
 - a. Under synthetic turf, scarify and recompact top 12 inches of existing subgrade to 95 percent.
- D. Tolerances:
 - 1. Compacted sub-grade shall conform to required elevations within a tolerance of one inch (1") in ten feet (10').

3.3 IMPERMEABLE FABRIC MEMBRANE

- A. The prepared soil subsurface is to be isolated from the installed field and drainage system above it with an impermeable fabric membrane placed across the entire surface of the field. This ensures no mixing of the soil sub surface with the aggregate drainage system, and keeps water from infiltrating into existing soils with high clay content.
- B. The membrane is to be additionally draped and formed into the collector pipe drainage trenches to ensure non-penetration of surrounding soil.
- C. Place membrane on subgrades free of mud, frost, snow, or ice.

3.4 PERFORATED PIPE SUBDRAINS

- A. Install prefabricated one inch by twelve inch (1" x 12") rectangular initial collector pipe sub-drains in a "V" design over impermeable fabric membrane with lines approximately twenty feet (20') on center as shown on the drawings.
 - 1. Minimum slope of rectangular pipe shall be as indicated on the drawings.
 - 2. Use connectors as recommended by the manufacturer.
- B. Install round section collector pipe as shown on the drawings.
 - 1. Methods and testing in accordance with Section 334100.
 - 2. Connect 1" x 12" lines using appropriate connectors, as recommended by manufacturer.
 - 3. Minimum slope of pipe shall be as indicated on the drawings.
- C. Connect to storm drainage utility system at locations and elevations as shown on the civil drawings.
- D. Protect installed piping from damage during construction activities, especially vehicular traffic & compaction processes.
 - 1. Piping with torn or otherwise damaged geotextile sleeves shall be rejected.

3.5 PERIMETER CURBING AND TURF FABRIC ANCHORAGE

- A. A continuous perimeter concrete header, either exposed or concealed as shown on plans, is required around the entire perimeter of all synthetic turf areas.
- B. Install free form concrete headers in accordance with the requirements of Division 3 and as detailed.
- C. Attach 2 x 4 recycled polymer composite nailer boards to concrete headers using glue and 3/8 inch diameter anchor bolts at 24 inches on center maximum spacing.

1. Polymer composite 2x4 nailer boards will serve as the attachment surface for the synthetic turf fabric.
2. Nailer boards shall be continuous around entire perimeter of all synthetic turf areas.
3. Top of 2x4 nailer boards shall be 1-1/2 inches from the top of exposed headers.

3.6 INSTALLATION OF BASE

- A. Place structural base materials in layers not more than 8 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.
 1. Minimum nominal compacted thickness of base layer: 4 inches.
- B. Place materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact structural base materials to the following percentages of maximum dry unit weight according to ASTM D 1557:
 1. 92 minimum-95% maximum.
 2. Over compaction of the stone base will not be tolerated.
- D. The finished grade of the aggregate base shall not vary more than a quarter of an inch ($\frac{1}{4}$ ") in ten feet (10') and $\frac{1}{2}$ " from design grade. A laser grader must be used to meet these requirements.

3.7 FIELD BOXES

- A. Install field boxes as required for all field appurtenances such as irrigation cool-down heads, quick coupler valves, electric outlets, etc. as specified elsewhere and as detailed.
- B. Backfill around field boxes with structural base material and compact backfill using methods approved by the Geotechnical Engineer.
 1. Required compaction percentages around field boxes shall match requirements for structural base.

3.8 FIELD QUALITY CONTROL

- A. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent work only after test results for previously completed work comply with requirements.
- B. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace materials to depth required; recompact and retest until specified compaction is obtained.

3.9 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 329500

DIVISION 33

UTILITIES

SECTION 33 11 00

WATER DISTRIBUTION

NOTE TO CONTRACTOR: 48 HOURS NOTICE IS REQUIRED PRIOR TO THE START OF ANY WORK TO BE PERFORMED IN THE PUBLIC RIGHT-OF-WAY.

WATER SERVICE NOTE: WATER SERVICE MUST BE MAINTAINED TO ALL USERS WITHIN THE CONSTRUCTION AREA AT ALL TIMES. IF THE PRIMARY SOURCE OF WATER IS INTERRUPTED, A TEMPORARY SECONDARY SOURCE SHALL BE SUPPLIED BY THE CONTRACTOR, APPROVED BY THE LOCAL WATER DEPARTMENT. ANY EXPENDITURES INCIDENTAL THERETO SHALL BE BORNE BY THE CONTRACTOR. THE WATER SHALL BE SAFE FOR DRINKING IN ACCORDANCE WITH PUBLIC HEALTH SERVICE DRINKING WATER STANDARDS.

PART 1 - GENERAL

1.1 SUMMARY

- A. This section describes general requirements, products, and methods of execution relating to domestic water and fire water systems. Unless otherwise noted, this section does not apply to irrigation water systems and water systems inside of buildings.
- B. Contractor shall furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing and piping and including the demolition and removal of certain equipment, piping and appurtenances all as required and as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.
- C. Section Includes:
 - 1. Piping and specialties for underground domestic water and fire outside the building.
 - 2. Trenching Requirements: Conform to the requirements of Section 31 20 00 Grading.
 - 3. Hydrostatic Pressure, Leakage & Disinfection Testing.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's catalog data for materials. Include technical data for piping, gaskets, joints and couplings, backflow devices, fire department connections, check valves, gate valves, ball valves and valve boxes.
- B. Certificates: Certificates attesting that tests set forth in referenced publications have been performed and the performance requirements have been satisfied.

1.3 LICENSES, PERMITS & FEES

- A. The Contractor installing the water lines shall have a Class "C-34", "C-36" or Engineering "A" Contractors license valid in the State of California.
- B. The Contractor shall obtain all necessary permits, licenses, or agreements required by any legally constituted agency, pay for all fees and give all necessary notices required for the construction of the work.

1.4 QUALITY ASSURANCE

- A. California Plumbing Code, CPC, 2013 Edition.

- B. Comply with NFPA 24, "Standard for the Installation of Private Fire Service Mains and Their Appurtenances," 2013 Edition for materials, installations, tests, flushing, and hydrant supervision.
- C. Comply with NFPA 13, "Standard for the Installation of Sprinkler Systems," 2013 Edition for materials, installations, tests, flushing, and valve and hydrant supervision.
- D. Comply with NFPA 70, "National Electrical Code," for electrical connections between wiring and electrically operated devices.
- E. Comply with the following as a minimum requirement:
 - 1. ANSI:
 - a. ANSI B16.18 Cast Copper Alloy Solder Joint Pressure Fittings.
 - b. ANSI B18.5.2.1M Metric Round Head Short Square Neck Bolts.
 - 2. ASTM:
 - a. ASTM A 47 Ferric Malleable Iron Castings.
 - b. ASTM A 48 Gray Iron Castings.
 - c. ASTM A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - d. ASTM A 307 Carbon Steel bolts and Studs, 60,000 psi Tensile Strength.
 - e. ASTM A 563 Ductile Iron Castings.
 - f. ASTM A 563 Carbon and Alloy Steel Nuts.
 - g. ASTM B 61 Steam or Valve Bronze Castings.
 - h. ASTM B 62 Composition Bronze or Ounce Metal Castings.
 - i. ASTM B 88 Seamless Copper Water Tube.
 - j. ASTM C 94 Ready-Mixed Concrete.
 - k. ASTM D 1527 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80.
 - l. ASTM D 1785 Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - m. ASTM D 2235 Solvent Cement for ABS Plastic Pipe, and Fittings.
 - n. ASTM D 2241 PVC Plastic Pipe Fittings, Schedule 40.
 - o. ASTM D 2282 ABS Plastic Pipe.
 - p. ASTM D 2466 PVC Plastic Pipe Fittings, Schedule 40.
 - q. ASTM D 2468 ABS Plastic Pipe Fittings, Schedule 40.
 - r. ASTM D 2564 PVC Plastic Piping Systems.
 - s. ASTM D 2774 Underground Installation of Thermoplastic Pressure Piping.
 - t. ASTM D 2855 Making Solvent-Cemented Joints with PVC Pipe and Fittings.
 - u. ASTM D 3139 Joints Pressure Pipes Using Flexible Elastomeric Seals.
 - v. ASTM F 402 Safe Handling Of Solvent Cements, Primer and Cleaners Used for Joining Thermoplastic Pipes and Fittings.
 - w. ASTM F 477 Elastomeric Seals for Joining Plastic Pipes.
 - 3. American Water Works Association (AWWA) Standards:
 - a. AWWA C104/A21.4 Cement-Mortar Lining For Ductile-Iron Pipe and Fittings For Water
 - b. AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings, 3 inches through 48 inches, for Water and Other Liquids.
 - c. AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron pressure Pipe and Fittings.
 - d. ASTM C151/A21.51-96 Ductile-Iron Pipe, centrifugally cast, for water 3 inches through 64 inches.
 - e. AWWA C153/A21.53 Ductile-Iron Compact Fittings, 3 inches through 16 inches, for Water and Other Liquids.
 - f. AWWA C500 Gate Valves for Water and Sewerage Systems.
 - g. AWWA C503 Wet-Barrel Fire Hydrants.
 - h. AWWA C508 Swing-Check Valves for Waterworks Service, 2 inches through 24 inches NPS.
 - i. AWWA C509 Resilient-Seated Gate Valves for Water and Sewerage Systems.

- j. AWWA C511 Reduced-Pressure Principal Backflow-Prevention Assembly.
 - k. AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - l. AWWA C651 Disinfecting Water Mains.
 - m. AWWA C800 Underground Service Line valves and Fittings.
 - n. AWWA C900 PVC Pressure Pipe, 4 inches through 12 inches, for Water Distribution.
 - o. AWWA M23 PVC Pipe - Design and Installation.
4. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry:
- a. MSS-SP-80 Bronze Gate, Globe, Angle and Check Valves.
 - b. MSS-SP-73 Silver Brazing Joints for Wrought and Cast Solder-Joint Fittings.
5. Uni-Bell PVC Pipe Association (UBPPA):
- a. UBPPA UNI-PUB-9 Installation of PVC Pressure Pipe.
 - b. UBPPA UNI-B-13 Standard Performance Specification on joined restrained devices for use with Poly Vinyl Chloride (PVC) Pipe.
6. Underwriters Laboratories Inc. (UL):
- a. UL 246 Hydrants for Fire-Protection Service.
 - b. UL 262 Gate Valves for Fire-Protection Service.
 - c. UL 312 Check Valves for Fire-Protection Service.
 - d. UL 789 Indicator Posts for Fire-Protection Service.
- F. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("Green Book"), Latest Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications".

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate with other utility work.

1.6 PRODUCT HANDLING

- A. Store items above ground on platforms, skids or other approved supports.
- B. Deliver piping with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.
- D. Handling: Use sling to handle valves and fire hydrants whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use hand wheels or stems as lifting or rigging points.
- E. Protect coating and linings on pipes, fittings and accessories from damage. Do not drag pipe to trench. Repair coatings or linings damaged.

1.7 DISPOSAL OF REMOVED MATERIALS INCLUDING ASBESTOS-CEMENT PIPE

- A. All removed materials, except those indicated on the plans or described herein to remain the property of the Owner, shall become the property of the Contractor and shall be disposed in accordance with local, state, and federal laws. Should any of those materials be considered as hazardous the Contractor shall provide the Owners Inspector with paper custody trail documentation of the disposal.
- B. Asbestos — Cement (A-C) Pipe Removal and Disposal: The plans for the project may indicate that existing asbestos-cement pipe is to be removed from the ground. The Contractor shall excavate, expose the pipeline and remove the A-C pipe to the nearest joint. Should the plans not call out the removal of the A-C pipe and A-C pipe is encountered, the Contractor shall obtain approval from the

Inspector as to whether or not the A-C pipe is to be removed or can be left in place. Cutting of the pipe shall only be done if absolutely there is no other way to expose the length of pipe to the nearest joint that be separated and the Inspector approves the cutting of the pipe. Cutting of the pipe shall be done with a mechanical saw with a pressure water source to dampen the pipe and the dust from the cutting. To remove a coupling, the coupling may have to be broken in the trench. The pipe once removed from the trench may be broken for handling. The breaking shall be done within a plastic bagging or sheeting material to minimize the release of asbestos fibers into the atmosphere. Once removed and broken, if necessary, the A-C material shall be bagged and disposed of legally with the Inspector to be given a copy of all Contractor paperwork as to the legal disposal of the material. If the A-C pipe section(s) are removed intact the pipe can be removed by the Contractor from the project site and become the property and responsibility of the Contractor.

1.8 DRAWINGS

- A. Because of the small scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his acceptance. Only when Architect's acceptance is given, in writing, shall Contractor proceed with installation of the work.
- C. In case of a difference in the specifications or drawings, or between the specifications and the drawings or in the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.9 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.10 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid confliction and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

1.11 INSPECTION

- A. Notice shall be given to the Owner's Inspector at least 48 hours before starting construction.

- B. Contractor shall not allow or cause any of his work to be covered up before it has been duly inspected, tested and approved by the Owner, Architect or any other authorized inspectors having legal jurisdiction over his work. Should he fail to observe the above, he shall uncover the work and, after it has been inspected, tested and approved, recover it at his own expense.
- C. Inspection of the work shall not relieve the contractor of any obligations to complete the work as prescribed by the standard specifications. Any known defective work shall be corrected before testing or final inspection will be permitted. Unsuitable materials may be rejected even if these materials have been previously overlooked by the Inspector.
- D. The Owner shall have the authority to suspend the work completely or in part for such time as it may deem necessary if the contractor fails to carry out instructions given by the Owner, or to perform any required provisions of the plans and specifications. The contractor shall immediately comply with a written order of the Owner to suspend the work completely or in part. The work shall be resumed when improper methods or defective work are corrected as ordered and approved in writing by the Owner.

1.12 SUBSTITUTIONS

- A. The Contractor assumes full responsibility that alternate manufacturers, items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures which ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates were selected without proper regard to the requirements of the job, will not be approved. No more than one proposed alternate will be considered for each item.
- B. This Contractor is responsible to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.
- C. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials and decisions of the Architect or that of his representative shall be final and conclusive.

1.13 RECORD DRAWINGS

- A. Contractor shall provide and keep up-to-date a complete "as-built" record set of redline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe:
 - 1. Water Distribution Main (pipe size 4 inches and larger).
 - a. Ductile Iron Pipe (DIP): Pressure Class 350 pipe conforming to AWWA/ANSI C151/A21.5, cement-mortar lining conforming to AWWA/ANSI C104/A21.4, with standard thickness per AWWA/ANSI C150/A21.50. U.S. Pipe, American Cast Iron Pipe Company (ACIPCO), or approved equivalent.
 - b. Polyvinyl Chloride Pipe (PVC): Pressure Class 235, DR 18, spigot and gasket bell end, conforming to AWWA C900, with equivalent cast-iron pipe outer diameter (O.D.). Acceptable manufacturers: J-M Manufacturing Blue Brute, Vinyl Tech, Diamond Plastic, PW Pipe, or approved equal.

2. Water Distribution Main (pipe size 3 inches and smaller).
 - a. Copper tubing with diameters 2-1/2" and 3" shall be seamless copper tube, Type K 'hard', drawn temper, meeting ASTM B 88 bearing NSF Standard 61 approval.
 - b. Copper tubing up to 2" diameter, use Type K 'soft', annealed temper, ASTM B 88. Muller Brass, Cambridge-Lee Halstead, or equal.
- B. Fittings:
1. All fittings for Iron Pipe Size pipe shall be manufactured in one piece of injection molded PVC compound meeting ASTM D1784. Fittings shall be Class 315 and conform to requirements of SDR 13.5. Fittings shall be designed to withstand a minimum of 630 psi quick burst pressure at 73 degrees F., tested in accordance with ASTM D1599.
 2. Wrought Copper, Solder-Joint Pressure Fittings: Solder type ANSI B 16.18. Note: Pipe, solder, and flux shall be lead-free for drinking water. Flux shall be an approved water-soluble material. Fittings for compression type joints shall conform to ASME B16.26 flared tube type.
 3. Ductile Iron: Ductile iron fittings shall be supplied in accordance with AWWA Standard C110, "Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. for Water and Other Liquids", or AWWA Standard C153, "Ductile Iron Compact Fittings, 3 In. Through 24 In for Water Service". All fittings shall have mechanical joints unless otherwise specified on Construction Plans.
 - a. Mechanical joints shall conform to the requirements of AWWA Standard C111, "Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings."
 - b. Flanged fittings shall conform to the requirements of AWWA Standard C110 or C153. Flanges shall be drilled to ANSI 816.1, 125 lb standard bolt template. The 250 lb. Flanges, when required, shall be drilled to ANSI B16.1, 250 lb. standard bolt template.
 - c. Where restrained joints are indicated on the plans, push-on "Tyton" joints shall be restrained with "Field-Lok" gaskets as manufactured by U.S. Pipe or approved equal.
 - d. Ductile iron pipe fittings shall be manufactured or supplied by American Ductile Iron Pipe (a division of American Cast Iron Pipe Company, Birmingham, Alabama), U.S. Pipe & Foundry Company, Tyler Pipe/Union Foundry, Griffin Pipe Products Company, Sigma Corporation, Star Pipe Products Co., or approved equal.
- C. Gaskets for Ductile Iron Pipe:
1. Gaskets for Ductile Iron Pipe: Gaskets for flanged joints shall be full faced, cut from 1/8 inch thick Nitrile Rubber (Buna-N), bolt holes pre-punched, conforming to the requirements of ANSI /ASME B16.2.1. Gaskets shall be manufactured or supplied by Tripac Fasteners, Long Beach Industrial Gaskets, or approved equal.
- D. Soldered Filler Metal: Meeting ASTM B 32, Alloy Sn95.
- E. Brazing Filler Metal: Meeting AWS AS.8, BCuP-5, Silver Solder 1000 degrees F, Silvaloy 15, or equal.
- F. Soldering Fluxes: ASTM B813, liquid or paste type.
- G. Brazing Fluxes: ANSI/AWS AS.31, Type FB3-A or FB3-C. The use of brazing flux is not necessary if the components being joined are wrought copper tube.
- H. Corporation stops shall be ground key type manufactured of bronze conforming to ASTM B61.
- I. PVC & Mechanical Pipe Couplings, Joints and Jointing Materials:
1. PVC C-900 Pipe: joints shall be integral, bell and spigot gasketed joints.
 - a. Provide each PVC C-900 Pipe joint connection with an elastomeric gasket suitable for the bell or coupling installation.
 - b. An elastomeric gasket shall be designed with a retainer ring which "locks" the gasket into integral bell groove and shall be installed at the point of manufacturer. Gasket shall be in conformance with ASTM F477.

- c. Gaskets for push on joints and compression type joints or mechanical joints for connections between pipes and metal fittings, valves, and other accessories shall be as specified in AWWA C111/A21.11.
 - d. Solvent weld joints are NOT PERMITTED.
- 2. Joints between pipe and metal fittings, valves, and other accessories shall be mechanical joints as specified in AWWA C111/A21. 11 unless otherwise noted on Construction Documents.
- J. Lining and Coating for Ductile Iron & Fittings:
 - 1. The interior of all ductile iron pipe and fittings shall be factory cement mortar lined in accordance with AWWA Standard C104. Lining materials shall conform to ASTM C-150, Type II.
 - 2. All buried ductile iron pipe and fittings shall have a factory applied bituminous coating of not less than 1 mil in thickness as specified in AWWA C151. The coating shall be free from blisters and holes; shall adhere to the metal surface at ambient temperatures encountered in the field.
 - 3. Cement mortar lining and bituminous coating of pipe or fittings in the field is not permitted.
- K. Bolts and Nuts for Mechanical Joints, Flanged Fittings, Flexible Couplings & Restraint Devices:
 - 1. All bolts and studs shall be Type 316 Stainless Steel per ASTM A193 Grade B8M, project ends of bolts 1/4 to 3/8 inch beyond nut.
 - 2. All nuts and washers shall be Type 316 Stainless Steel per ASTM A194 Grade 8M, provide 1 washer per nut.
 - 3. All exposed flanges and other metal surfaces and all damaged coatings shall be coated after assembly with a mastic, Minnesota Mining and Manufacturing EC 244, Koppers Bitumastic (Super-Tank) 505, or an approved equal.
 - 4. Stainless steel parts shall not be coated except for the threaded portion, which will be assembled with a liberal coat of anti-seize compound.
 - 5. All bolts shall be lubricated with anti-seize compound.
- L. Gate Valves:
 - 1. Gate valves 2-1/2" or larger: Resilient seated gate valves shall be ductile iron and coated with a fusion bonded epoxy. Gate valves shall have non-rising stems (NRS) and shall be manufactured to meet or exceed the requirements of AWWA Standard C509, with fully encapsulated disk. The following parts of the valve shall be made of ductile iron: bonnet, body, yoke, wrench nut, O-ring packing plate or seal plate, gland follower, and gate. Omit valve handle and furnish with 2-inch operating unit.
 - a. Approved gate valve manufacturer / model:
 - 1) American AVK Series 25
 - 2) American Flow Control Series 2500
 - 3) Clow F-6100
 - 4) Kennedy 4571
 - 5) Mueller A-2360
 - 6) M & H Valve Company
 - b. All gate valves shall be provided with a stem extension if depth of valve nut exceeds 3 feet from top of nut to finished surface. All valve extensions shall be centered in the valve well by use of a guide and shall operate freely without binding after installation. All valves shall open by turning the wrench nut left (counter-clockwise).
 - c. Gate valves must be U.L. Listed & FM approved: minimum of 200psi.
 - d. All gate valves shall be wrapped with 3 layers of 8-mil polyethylene.
- M. Ball Valves:

1. Ball valves 2" or smaller: Ball valves shall be silicon performance bronze alloy, Lead-Free, rated 600 psi, two-piece, threaded ends, full port, manufactured in accordance with MSS SP-110.
 - a. Approved ball valve manufacturer / model: Nibco T-585-66-LF.
- N. Valve Boxes, Risers and Lids for Buried Valves:
 - a. Valve boxes and cover shall be as shown on the plans.
 - b. Valve riser material, where applicable, shall be 10-inch Schedule 80 PVC, or 10- inch SDR 35 PVC pipe
 - c. Valve boxes shall be marked "WATER" embossed above surface.
- O. Thrust Restraining Materials: All pipe bends and tees 2.5-inches and greater shall be restrained from movement by either the use of concrete thrust blocks or mechanical joint restraints. Restraint systems to be used on PVC C-900 pipe shall meet or exceed A.S.T.M. Standard F1674-96, "Standard Test Methods for Joint Restraint Products for Use with PVC Pipe," or the latest revision thereof. Restraint systems used on ductile pipe shall meet or exceed U.L. Standard 194. Underwriter Laboratories (U.L.) and/or Factory Mutual (FM) certifications are required on all restraint systems. All mechanical restraint devices shall be wrapped with 3 layers of 8-mil polyethylene after assembly.
 1. Mechanical Joint Fittings:
 - a. Restrainer mechanism shall be integrated into the design of the follower gland. As the mechanism is activated, multiple wedging action shall be imparted against the pipe increasing its resistance as internal pressure increases. After burial of the restraining mechanism, joint flexibility shall be maintained. The actuating bolt shall be threaded into the restraining wedge and have a 1-1/4" across the flats hex head. The actuating bolt system shall have a torque-limiting head designed to break off at preset torque levels, thus insuring proper action of the restraining device. After removal of the torque-limiting head, a 1 1/4" hex head shall remain to facilitate the removal and re-assembly of the gland. Glands shall be manufactured of high strength ductile iron in accordance with ASTM A536, Grade 65-45-12 requirements. Wedge mechanisms shall be heat- treated ductile iron, hardened to at least 370 BHN hardness. The restraining mechanism shall have a pressure rating equal to that of the pipe on which it is used and shall have a safety factor of at least 2:1. The restraining gland shall conform to the requirements of ASTM F 1674, and UNI-B-13-94, "Recommended Performance Specification For Joint Restraint Devices For Use With Polyvinyl Chloride (PVC) Pipe."
 - b. The following qualified product list identifies specified manufacturers models approved for installation in this water distribution system:

Manufacturer	PVC C-900 Pipe	Ductile Iron Pipe
EBBA Iron Sales, In	2000 PV	Megalug 1100
Romac Industries, In	Romagrip PVC	Romagrip DI
Star Pipe Products	Stargrip 4000	Stargrip 3000
Uni-Flange Corporation	Series 1500	Series 1400
2. Bell and Spigot Harness:
 - a. Restraint Devices for bell and spigot joints of PVC Pipe shall consist of split restraint rings, one installed on the spigot, connected to one installed on the pipe barrel behind the bell. The restraint devices shall incorporate a series of machined serrations (not "as cast") on the inside diameter to provide positive restraint, exact fit, 360° contact and support of the pipe wall. Restraint Devices shall be of ductile iron, ASTM A536, Grade 65-45-12 and connecting rods shall be of high strength, low alloy material in accordance with ANSI / AWWA C111/A21.11 unless specified as stainless steel in these specifications.

- b. All Restraint Devices shall have a water working pressure rating equivalent to the full rated pressure of the PVC Pipe they are installed on, with a minimum 2:1 safety factor in any nominal pipe size. In addition, they shall meet or exceed the requirements of Uni-8-13-94, "Recommended Performance Specification For Joint Restraint Devices For Use With Polyvinyl Chloride (PVC) Pipe." Notarized certification from the manufacturer of the restraint device shall be provided with submittals.
- c. The following qualified product list identifies specified manufacturers models approved for installation in this water distribution system:

<u>Manufacturer</u>	<u>PVC C-900 Pipe</u>	<u>Ductile Iron Pipe</u>
EBBA Iron Sales, In	1600 Series	1700 Series
Romac Industries, In	611 Series	611 Series
Star Pipe Products	1100 Series	Not Approved
Uni-Flange Corporation	Series 1390	Not Approved

3. Push-On Pipe Bells & Plain End Pipe: Where restrained joints are indicated on the Construction Drawings for ductile iron pipe, push-on joints shall be restrained with "Field-Lok 350" gaskets as manufactured by U.S. Pipe or approved equal. "TR-Flex" restrained joint pipe as manufactured by U.S. Pipe or approved equal is also an acceptable option for restrain of push-on joints. Restrained push-on joint pipe and fittings shall be capable of being deflected after assembly.
4. Flange Adapters:
 - a. Flange Adapters shall be manufactured from ductile iron per ASTM A536, Grade 65-42-12 and shall have bolt circles and bolt holes to meet ANSI B16.1 — Class 125 or Class 250 if required and shown on plans.
 - b. The following qualified product list identifies specified manufacturers models approved for installation in this water distribution system

<u>Manufacturer</u>	<u>PVC C-900 Pipe</u>	<u>Ductile Iron Pipe</u>
EBBA Iron Sales, In	2100 Series	2100 Series
Romac Industries, In	Not Approved	Field Flange
Star Pipe Products	Not Approved	Series 200
Uni-Flange Corporation	Not Approved	Series 200/400/420

5. Concrete: Concrete for thrust blocks shall conform to Concrete Class 520-C- 2500. If thrust block is to be disturbed or backfill is to be placed prior to developing its required strength, additional mechanical thrust restraining devices approved by the Civil Engineer shall be installed.
- P. Polyethylene Encasement Film Wrap: All ductile iron pipe and fittings buried underground shall be protected with double wrapped plastic film in accordance with AWWA C105 "American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems" and each wrap shall be a minimum thickness of 0.008 in. (8 mils). All joints between plastic tubes shall be taped and secured with general purpose polyethylene tape, 2 inches wide and 10 mils thick (Scotchrap No. 50, Plicoflex No. 340, Protecto Wrap No. 200, Polyken No. 900, or approved equal).
- Q. Sleeve-type Flexible Transition & Flanged Couplings:
1. Sleeve-type couplings shall be in accordance with ANSI/AWWA C219 - Standard for Bolted Sleeve-type couplings for Plain-End Pipe, and shall be of stainless steel or ductile iron with stainless steel bolts, without pipe stop, and be of sizes to fit the pipe and fittings indicated. The middle ring shall be not less than 1/4-inch in thickness and shall be either 5 of 7 inches long for sizes up to and including 30 inches and 12 inches long for sizes greater than 30 inches, for standard steel couplings, and 16 inches long for long-sleeve couplings. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings, and of sufficient strength to accommodate the number of bolts necessary to obtain

- adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket.
2. Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," Grade 60, or equivalent suitable elastomer.
 3. The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D2000 Classification System for Rubber Products in Automotive applications, AA709Z, meeting Suffix B13 Grade 3. All gaskets shall be compatible with the piping service and fluid utilized.
 4. Bolts, nuts, & washers for couplings shall meet the requirements listed in Section 2.1K, herein. All cast components shall be fusion bonded epoxy coated per AWWA C213. After installation couplings shall be wrapped with 8-mil polyethylene wrap per AWWA C-105 and section 2.1M requirements listed herein.
 5. Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket, which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.
 6. All sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be in accordance with the AWWA M11 standard, or as indicated.
 7. The following qualified product list identifies specified manufacturers models approved for:

Straight & Transition Couplings

Romac Industries, Inc.:	Style "501"
Ford Meter Box Co.:	Style "FC1" or "FC2A"
Smith-Blair:	400 Series
JCM Industries:	200 Series
Dresser	Style 62 or 162

Flanged Coupling Adapters

Romac Industries, Inc.:	Style "FCA 501" or "FC400"
Ford Meter Box Co.:	Style "FFCA"
JCM Industries:	300 Series
Smith-Blair:	Style "913"
Dresser	Style 227

R. Backflow Protection Device:

1. Provide backflow preventers as shown on the Construction Documents. Subject to local water purveyor approval.
2. All devices must be approved by the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research (USC Foundation).
3. Double Check Detector Assemblies (DCDA): Provide a cast-iron body DCDA consisting of mainline double check assemblies in parallel with a bypass double check and meter assembly, two shut-off valves and four test cocks. DCDA shall be tamper-proof and conform to AWWA C510. Febco Model LF876V or approved equivalent.
 - a. rises Inc. No. 2 valve box with cast iron cover, marked "SEWER" Edwards 71007 Safety Red. Apply paint after all testing and disinfection has passed, but prior to final acceptance by the Utility or Inspector.
4. Reduced Pressure Principle Assemblies (RPPA): Provide a cast-iron body RPPA consisting of two independently operating check valves with a pressure differential relief valve located between the two check valves, two shut-off valves and four test cocks. RPPA shall be tamper-proof and conform to AWWA C511.

5. Backflow prevention assemblies (devices), shall be tested and certified by a certified backflow tester, and a test report shall be provided to the water agency having jurisdiction. Testing shall be performed in the presence of the IOR.
- S. Check Valves: Valves shall have clear port opening and a cast-iron body. Provide spring-loaded or weight-loaded valves where indicated on the Construction Documents
 1. For the fire water system, UL-Listed & FM approved, ASTM A 126 Class B cast-iron body and bolted bonnet with flanged end connections; bronze disc and seat; and having 200 psig rating.
 - a. Approved models: "Nibco" Model F-908-W or "Clow Valve Company" Style 106.
 - b. Paint one coat Dunn Edwards Versaprim 42-44 and two coats Dunn Edwards 71007 Safety Red. Apply paint after all testing and disinfection has passed, but prior to final acceptance by the Owner.
- T. Control Valve Supervisory Switch.
 1. Provide U.L. Listed and FM approved, Notifier Series NIP supervisory switch for Post Indicator Valve Assembly. The mechanism shall be contained in a red baked enamel, weatherproof housing and shall incorporate the necessary facilities for attachment to the valve. The switch mechanism shall have a minimum capacity of 1 ampere, 125 volts a-c. The entire installed assembly shall be tamper proof and arranged to cause switch operation if the housing cover is removed or if the unit is removed from its mounting. Install supervisory switches where shown on drawings and provide all wires and conduits required from supervisory switch to the fire alarm panel in building.
- U. Tapping Sleeve and Tapping Valve: Complete assembly, including tapping sleeve, tapping valve, and bolts and nuts. Use sleeve and valve compatible with tapping machine.
 1. Tapping Sleeve: Cast- or ductile-iron, 2-piece bolted sleeve with flanged outlet for new branch connection. Sleeve may have mechanical-joint ends with rubber gaskets or sealing rings in sleeve body. Include sleeve matching size and type of pipe material being tapped and of outlet flange required for branch connection

PART 3 - EXECUTION

3.1 CLEARANCES OF WATER LINE

- A. Buildings: 3 feet.
- B. Parallel to Sewer Line:
 1. Water lines 4 inches or less in diameter shall not be installed in a common trench with the building sanitary drain unless the bottom of the water line is at least 12 inches above the top of the building sanitary drain or where the water line is installed on a solid shelf excavated on one side of the common trench with a minimum clear horizontal distance of 12 inches from the building sanitary drain.
 2. Water mains larger than 4 inches in diameter shall be separated from the Project site sanitary sewer, receiving more than one building sanitary drain or acid pipeline, in accordance with the requirement of the State of California, Human and Welfare Agency, Department of Health Services.
- C. Crossing Sewer Line:
 1. A water main shall be separated from sanitary sewer in accordance with the requirements of the State of California Administrative Code, Title 22, Section 64630(e)(2), unless modified herein.
 2. Install water main a minimum of 12 inches clear, above or below a sanitary sewer.
 3. A water main greater than 4 inches in diameter, crossing under a sanitary sewer line, shall be installed with all their joints located at least 10 feet away from each side of the sanitary sewer line.

4. A water main greater than 4 inches in diameter, crossing over a sanitary sewer line, shall be installed with all their joints located at least 5 feet away from each side of the sanitary sewer line.

- D. Install all water mains no closer than 10 feet horizontally clear from the edge of sewage leach fields, seepage pits and septic tanks.

3.2 LAYING OF DUCTILE IRON PIPE

- A. Acceptable line and grade for piping: The pipe shall be laid true to the line and grade shown on the plans within acceptable tolerances. The tolerance on grade is 1 inch. The tolerance on line is 2 inches. Grade shall be measured along the pipe invert.
- B. Installations of pipe and fittings shall be in accordance with AWWA Standard C600, "Installation of Ductile-Iron Water Mains and Their Appurtenances" and the pipe manufacturer's installation manual. The DIPRA Publication "Guide for the Installation of Ductile Iron Water Mains" shall be used for details of pipe installation practice except as follows and where noted otherwise on plans. Maximum deflection per joint for 8-inch thru 12-inch pipe is 3 degrees; minimum laying radius for 18 feet pipe lengths is 345 feet. Maximum deflection per joint for 16-inch pipe is 2 degrees; minimum laying radius for 18 feet pipe lengths is 520 feet.
- C. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe-laying crew cannot put the pipe into the trench and in place without getting soil into it, the Engineer may require that before lowering the pipe into the trench, a temporary plug be placed over each end and left there until the connection is to be made to the adjacent pipe. During the laying operations, no debris, tools, clothing or other materials shall be left in the pipe.
- D. At times when pipe laying is not in progress, the open ends of pipe shall be closed by watertight plug or other means approved by the Engineer. This provision shall apply during the lunch-hour breaks as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.
- E. The cutting of pipe for inserting tees, fittings or closure pieces shall be done in a neat workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. No pipe shall be laid in water or when, in the option of the Engineer trench conditions are unsuitable. Field welding of Ductile Iron Pipe for repair or for joining is prohibited.
- F. Until thrust blocks and supports are poured, fittings shall be temporarily supported by placing wooden skids under the bells so that the pipe is not subjected to the weight of the fitting.
- G. Fittings shall be supported independently of the pipe.

3.3 LAYING OF COPPER PIPE

- A. Contractor shall follow the "Guide Specification for Copper and Copper Alloy Building Piping Systems", Revision 1, by the Copper Development Association Inc, available at: http://www.copper.org/pub_list/plumbing.html
- B. Soldered Joints: For copper tubing 1 inch and smaller construct joints according to ASTM B828.
- C. Brazed Joints: For copper tubing 1-1/4 inch and larger, for all below and above grade piping, construct joints according to ANSI/AWS C3.4.
- D. All underground copper tubing shall be double polyethylene encased in sleeves, 10-mil minimum thickness, and all openings in the sleeves shall be taped shut with Polyken #900 Tape Wrap or approved equal.
- E. Unions and Flanges: Ground joint, cast bronze unions for sizes 2 inch and smaller, 150- pound flange, cast brass, for sizes larger than 2 inches conforming to ANSI B16.24.

3.4 CONNECTIONS TO EXISTING UTILITIES

- A. All tie-in locations shall be excavated a minimum of TWO (2) working days in advance of final connection to expose the affected portions of existing pipelines and to allow time for the necessary measurements, assembling of materials and equipment, and assuring that all pre-assembled piping and fittings will be compatible with the existing main.
- B. Changes or delays caused by the Contractor's failure to perform "Potholing" and interference location work shall not be eligible for extra work, compensation, or time extension.
- C. The Contractor shall immediately notify the Owner's Inspector in writing, upon learning of the existence or location of any utility facility omitted from or shown incorrectly on the contract drawings, or improperly marked or otherwise indicated. The Contractor shall provide full details as to depth, location, size and function of the utility in writing to the Inspector and note it on the "as-built" plans.
- D. The Contractor shall not interrupt or disturb any utility facility in the public right-of-way without authority from the utility company or order from the Inglewood Water Department.
- E. The Contractor shall furnish and place the necessary protection around a utility when protection is called for on the contract drawings, visible to the Contractor, or marked as such. The Contractor shall install the utility protection at no additional expense to the Owner.
- F. Shutdown of Public Water Mains: All work necessary to shut down an existing public water main for the benefit of a Contractor shall be by local water purveyor personnel and shall require prior approval by the local water purveyor. Unless at the direct supervision of the local water purveyor, under no circumstances shall the Contractor operate valves, hydrants, and other appurtenant equipment on the existing public system. It shall be the Contractor's responsibility to coordinate the necessary shutdown schedules through the Utility Inspector assigned to the project. Scheduled shutdowns shall require sufficient time to allow operations personnel to review, approve, and develop an appropriate Operation Program. The Contractor shall be responsible for maintaining all schedules current and coordinating all deviations which may occur from time to time with the Utility Inspector.

3.5 VALVES

- A. Water valves shall be installed at locations shown on the Construction Drawing, or as directed by the Inspector. Valves shall be set plumb, and shall be stabilized and supported separately from the pipeline. Information regarding size, type, make, and number of turns to close shall be supplied to the Utility. AU valves shall be covered with a valve box assembly. Valve boxes shall be plumb, centered over the valve nut, and supported separately from the valve body. Valve boxes shall be lowered to below paving grade level prior to street paving, and after final grade has been established by the final grade. In any event, Contractor shall ensure that all valve boxes will provide access to the operation of the valve by the Utilities' personnel. Valve boxes shall be flagged or barricaded during construction to divert traffic around their location.
- B. Wrap buried valves, 2'-0" inches and larger, with two layers of 8-mil polyethylene wrap per AWWA C105.
- C. All exposed flanges and other metal surfaces and all damaged coatings shall be coated after assembly with a mastic, Minnesota Mining and Manufacturing EC 244, Hoppers Bitumastic (Super-Tank) 505, or an approved equal.
- D. Stainless steel parts shall not be coated except for the threaded portion, which will be assembled with a liberal coat of anti-seize compound.

3.6 PROTECTION OF METAL SURFACES

- A. All exposed surfaces of the valves, flanges, bolts, nuts, tie-rods, turn buckles, etc. in contact with the earth and backfill materials shall be coated with a minimum of 30 mils of bitumastic coating prior to backfilling. In addition to this bitumastic coating, all iron or steel surfaces such as valves, flanges, bolts, nuts, couplings, shall be encased in 8 mil polyethylene wrapping in accordance with AWWA C105 "American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems".

3.7 ELECTROLYSIS PREVENTION

- A. Insulating (dielectric) couplings or 6-inch long brass nipples shall be installed at locations specified or as required. Dielectric insulators shall be provided to insulate dissimilar metal to metal contact. Flanges shall be provided with a complete insulating component consisting of gasket bolt sleeves and bolt washers. Dielectric insulators shall be installed at locations indicated or as required.
- B. Where steel or cast iron below grade connects to copper or brass piping above grade, the transition from steel or cast iron pipe to copper or brass pipe shall be installed in an above grade accessible location.
- C. Underground dielectric connections shall be in accessible yard boxes.
- D. Above ground dielectric connections shall be exposed.

3.8 PIPELINE FLUSHING & HYDROSTATIC TESTING

- A. General Requirements
 - 1. Hydrostatic testing and disinfecting (chlorination and flushing) of newly laid or repaired pipelines and appurtenances must be completed before the pipelines can be connected to the existing water distribution system. Pipelines and appurtenances shall remain isolated from the existing water distribution system during hydrostatic testing and disinfecting.
 - 2. All services, air release valves, and other appurtenances connected to the newly laid pipeline shall be pressure tested and disinfected at the same time as that of the pipeline. Care shall be taken to expel all air from the pipeline and services during any filling operation.
- B. Temporary Piping and Appurtenances for Flushing, Testing, and Disinfecting
 - 1. The Contractor and/or subcontractor shall supply all temporary piping, corporation and curb stops, test plates, bulkheads, plugs, pipe end caps, valves, fittings, calibrated meters, equipment, labor and method necessary for pressure testing, chlorinating, and flushing of the newly laid pipeline. The Contractor shall also provide any temporary piping, backflow devices, and appurtenances needed to carry potable water to the section of pipeline being flushed, pressure tested, or disinfected.
 - 2. Corporation and curb stop taps used for flushing, pressure testing, and disinfecting shall comply with service tap requirements for ductile iron pipe. Unless specified otherwise, the tap shall be made at the top of pipe.
- C. Private fire service mains and lead-in connections to system risers shall be flushed thoroughly before connection is made to building system piping in order to remove foreign materials that might have entered the main during the course of the installation or that might have been present in existing piping. The minimum rate of flow shall be not less than the water demand rate of the system, which is determined by the system design, or not less than that necessary to provide a velocity of 10 ft/s, whichever is greater. For all systems, the flushing operations shall be continued for a sufficient time to ensure thorough cleaning. The General Contractor & Owner's Inspector shall be present during the flushing.
- D. It is the responsibility of the Contractor to dispose of the flushed water from the project area. The Contractor shall take all precautions necessary in providing for adequate drainage from the site. The disposal of water is described later in this Section.
 - 1. Underground fire mains shall be flushed at the flow rates specified below per N.F.P.A. 24 10.10.2.1.3 according to the maximum pipe size in the line. While conducting the flushing operation, the Contractor shall exercise care that the water does not create any damage. The Contractor shall be responsible for any damage caused by this operation.

Flow required to produce a velocity of 10 ft per second in pipes:

4" — 390 GPM

8"— 1560 GPM

3.9 HYDROSTATIC (PRESSURE) TESTING FOR FIRE PROTECTION SYSTEM

- A. Unless specified differently on the plans or as supplemented herein, hydrostatic testing shall comply with NFPA 24, "Standard for the Installation of Private Fire Service Mains and Their Appurtenances," 2013 Edition. After completion of the hydrostatic testing, the sub-contractor shall fill out the certificate shown in Figure 10.10.1, N.F.P.A. 24, 2013 Edition, located at the end of this specification. The General Contractor & Inspector shall be present during the testing.
- B. Preparation for the Hydrostatic Test
1. All concrete anchor and thrust blocks associated with sections of the pipelines to be tested, shall have cured for a minimum time of 72 hours prior to any flushing or pressurizing of the pipeline. Restrained joints or other methods of pipe support may be used to reduce this time if approved by the Inspector.
 2. The Contractor shall flush the pipeline with potable water to remove dirt and debris. Flushing and disposal of water is discussed elsewhere in this Section.
 3. The amount of pipeline footage to be tested at one time shall be determined by the Inspector and shall not exceed 1,000 feet in length. Test plates (bulkheads), corporation stops, and other temporary facilities required for testing purposes shall be installed at the Contractor's expense. Testing against valves is not permitted unless approved by the Inspector.
 4. Each hydrant and control valve shall be fully opened and closed under system water pressure to ensure proper operation.
- C. Procedures for Hydrostatic Testing
1. Each section of pipeline and all fire hydrants, services, and appurtenances connected thereto, shall be subjected to the hydrostatic test. The pipeline shall be filled with potable water. Care shall be exercised to see that provisions are made for the escape of air at high points and ends of laterals. Contractor shall see that all combination air release valves are open and operating. After the line has been completely filled, it shall be allowed to stand at 40 psi minimum pressure for a sufficient length of time to permit the escape of any pockets of air and allow the mortar lining to absorb the maximum moisture. During this time, all visible pipe, fittings and joints shall be inspected for leakage.
 2. All new private fire service mains shall be tested hydrostatically at not less than 200 psi pressure for two hours or at 50 psi in excess of the maximum static pressure when the maximum static pressure is in excess of 150 psi.
- D. Repetition of Hydrostatic Test
1. If the leakage in the section of pipeline being tested exceeds the maximum allowable rate specified herein, such section will be considered defective. The plumbing contractor shall determine the points of leakage and make the necessary repairs at his expense. The subcontractor will then conduct another hydrostatic test. This procedure shall be continued until the leakage falls below the allowed maximum.
 2. The amount of leakage in buried piping shall be measured at the specified test pressure by pumping from a calibrated container. For new pipe, the amount of leakage at the joints shall not exceed two quarts per hour (1.89L/h) per 100 gaskets or joints irrespective of pipe diameter.
 3. The amount of allowable leakage shall be permitted to be increased by one fluid ounce per inch valve diameter per hour (30 ml / 25 mm/h) for each metal seated valve isolating the test section.
 4. Tests shall be made by the contractor in the presence of the authority having jurisdiction or the representative of the owner. Contractor shall fill out the certificate shown in Figure 10.10.1, N.F.P.A. 24, 2013 Edition, located at the end of this specification.
- E. After Satisfactory Hydrostatic Test

1. All valves shall be tested for leak proof tightness after the pipeline hydrostatic test with the test pressure on one side of the valve and atmospheric pressure on the other side.
2. Regardless of the hydrostatic test results, the Contractor shall repair all detectable leaks.

3.10 HYDROSTATIC (PRESSURE) TESTING FOR DOMESTIC WATER

- A. After completion of the hydrostatic testing, the subcontractor shall provide a signed copy of all test results to the Inspector. The Contractor and Inspector shall be present during the testing.
- B. Test PVC plastic water system in accordance with UBPPA UNI-B-3 for pressure and leakage. The amount of leakage from PVC piping shall not exceed the amounts given in UBPPA UNI-B-3, except that no leakage is permitted for joints installed with sleeve type mechanical couplings.
- C. Test water service lines in accordance with applicable requirements of AWWA C 600. No leakage is permitted
- D. Pressure testing: Before pressure test, fill portion of piping being tested with water for a minimum of 24 hours. Provide hydrostatic pressure of 50 psi greater than the maximum working pressure of tested system. Provide and maintain hydrostatic test pressure for at least 2 hours to ensure no leakage of any portion of piping or appurtenances under pressure test.
- E. Repetition of Hydrostatic Test: If the leakage in the section of pipeline being tested exceeds the maximum allowable rate specified above, such section will be considered defective. The Contractor shall determine the points of leakage and make the necessary repairs at his expense. The subcontractor will then conduct another hydrostatic test. This procedure shall be continued until the leakage falls below the allowed maximum.
- F. After Satisfactory Hydrostatic Test:
 1. All valves shall be tested for leak proof tightness after the pipeline hydrostatic test with the test pressure on one side of the valve and atmospheric pressure on the other side.
 2. After test sections have successfully met the hydrostatic test requirements to the satisfaction of the Inspector, the entire pipeline or each test section shall be filled or shall remain filled with potable water until the pipeline is disinfected. Test plates, corporation stops, and other test facilities shall remain in place if needed for disinfecting or removed as directed by Inspector.
 3. Regardless of the hydrostatic test results, the Contractor shall repair all detectable leaks.

3.11 DISINFECTION PROCEDURES

- A. Fire mains, on private property, from the backflow device to the building fire riser and / or fire hydrant do NOT need to be disinfected.
- B. All potable water lines MUST be disinfected per the following requirements.
- C. The Contractor shall supply all materials, labor, equipment and methods necessary to disinfect the water main. The Contractor shall hire a State certified laboratory to perform the required bacteriological tests for the newly laid pipelines.
- D. Preparation for Disinfecting Pipelines: Contractor shall tightly shut off every service connection served by the pipeline being disinfected at the curb stop before water is applied to the pipeline. Care should be taken to expel all air from the main and services during the filling operation.
- E. Inject solution of liquid chlorine or sodium hypochlorite and water containing at least 50 PPM of free chlorine into a system in a manner to ensure that entire system is completely filled with solution. During this procedure operate valves and test outlets for residual chlorine. Continue injection until outlets indicate at least 59 PPM of free chlorine.
- F. After injection, isolate system and hold solution in retention for a period of at least 8 hours. Perform tests for residual chlorine after retention. If such tests indicate less than 50 PPM of residual chlorine, repeat entire procedure. After satisfactory sterilization has been verified, flush entire system until all traces of chlorine have been removed or until chlorine content is no greater than in existing water supply.

3.12 DISPOSAL OF TEST WATER

- A. The disposal of all water used in flushing, hydrostatic testing, and disinfecting the sections of pipeline shall be the sole responsibility of the Contractor. The disposal of water shall, in all cases, be carried out in strict observance of the water pollution control requirements of the California Regional Water Quality Control Board.
- B. The Contractor shall obtain an NPDES permit and comply with that permit in his discharge of test water.
- C. The Contractor shall apply a reducing agent to the solution to neutralize residual chlorine or chloramines remaining in the water. Additionally, the flow of water from the sections of pipeline shall be controlled to prevent erosion of surrounding soil, damage to vegetation, altering of ecological conditions in the area, and damage to any construction or maintenance activity occurring in any ditch or storm drain downstream of discharge.

3.13 CONNECTING TO EXISTING DISTRIBUTION SYSTEM

- A. Make connections larger than 2-inch NPS (DN50) with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to manufacturer's written instructions.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Install gate valve onto tapping sleeve. Comply with AWWA C600. Install valve with stem pointing up and with cast-iron valve box.
 - 4. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
- B. After all hydrostatic tests and disinfecting has been completed and demonstrated to comply with the Specifications, the Contractor shall connect newly laid pipeline to the existing distribution system.
- C. Where connections are to be made to an existing potable water system, swab or spray the interior surfaces of all pipe and fittings used in making the connections with a five (5) percent or greater hypochlorite solution as directed by the Inspector.
- D. As soon as the connection is completed, thorough flushing is required until all discolored water is removed.

3.14 REMOVAL OF TEMPORARY PIPING AND APPURTENANCES

- A. After the newly laid section of pipeline has been approved by the Inspector for connection to the existing distribution system, the Contractor shall disconnect and remove all temporary piping, fittings, test plates, backflow devices, and other appurtenances used for pressure testing, chlorinating, and flushing.
- B. Contractor shall remove and replace all stops used for testing and disinfecting of the pipeline with stainless steel repair clamps.

3.15 CLEANING

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.16 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.17 CONTRACTOR'S MATERIAL & TEST CERTIFICATE FOR PRIVATE FIRE SERVICE MAINS

Contractor's Material and Test Certificate for Underground Piping			
PROCEDURE Upon completion of work, inspection and tests shall be made by the contractor's representative and witnessed by an owner's representative. All defects shall be corrected and system left in service before contractor's personnel finally leaves the job. A certificate shall be filled out and signed by both representatives. Copies shall be prepared for approving authorities, owners, and contractor. It is understood the owner's representative's signature in no way prejudices any claim against contractor for faulty material, poor workmanship, or failure to comply with approving authority's requirements or local ordinances.			
Property name			Date
Property address			
Plans	Accepted by approving authorities (names)		
	Address		
	Installation conforms to accepted plans		☐ Yes ☐ No
	Equipment used is approved If no, state deviations		☐ Yes ☐ No
Instructions	Has person in charge of fire equipment been instructed as to location of control valves and care and maintenance of this new equipment? If no, explain		☐ Yes ☐ No
	Have copies of appropriate instructions and care and maintenance charts been left on premises? If no, explain		☐ Yes ☐ No
Location	Supplies buildings		
Underground pipes and joints	Pipe types and class		Type joint
	Pipe conforms to _____ standard		☐ Yes ☐ No
	Fittings conform to _____ standard If no, explain		☐ Yes ☐ No
	Joints needing anchorage clamped, strapped, or blocked in accordance with _____ standard If no, explain		☐ Yes ☐ No
Test description	Flushing: Flow the required rate until water is clear as indicated by no collection of foreign material in burlap bags at outlets such as hydrants and blow-offs. Flush at one of the flow rates as specified in 10.10.2.1.3. Hydrostatic: All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi (13.8 bar) or 50 psi (3.5 bar) in excess of the system working pressure, whichever is greater, and shall maintain that pressure ± 5 psi (0.35 bar) for 2 hours. Hydrostatic Testing Allowance: Where additional water is added to the system to maintain the test pressures required by 10.10.2.2.1, the amount of water shall be measured and shall not exceed the limits of the following equation (for metric equation, see 10.10.2.2.6). $L = \frac{SD\sqrt{P}}{148,000}$ L = testing allowance (makeup water), in gallons per hour S = length of pipe tested, in feet D = nominal diameter of the pipe, in inches P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)		
Flushing tests	Now underground piping flushed according to _____ standard by (company) If no, explain		☐ Yes ☐ No
	How flushing flow was obtained ☐ Public water ☐ Tank or reservoir ☐ Fire pump		Through what type opening ☐ Hydrant butt ☐ Open pipe
	Lead-ins flushed according to _____ standard by (company) If no, explain		☐ Yes ☐ No
	How flushing flow was obtained ☐ Public water ☐ Tank or reservoir ☐ Fire pump		Through what type opening ☐ Y connection to flange and spigot ☐ Open pipe

FIGURE 10.10.1 Sample of Contractor's Material and Test Certificate for Underground Piping.

Hydrostatic test	All new underground piping hydrostatically tested at _____ psi for _____ hours		Joints covered ☐ Yes ☐ No
Leakage test	Total amount of leakage measured _____ gallons _____ hours		
	Allowable leakage _____ gallons _____ hours		
Forward flow test of backflow preventer	Forward flow test performed in accordance with 10.10.2.5.2: ☐ Yes ☐ No		
Hydrants	Number installed	Type and make	All operate satisfactorily ☐ Yes ☐ No
Control valves	Water control valves left wide open If no, state reason		☐ Yes ☐ No
	Hose threads of fire department connections and hydrants interchangeable with those of fire department answering alarm		☐ Yes ☐ No
Remarks	Date left in service		
Signatures	Name of installing contractor		
	Tests witnessed by		
	For property owner (signed)	Title	Date
	For installing contractor (signed)	Title	Date
Additional explanation and notes			
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FIGURE 10.10.1 *Continued*

END OF SECTION

SECTION 33 30 00

SITE SANITARY SEWER UTILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Supply and installation of private sanitary sewer system from building wall perimeter, unless noted otherwise, to campus site sanitary sewer point of connection as shown on Construction Documents.
- B. Contractor shall furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all piping and including the demolition and removal of certain equipment, piping and appurtenances all as required and as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.2 RELATED SECTIONS

- A. Trenching Requirements: Conform to the requirements of Section 31 2200 — Grading.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's Catalog data for materials. Include technical data for pipe, gaskets, joints, couplings, manhole, frame, cover, manhole interior coating, and cleanout valve box with lid.
- B. Certificates: Submit manufacturer's certified statement that the pipe has been manufactured and tested in accordance with the applicable requirements of the California Plumbing Code, ASTM, & The Standard Specifications for Public Works Construction.
- C. Contractor is responsible for providing shoring plans to the I.O.R. for approval prior to construction. Excavation shall have sheeting, shoring and bracing conforming to CAL / OSHA requirements. Lateral pressures for design of sheeting, shoring and bracing shall be based on type of soil exposed, groundwater conditions, surcharge loads adjacent to the excavation and type of shoring that will be used.

1.4 LICENSES, PERMITS & FEES

- A. The Contractor shall have a Class "C-34", "C-36", "C-42" or Engineering "A" Contractors license valid in the State of California.
- B. The Contractor shall obtain all necessary permits, licenses, or agreements required by any legally constituted agency, pay for all fees and give all necessary notices required for the construction of the work.
- C. The Owner shall reimburse the contractor for all necessary permits or inspection fees by any legally constituted agency.

1.5 DISPOSAL OF REMOVED MATERIALS INCLUDING ASBESTOS-CEMENT PIPE

- A. All removed materials, except those indicated on the plans or described herein to remain the property of the Owner, shall become the property of the Contractor and shall be disposed in accordance with local, state, and federal laws. Should any of those materials be considered as hazardous the Contractor shall provide the Owners Inspector with paper custody trail (Hazardous Waste Manifest) documentation of the disposal.
- B. Asbestos — Cement (A-C) Pipe Removal and Disposal: The plans for the project may indicate that existing asbestos-cement pipe is to be removed from the ground. Where so indicated the Contractor (Licensed Asbestos Abatement Contractor under an Approved South Coast Air Quality Management District Procedure S Plan) shall excavate with care, expose the pipeline and remove the A-C pipe to the nearest joint. Should the plans not call out the removal of the A-C pipe and A-C pipe is

encountered, the Contractor shall obtain approval from the Inspector as to whether or not the A-C pipe is to be removed or can be left in place. Cutting of the pipe shall only be done if absolutely there is no other way to expose the length of pipe to the nearest joint that be separated and the Inspector approves the cutting of the pipe. Cutting of the pipe shall be done with a Chain Snap Tool using wet methods to control dust (The contractor shall have at a minimum, CA DOSH 8 hour cement pipe training or be a Licenses Asbestos Abatement Contractor). To remove a coupling, the coupling may have to be broken in the trench. The pipe once removed from the trench may be broken for handling. The breaking shall be done within a plastic bagging or sheeting material to minimize the release of asbestos fibers into the atmosphere. Once removed and broken, if necessary, the A-C material shall be bagged and disposed of legally with the Inspector to be given a copy of all Contractor paperwork as to the legal disposal of the material. If the A-C pipe section(s) are removed intact the pipe can be removed by the Contractor from the project site and become the property and responsibility of the Contractor.

1.6 DRAWINGS

- A. Because of the small scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his acceptance. Only when Architect's acceptance is given, in writing, shall Contractor proceed with installation of the work.
- C. In case of a difference in the specifications or drawings, or between the specifications and the drawings or in the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.7 EXAMINATION OF PREMISES

- A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.8 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid confliction and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all

required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

1.10 SUBSTITUTIONS

- A. The Contractor assumes full responsibility that alternate manufacturers, items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures which ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates were selected without proper regard to the requirements of the job, will not be approved. No more than one proposed alternate will be considered for each item.
- B. This Contractor is responsible to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.
- C. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials and decisions of the Architect or that of his representative shall be final and conclusive.

1.11 RECORD DRAWINGS

- A. Contractor shall provide and keep up-to-date a complete "as-built" record set of redline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.12 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 - 1. System Description: Grades and elevations are to be established with reference to the benchmarks referenced on the Plans.
 - 2. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("Green Book"), 2015 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications."
 - 3. California Plumbing Code, CPC, 2013 Edition, Chapter 7.
 - 4. California Administrative Code, Title 22, Section 64630(e)(2).
 - 5. Underwriters Laboratories.
 - 6. American Society of Testing Materials.

1.13 INSPECTION

- A. Contractor shall not allow or cause any of his work to be covered up before it has been duly inspected, tested and approved by the Owner, Architect or any other authorized inspectors having legal jurisdiction over his work. Should he fail to observe the above, he shall uncover the work and, after it has been inspected, tested and approved, recover it at his own expense.
- B. Inspection of the work shall not relieve the contractor of any obligations to complete the work as prescribed by the standard specifications. Any known defective work shall be corrected before testing or final inspection will be permitted. Unsuitable materials may be rejected even if these materials have been previously overlooked by the Inspector.

- C. The Owner shall have the authority to suspend the work completely or in part for such time as it may deem necessary if the contractor fails to carry out instructions given by the Owner, or to perform any required provisions of the plans and specifications. The contractor shall immediately comply with a written order of the Owner to suspend the work completely or in part. The work shall be resumed when improper methods or defective work are corrected as ordered and approved in writing by the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipeline:

1. Project site sanitary sewer.
 - a. PVC Sewer Pipe, ASTM D-3034, SDR-35. The pipe will have a permanently installed reinforced rubber ring gasket in an integral bell joint. PVC Sewer Fittings SDR-35 shall be manufactured in accordance with ASTM Standards D-3034 and F-1336 or F-679. The PVC material shall have a minimum cell classification of 12454-B, 12454-C or 12364-C as defined in ASTM D-1784. Manufactured by J-M, Certainteed, Vinyl Tech, Diamond Plastics Corp, Pacific Western Plastics or approved equal.
 - b. Vitrified clay extra strength with plain end, meeting the requirements of ASTM C 700, installed with mechanical compression couplings. Joints conforming to ASTM C 425. Installation shall be in accordance with ASTM C 12. Manufactured by Mission Clay Products, or equal.
 - c. Acrylonitrile-Butadiene-Styrene Schedule 40 plastic drainpipe and fittings meeting the requirements of ASTM D 2661 and D 3311. Provide ABS solvent cement for piping and joint connections and install in accordance with IAMPO Standards IS 5, 9, and UPC Section 718.
 - d. Cast iron soil, hubless, service weight, with stainless steel-banded hubless coupling. FS WW-P-401, conforms to CISPI 310 and IAPMO IS 6. Manufactured by American Foundry, Tyler, or equal.

B. Cleanout Assemblies: Cleanout plug shall be line size.

1. See Construction Documents for details.

C. Concrete, Mortar and Related Materials: Conform to Section 32 1313: Site Concrete Work.

D. Manhole Brick Mortar, Grout, and Plaster: Conform to Standard Specifications for Public Works Construction, Section 202 - Masonry Materials.

E. Metal Covers, Frames and Accessories:

1. Conform to Section 206 — Miscellaneous Metal Items of the Standard Specifications for Public Works Construction.
2. Metal Covers and Frames: Vandal-resistant design.
3. Hot-dip galvanize all steel parts after fabrication and prior to assembly in accordance with Section 210 — Paint and Protective Coating of the Standard Specifications for Public Works Construction.

F. Yard Boxes:

1. Brooks Products No. 3-RT-CI w/ cast iron cover, marked "SEWER" on top. All metal parts shall be hot-dipped galvanized after fabrication.
2. Eisel Enterprises Inc. No. 2 valve box with cast iron cover, marked "SEWER" on top. All metal parts shall be hot-dipped galvanized after fabrication.

G. Bedding Materials: Conform to the requirements of Section 31 2200 — Grading.

PART 3 - EXECUTION ON PRIVATE PROPERTY

3.1 PIPELINE INSTALLATION

- A. Install pipeline in a practical alignment and uniform slope to the point of connection as indicated on the plans. No trenches shall be sawcut or excavated, nor shall any pipe be laid prior to excavating the point of connection (POC) location to verify the depth is adequate and line size is correct to install the system per the design plans. If deviations occur, report them to the Owner's Representative through a written RFI before commencing.
- B. No pipe shall be laid until the Geotechnical Project Manager inspects and approves the conditions of the bottom of the trench.
- C. Pipe laying shall proceed "up grade" with the spigot section of the bell-and-spigot pipe pointing in the direction of the flow.
- D. Each section of pipe shall be laid true to line and grade and in such a manner as to form an close concentric joint with the adjoining pipe and to prevent sudden offsets in the flow line.
- E. Where invert elevations are indicated, run pipe at a uniform slope between inverts shown.
- F. Join pipes and fittings as recommended by the manufacturer.
- G. All sewer lines & cleanouts shall be staked by a licensed surveyor if slope of grade is less than 2% and a complete set of cut sheets shall be supplied to the Inspector. All construction staking shall be installed and verified for grade and alignment prior to the start of construction.
- H. Refer to ASTM D 2321-00 "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications" or Uni-Bell PVC Pipe Association UNI- PUB-6 "Installation Guide for PVC Solid-Wall Sewer Pipe" for installation information.
- I. Pipe shall not be laid when the condition of the trench or the weather is unsuitable.
- J. The interior of the sewer pipe shall be kept clean of dirt and debris at all times. When work is not in progress, open ends of pipe and fittings shall be plugged.
- K. Where clearing after laying is difficult because of small pipe size, a suitable swab or squeegee shall be kept in the pipe and buffed forward past every joint immediately after joining has been completed.

3.2 CLEARANCES OF SANITARY PIPELINE

- A. Buildings or Structures - 5 feet.
- B. Parallel to Water Line:
 - 1. Building sanitary drain, (that which starts from the building perimeter to existing site sewer) shall not be laid in a common trench with the water line unless the bottom of the water line shall be at least 12 inch above the top of the sewer pipeline.
 - 2. In addition, the water pipe shall be placed on a solid shelf excavated on one side of the common trench with a minimum clear horizontal distance of 12 inch sewer or drain line.
 - 3. Site sanitary sewer (receiving more than one building sanitary drain or acid pipeline) shall be separated from the water line in accordance with the requirements of the State of California, Human and Welfare Agency, Department of Health Services.
- C. Crossing Water Line:
 - 1. Building sanitary drain shall be installed a minimum of 12 inches below the potable water line
 - 2. Site sanitary sewer shall be separated from the water main in accordance with the requirements of the State of California Administrative Code, Title 22, Section 64630(e)(2).

3.3 CLEANOUTS

- A. In general, provide cleanouts at the upper terminal for each sanitary pipeline, at intervals not exceeding 100 feet in straight run and any fraction thereof and for each aggregate horizontal change in direction exceeding 135 degrees. See construction drawings for locations.
- B. Install required cleanouts before horizontal pipelines are covered.
- C. In concrete-paved areas, extend cleanouts flush with finish grade.

- D. In unpaved and asphalt-paved areas, install cleanouts in yard boxes 4 inches below the yard box cover. Gravel fill yard boxes around cleanouts.
- E. In traffic areas, install countersunk cleanout plugs where raised heads protrude.

3.4 PIPE REMOVAL

- A. Contractor shall leave the existing campus sewer lines in place during construction except at service laterals to buildings where they shall be removed and disposed.
- B. Sewer lines which are to remain as abandoned, but have had pipe cut and removed, shall be capped.

3.5 PROTECTION

- A. Where new building sewers are to be connected into a sewer line which is in active use, the CONTRACTOR shall call for such protection as is necessary to prevent construction debris from being washed into the active sewers. Plugged inlets or other suitable protection shall be called for in the active manhole before beginning manhole modifications or tract sewer cleaning.

3.6 FIELD INSPECTION FOR PLASTIC PIPE & FITTINGS

- A. Inspect interior of sewer piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place with the use of closed circuit television (cctv), and again at completion of Project. The final video inspection shall be performed after the successful completion of the air or water pressure test and mandrel test and prior to the certificate of occupancy by the Owner for the new building. All mains and sewer laterals shall be video inspected. The Contractor shall give the Inspector a minimum of 48 hours notice prior to this video inspection. A video tape of the inspected pipeline shall be delivered to the Inspector for approval.
 - 1. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Crushed, broken, cracked, or otherwise damaged piping.
 - c. Infiltration: Water leakage into piping.
 - d. Exfiltration: Water leakage from or around piping.
 - 2. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 3. Re-inspect and repeat procedure until results are satisfactory.
- B. Television Inspection: The entire length of all new sewer pipe shall be inspected using Closed-Circuit Television (CCTV) equipment. The inspection shall be conducted after the line has been successfully installed, covered with bedding material, cleaned (batted) and prior to paving. The inspection shall be conducted in the presence of the I.O.R. All labor and equipment necessary to conduct the CCTV inspection shall be furnished by the Contractor. CCTV inspection shall be per the following.
 - 1. Record the inspection using a four-head, VHS format, video cassette recorder in standard play mode. Deliver the original videotapes, audio commentary, log sheets, and reports to the I.O.R. at the close of the each working day. As desired, the Contractor may produce duplicates for his own use. At the option of the Contractor, or request of the Owner, the video recordings may be converted to MPEG format and copied onto a DVD compatible with Microsoft software.
 - 2. CCTV Equipment: Camera: Remote-controlled, focus from 6" to infinity. Resolution at 450 lines per inch, minimum. During the reinstatement of laterals, only use "rotating lens" or "pan and tilt" cameras. Footage counter: Accurate within +1%. Include the real time counter measurement as a caption on the recorded tape. Use maintenance hole stations and maintenance hole numbers as references. Television monitor: Color, minimum 460 lines per inch resolution. Lighting: Adequate to fully illuminate the pipeline and positioned to not produce glare. Mobility: Capable of steadily traveling with or against the flow. The maximum speed while inspecting and recording is 9 m per minute (30 feet per minute).

3. Quality of CCTV Inspection Record: The recorded video image must clearly show the full circumference of the pipeline, in focus, with adequate lighting to see detail, with uniform and steady travel, and depicting the date and time of inspection, footage of travel, street, project title and pipe size. At laterals, service connections and pipe defects, provide a closer, more detailed examination and document the orientation, location and size. The written records must further describe those laterals, service connections and pipe defects and index them to their location on the video record.
4. Introduce water into the upstream end of the pipe for the required length of time such that the water flow leaving the pipe at the downstream end equals the flow entering the upstream end of the pipe. Discontinue water flow and perform the CCTV inspection of the pipe.
5. If debris is encountered, retrieve the CCTV unit, re-clean the pipeline and resume CCTV inspection. Pipe will be considered acceptable when the video camera records no ponding of water (except in joint recesses) within the pipe, no breaks in the pipe and no openings or breaks at the joints, and the pipe is clean and free of dirt and debris. Remove and replace, or readjust to grade, any pipe failing to meet the acceptable video requirements.
6. At the completion of the video inspection, one copy of the tapes shall be turned over to the I.O.R.

3.7 TESTING OF SEWER PIPE

- A. After installation of sewer pipe testing shall be performed. The piping of the sewer system shall be tested with water or air except that plastic pipe shall not be tested with air. Contractor to follow guidelines set forth California Plumbing Code section 712.0 Testing.

3.8 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 33 40 00

STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The CONTRACTOR shall furnish all materials for concrete in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished concrete, in accordance with the requirements of the Contract Documents.
- B. Supply and installation of campus storm drain system.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's catalog data for all required materials. Include technical data for pipe, drain inlets, catch basins, grates, gaskets, joints and couplings.
- B. Contractor is responsible for providing shoring plans to the Inspector for approval prior to construction. Excavation shall have sheeting, shoring and bracing conforming to CAL/OSHA requirements. Lateral pressures for design of sheeting, shoring and bracing shall be based on type of soil exposed, groundwater conditions, surcharge loads adjacent to the excavation and type of shoring that will be used.

1.3 RELATED SECTIONS

- A. Trenching Requirements: Conform to the requirements of Section 31 2200 — Grading. Samples: Samples for each door face material in specified finish.

1.4 QUALITY ASSURANCE

- A. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("Green Book"), 2015 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications".

1.5 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate with other utility work.

1.7 DISPOSAL OF REMOVED MATERIALS

- A. All removed materials, except those indicated on the plans or described herein to remain the property of the Owner, shall become the property of the Contractor and shall be disposed in accordance with local, state, and federal laws. Should any of those materials be considered as hazardous the Contractor shall provide the Owners Inspector with paper custody trail documentation of the disposal.

1.8 SUBSTITUTIONS

- A. The Contractor assumes full responsibility that alternate manufacturers, items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures which ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates were selected without proper regard to the requirements of the job, will not be approved. No more than one proposed alternate will be considered for each item.
- B. This Contractor is responsible to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.
- C. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials and decisions of the Architect or that of his representative shall be final and conclusive.

1.9 RECORD DRAWINGS

- A. Contractor shall provide and keep up-to-date a complete "as-built" record set of redline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, pipe invert locations, drain basins, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.10 INSPECTION OF WORK

- A. Contractor shall not allow or cause any of his work to be covered up before it has been duly inspected, tested and approved by the Owner or any other authorized inspectors having legal jurisdiction over his work. Should he fail to observe the above, he shall uncover the work and, after it has been inspected, tested and approved, recover it at his own expense.
- B. Inspection of the work shall not relieve the contractor of any obligations to complete the work as prescribed by the standard specifications. Any known defective work shall be corrected before testing or final inspection will be permitted. Unsuitable materials may be rejected even if these materials have been previously overlooked by the Inspector.
- C. The Owner shall have the authority to suspend the work completely or in part for such time as it may deem necessary if the contractor fails to carry out instructions given by the Owner, or to perform any required provisions of the plans and specifications. The contractor shall immediately comply with a written order of the Owner to suspend the work completely or in part. The work shall be resumed when improper methods or defective work are corrected as ordered and approved in writing by the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Solid Wall Piping Materials
 - 1. Poly Vinyl Chloride (PVC) Sewer Pipe, ASTM D-3034, SDR-35. The pipe will have a permanently installed reinforced rubber ring gasket in an integral bell joint. PVC Sewer Fittings SDR-35 shall be manufactured in accordance with ASTM Standards D-3034 and F- 1336 or F- 679. The PVC material shall have a minimum cell classification of 12454-B, 12454- C or 12364-C as defined in ASTM D-1784.
 - 2. ADS N-12 WT (water-tight) IB Pipe, manufactured by Advanced Drainage Systems, Inc (ADS), or approved equal: High density polyethylene corrugated pipe (HDPE) with an integrally formed smooth interior and annular exterior corrugations. Pipe shall be joined with the N-12 WT IB joint meeting the requirements of AASHTO M294 or ASTM F2306.

3. Perforated Drain Pipe: ADS N-12 ST IB (Soiltight) pipe with perforations, Princisco Goldflo soiltight perforated pipe, or approved equal. Perforation shall be either holes or slots. Pipe shall be installed with perforations facing down
- B. Pre-Cast Concrete Catch Basins:
1. As noted on plans.
- C. Grates & Covers:
1. All grates and covers must be vandal proof / bolt down type.
 2. A.D.A. - Where noted on the plans install A.D.A. grates on catch basins. A maximum spacing between grating bars in accessible path of travel is 1/2 inch in the direction of travel, or 1/2 inch in either direction when the path of travel is not limited to one direction.
 3. Heel Proof - Where noted on the plans install heel proof grates on catch basins requiring a maximum 1/4 inch opening.
- D. Aggregate Around Perforated Pipe: As shown on subdrain trench details.
- E. Steel Reinforcing Bars: ASTM A 615 deformed grade 40 billet steel, plain finish, unless otherwise specified on Construction Document.
- F. Filter Material for Subsurface Drain: Non-woven geotextile filter fabric, Mirafi 14ON, or equal.
- G. Concrete, Mortar and Related Materials: Conform to Section 32 1313 Site Concrete Work.
- H. Paint and Protective Coatings
1. All storm drain hardware, including frames and covers, grates, protection bars, steps, etc., shall be protected from corrosion. Storm drain hardware made of cast iron shall be protected by painting with, or dipping in, a commercial grade asphalt paint. Storm drain hardware made of steel shall be galvanized.
 2. Hot-dip galvanize steel parts after fabrication and before installation, in accordance with Section 210 - Paint and Protective Coating of the Standard Specifications for Public Works Construction.

PART 3 - EXECUTION

3.1 PIPELINE INSTALLATION

- A. Existing utilities: Locate existing underground utilities in all areas of work prior to excavation or commencement of work. If utilities are to remain in place provide adequate means of protection during trenching operations.
- B. B. Install pipeline in a practical alignment and uniform slope to the point of connection as indicated on Construction Document. Prior to trench excavation, verify size, material, depth, and location of the point of connection. Notify Civil Engineer if point of connection elevation is different than that shown on construction drawing as it may affect the design of the system.
- C. Excavating, trenching, and backfilling are specified in Section 31 2200 — Grading.
- D. No pipe shall be laid until the Geotechnical Project Manager inspects and approves the conditions of the bottom of the trench.
- E. All storm drain pipelines, trench drains, catch basins and drain inlets shall be staked by a licensed surveyor if slope of grade is less than 2% and a complete set of cut sheets shall be supplied to the Inspector. All construction staking shall be installed and verified for grade and alignment prior to the start of construction.
- F. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

- G. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- H. Make connections to existing piping and underground structures so finished work complies as nearly as practical with requirements specified for new work.
- I. The cutting of pipe for inserting tees, fittings or closure pieces shall be done in a neat workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. No pipe shall be laid in water or when, in the option of the Engineer trench conditions are unsuitable.
- J. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe-laying crew cannot put the pipe into the trench and in place without getting soil into it, the Engineer may require that before lowering the pipe into the trench, a temporary plug be placed over each end and left there until the connection is to be made to the adjacent pipe. During the laying operations, no debris, tools, clothing or other materials shall be left in the pipe.
- K. At times when pipe laying is not in progress, the open ends of pipe shall be closed by watertight plug or other means approved by the Engineer. This provision shall apply during the lunch-hour breaks as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.
- L. All grates, frames and covers for drain inlets, catch basins & trench drains shall be locked down to prevent theft after final construction by the contractor.

3.2 FIELD INSPECTION FOR PIPE & FITTINGS

- A. Drainage pipes and inlets shall be cleaned of all debris and flow tested prior to acceptance to flush out all debris. Flood testing required in presence of inspector to confirm drainage is working properly.
- B. Install pipeline in a practical alignment and uniform slope to the point of connection as indicated on Construction Document. Prior to trench excavation, verify size, material, depth, and location of the point of connection. Notify Civil Engineer if point of connection elevation is different than that shown on construction drawing as it may affect the design of the system.
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END OF SECTION