

SECTION 23 01 30.51 -HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.3 DEFINITIONS

- A. ASCS: Air systems cleaning specialist.
- B. NADCA: National Air Duct Cleaners Association.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For an ASCS.
- B. Strategies and procedures plan.
- C. Cleanliness verification report.

1.5 QUALITY ASSURANCE

- A. ASCS Qualifications: A certified member of NADCA.
 - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
 - 2. Supervisor Qualifications: Certified as an ASCS by NADCA.
- B. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.
- C. Cleaning Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2006.
- C. Prepare written report listing conditions detrimental to performance of the Work.
- D. Proceed with work only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:
 - 1. Supervisor contact information.
 - 2. Work schedule including location, times, and impact on occupied areas.
 - 3. Methods and materials planned for each HVAC component type.
 - 4. Required support from other trades.
 - 5. Equipment and material storage requirements.
 - 6. Exhaust equipment setup locations.
- B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- C. Comply with NADCA ACR 2006, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.3 CLEANING

- A. Comply with NADCA ACR 2006.
- B. Remove visible surface contaminants and deposits from within the HVAC system.
- C. Systems and Components to Be Cleaned:
 - 1. Air distribution devices for exhaust air.
 - 2. Ductwork:
 - a. Exhaust-air ducts.
- D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- E. Particulate Collection:
 - 1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
 - 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building.
- F. Control odors and mist vapors during the cleaning and restoration process.
- G. Clean all air-distribution devices, registers, grilles, and diffusers.
- H. Clean visible surface contamination deposits according to NADCA ACR 2006 and the following:
 - 1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.

2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
3. Clean airstream components.

I. Duct Systems:

1. Create service openings in the HVAC system as necessary to accommodate cleaning.
2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).

J. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.

K. Mechanical Cleaning Methodology:

1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.
2. Cleaning Mineral-Fiber Insulation Components:
 - a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.
 - b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
 - c. Fibrous materials that become wet shall be discarded and replaced.

3.4 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR 2006, "Verification of HVAC System Cleanliness" Section.
- B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.

- C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Additional Verification:
 - 1. Perform surface comparison testing or NADCA vacuum test.
 - 2. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.
- E. Prepare a written cleanliness verification report. At a minimum, include the following:
 - 1. Written documentation of the success of the cleaning.
 - 2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
 - 3. Surface comparison test results if required.
 - 4. Gravimetric analysis (nonporous surfaces only).
 - 5. System areas found to be damaged.
- F. Provide with photographic documentation.

3.5 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2006, "Restoration and Repair of Mechanical Systems" Section.
- B. Replace damaged insulation.
- C. Ensure that closures do not hinder or alter airflow.
- D. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.
- E. Reseal fibrous-glass ducts.

3.6 PROJECT CLOSEOUT

- A. Post-Project Report:
 - 1. Post-cleaning photo images.
 - 2. Post-cleaning verification summary.
- B. Drawings:
 - 1. Deviations of existing system from Owner's record drawings.
 - 2. Location of service openings.

END OF SECTION

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Equipment installation requirements common to equipment sections.
7. Painting and finishing.
8. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

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1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.2 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

END OF SECTION

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SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 1. Motor controllers.
 2. Torque, speed, and horsepower requirements of the load.
 3. Ratings and characteristics of supply circuit and required control sequence.
 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 SINGLE-PHASE MOTORS

- A. Motor shall be an electronic commutation (EC) motor specifically designed for HVAC applications. AC induction type motors are not acceptable.
- B. Motors shall be permanently lubricated with heavy-duty ball bearings to match the fan load and prewired to the specific voltage and phase.
- C. Internal motor circuitry shall convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown).
- D. Motor shall be a minimum of 85% efficient at all speeds.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 23 05 13
COMMON MOTOR REQUIREMENTS

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SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Duct Labels.
 - 4. Warning tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. The manufacturer, contractor or supplier shall resubmit the specification section and shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular section. Next to each specification item, indicate the following:
 - 1. "No Exception Taken".
 - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- C. Samples: For color, letter style, and graphic representation required for each identification material and device.
- D. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.3 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturers:
 - 1. Craftmark Identification Systems
 - 2. Seton Identification Products
 - 3. MSI Marking Services
 - 4. Setmark

2.2 EQUIPMENT LABELS

- A. Metal Labels for Equipment:

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1. Material and Thickness: Brass or anodized aluminum, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or contact-type permanent adhesive, compatible with label and substrate.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Three-layer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick and having predrilled holes for attachment hardware.
2. Color Coding:
 - a. Letter Color: White.
 - b. Background Color: Red.
3. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel rivets or contact-type permanent adhesive, compatible with label and substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.3 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.

B. Color Coding:

1. Background Color: Yellow.
2. Letter Color: Black.

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IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

- C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless-steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Blue.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER", "CAUTION" or "DO NOT OPERATE."
 - 4. Color:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

PART 3 - EXECUTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

3.1 PREPARATION

- A. Clean equipment surface of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Green: For cold-air supply ducts.
 - 2. Brown: For exhaust-, and return-air ducts.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - 2. Testing, Adjusting, and Balancing Equipment:
 - a. Motors.
 - 3. Testing, adjusting, and balancing existing systems and equipment.
 - 4. Duct leakage tests.
 - 5. Control system verification.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.3 PREINSTALLATION MEETINGS

- A. TAB Conference: Conduct a TAB conference at Project site with the Engineer and Commissioning Agent after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
 - 1. Minimum Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Needs for coordination and cooperation of trades and subcontractors.
 - d. Proposed procedures for documentation and communication flow.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Submit TAB strategies and step-by-step procedures as specified

in "Preparation" Article.

- D. System Readiness Checklists: Submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Engage an independent TAB Contractor certified by AABC.
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3- "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one of the following:
 - 1. American Air Balance.
 - 2. Air Balance Co., Inc.

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

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- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.

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4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete.
 - c. Fans are operating, free of vibration, and rotating in correct direction.
 - d. Ceilings are installed.
 - e. Windows and doors are installed.
 - f. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE Standard 111 or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 1. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish.
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check for airflow blockages.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 1. Measure total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
 1. Measure airflow of submain and branch ducts.
 2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 2. Measure inlets and outlets airflow.
 3. Adjust each inlet and outlet for specified airflow.

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4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
 1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
 2. Re-measure and confirm that total airflow is within design.
 3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
 4. Mark all final settings.
 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
 6. Measure and record all operating data.
 7. Record final fan-performance data.

3.7 DUCT LEAKAGE TESTS

- A. Witness the duct pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified tolerances.
- C. Report deficiencies observed.

3.8 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
 1. Verify temperature control system is operating within the design limitations.
 2. Confirm that the sequences of operation are in compliance with Contract Documents.
 3. Verify that controllers are calibrated and function as intended.
 4. Verify that controller set points are as indicated.
 5. Verify the operation of lockout or interlock systems.
 6. Verify the operation of valve and damper actuators.
 7. Verify that controlled devices are properly installed and connected to correct controller.
 8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
 9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.9 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 2. Air Outlets and Inlets: Plus or minus 10 percent.

3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 1. Title page.
 2. Name and address of the TAB specialist.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.

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9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:
 - a. Unit identification.
 - b. Location.

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- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Unit arrangement and class.
- g. Discharge arrangement.
- h. Sheave make, size in inches, and bore.
- i. Center-to-center dimensions of sheave and number of adjustments in inches.
- j. Number, make, and size of belts.
- k. Number, type, and size of filters.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave and number of adjustments in inches.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.
- f. Preheat-coil static-pressure differential in inches wg.
- g. Cooling-coil static-pressure differential in inches wg.
- h. Heating-coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Outdoor-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

F. Fan Test Reports: For exhaust fans, include the following:

1. Fan Data:

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- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and size.
- e. Manufacturer's serial number.
- f. Arrangement and class.
- g. Sheave make, size in inches, and bore.
- h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.

G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated airflow rate in cfm.

- h. Indicated velocity in fpm.
- i. Actual airflow rate in cfm.
- j. Actual average velocity in fpm.
- k. Barometric pressure in psig.

H. Air-Terminal-Device Reports:

1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary airflow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.

I. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.

- b. Entering-water temperature in deg F.
- c. Leaving-water temperature in deg F.
- d. Water pressure drop in feet of head or psig.
- e. Entering-air temperature in deg F.
- f. Leaving-air temperature in deg F.

J. Instrument Calibration Reports:

- 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.12 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of commissioning authority.
- B. Commissioning authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
 - 3. If the second verification also fails, Owner may contact AABC or NEBB Headquarters regarding the Performance Guaranty.
- F. Prepare test and inspection reports.

3.13 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

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B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

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SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 1. Flange connectors.
 2. Flexible connectors.
 3. Flexible ducts.
 4. Duct accessory hardware.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances, and method of field assembly into duct systems and other construction. Include the following:
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- D. Source quality-control reports.
- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

1.5 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - EXECUTION

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet

metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: [G60] [G90].
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches .

2.2 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.3 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd. .
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.

3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 1. Minimum Weight: 24 oz./sq. yd. .
 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 3. Service Temperature: Minus 50 to plus 250 deg. F.
- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 1. Minimum Weight: 16 oz./sq. yd.
 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
 3. Service Temperature: Minus 67 to plus 500 deg. F.
- H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
 1. Minimum Weight: 14 oz./sq. yd.
 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 3. Service Temperature: Minus 67 to plus 500 deg. F.
- I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.4 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Casco Silentflex II.
- B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.

2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F.
4. Insulation R-Value: Comply with Title 24.

2.5 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install test holes at fan inlets and outlets and elsewhere as indicated.
- D. Install flexible connectors to connect ducts to equipment.
- E. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- F. Install duct test holes where required for testing and balancing purposes.
- G. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.
- H. All equipment and components requiring access above hard lid ceiling shall be provided with adequate service clearance and ceiling access panels. Coordinate ceiling access panel location based upon installation location in field and in accordance with Section 08 31 00 – Access Doors and Panels.

END OF SECTION

SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Ceiling-mounted ventilators.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Fan speed controllers.

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

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Size and location of initial access modules for acoustical tile.
3. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.9 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CEILING-MOUNTED VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company

B. Basis of Design is Greenheck. If contractor submits on listed alternates, he shall assume monetary and logistical responsibility for any and all necessary structural, electrical, plumbing, architectural and HVAC modifications. Contractor shall also compensate the Architect of Record (AOR) and Mechanical Engineer of Record (MEOR) for efforts related to reviewing submittals to establish acceptability and updating energy compliance calculations. If retaining first paragraph below, retain option if manufacturer's name and model number are indicated in schedules or plans on Drawings; delete option and insert manufacturer's name and model number if not included on Drawings.

C. Housing: Steel, lined with acoustical insulation.

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

E. Grille: Aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.

F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
4. Motion Sensor: Motion detector with adjustable shutoff timer.
5. Filter: Washable aluminum to fit between fan and grille.
6. Isolation: Rubber-in-shear vibration isolators.
7. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

2.3 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Connect wiring according to Division 26.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 1. Verify that shipping, blocking, and bracing are removed.
 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Verify that cleaning and adjusting are complete.
 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 5. Adjust belt tension.
 6. Adjust damper linkages for proper damper operation.
 7. Verify lubrication for bearings and other moving parts.
 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 10. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- C. Lubricate bearings.

END OF SECTION

SECTION 26 00 00 – GENERAL ELECTRICAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This specification shall apply to all phases of Work hereinafter specified, shown on Drawings, or as required to provide a complete installation of electrical systems for this Project. Work required under this specification is not limited to just the Electrical Drawings - refer to Architectural, Structural, Landscape, and Mechanical/Plumbing Drawings, as well as all other drawings applicable to this project, which designate the scope of work to be accomplished. The intent of the Drawings and Specifications is to provide a complete and operable electrical system that includes all documents that are a part of the Contract.

1. Work Included: Furnish labor, material, services and skilled supervision necessary for the construction, erection, installation, connections, testing, and adjustment of all circuits and electrical equipment specified herein, or shown or noted on Drawings, and its delivery to the Owner complete in all respects ready for use.
2. The electrical Work includes installation or connection of certain materials and equipment furnished by others. Verify installation details, installation and rough-in locations from the actual equipment or from the equipment shop drawings.

B. Electrical Drawings: Electrical Drawings are diagrammatic, and are intended to convey the scope of work, indicating intended general arrangement of equipment, conduit and outlets. Follow Drawings in laying out Work and verify spaces for installation of materials and equipment based on actual dimensions of equipment furnished.

1.2 QUALITY ASSURANCE

A. Design, manufacture, testing and method of installation of all apparatus and materials furnished under requirements of these specifications shall conform to latest publications or standard rules of the following:

1. Institute of Electrical and Electronic Engineers - IEEE
2. National Electrical Manufacturers' Association - NEMA
3. Underwriters' Laboratories, Inc. - UL
4. National Fire Protection Association - NFPA
5. Federal Specifications - Fed. Spec.
6. American Society for Testing and Materials - ASTM
7. American National Standards Institute - ANSI
8. National Electrical Safety Code - NESC
9. Insulated Cable Engineers Association - ICEA
10. American Institute of Steel Construction - AISC
11. State Codes In Force In The Specific Project Area
12. Occupational Safety and Health Administration (OSHA)
13. Electronics Industries Association/Telecommunications Industry Association (EIA/TIA)

14. California Electrical Code - CEC
15. Local Authority Having Jurisdiction (AHJ) Published Electrical Standards and Codes

B. Perform Work in accordance with the National Electrical Code, applicable building ordinances, and other applicable codes, hereinafter referred to as the "Code." The Contractor shall comply with the Code including local amendments and interpretations without added cost to the Owner. Where Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where code conflicts occur, the most stringent shall apply unless variance is approved.

1. Comply with all requirements for permits, licenses, fees and codes. The Contractor, at Contractor's expense, shall obtain all permits, licenses, fees, special service costs, inspections and arrangements required for Work under this contract, unless otherwise specified.
2. Comply with requirements of the applicable utility companies serving this Project. Make all arrangements with utility companies for proper coordination of Work.

1.3 GENERAL REQUIREMENTS

- A. Guarantee: Furnish a written guarantee for a period of (1) one-year from date of acceptance.
- B. Wherever a discrepancy in quantity or size of conduit, wire, equipment, devices, circuit breakers, etc., (all materials), arises on the Drawing and/or Specifications, the Contractor shall be responsible for providing and installing all material and services required by the strictest condition noted on Drawings and/or in Specifications to ensure complete and operable systems as required by the Owner and Engineer.
- C. All Core Cutting, Drilling, and Patching:
 1. For the installation of work under this Section, the aforementioned shall be performed under this Section of the Specifications and the Concrete section of the Specifications.
 2. No holes will be allowed in any structural members without the written approval of the Project's Structural Engineer.
 3. For penetrations of concrete slabs or concrete footings, the work shall be as directed in the Concrete Section of Specifications.
 4. The Contractor shall be responsible for patching and repairing surfaces where he is required to penetrate for work under this contract.
 5. Penetrations shall be sealed to meet the rated integrity of the surface required to be patched and repaired. The patched surface shall be painted or finished to match the existing surface.
- D. Verifying Drawings and Job Conditions:
 1. The Contractor shall examine all Drawings and Specifications in a manner to be fully cognizant of all work required under this Section.
 2. The Contractor shall visit the site and verify existing conditions. Where existing conditions differ from Drawings, adjustment(s) shall be made and allowances included for all necessary equipment to complete all parts of the Drawings and Specifications.

1.4 WORK IN COOPERATION WITH OTHER TRADES

- A. Examine the Drawings and Specifications and determine the work to be performed by the electrical, mechanical and other trades. Provide the type and amount of electrical materials and equipment necessary to place this work in proper operation, completely wired, tested and ready for use. This shall include all conduit, wire, disconnects, relays, and other devices for the required operation sequence of all electrical, mechanical and other systems or equipment.
- B. Provide a conduit-only system for low voltage wiring required for control of mechanical and plumbing equipment described in this or other parts of the Contract Documents. Install all control housings, conduits, and backboxes required for installing conductors to the controls.
- C. Install separate conduits between each heating, ventilating and air conditioning sensing device and its control panel and/or control motor. Before installing any conduit for heating, ventilating and air conditioning control wiring, verify the exact requirements from the control diagrams provided with the equipment manufacturer's shop drawings.

1.5 TESTING AND ADJUSTMENT

- A. Upon completion of all electrical work, the Contractor shall test all circuits, switches, light fixtures, lighting control and dimming systems including distributed systems, UPSs, generators, SPDs, lighting inverters, transfer switches, motors, circuit breakers, motor starters and their auxiliary circuits and any other electrical items to ensure perfect operation of all electrical equipment.
- B. Equipment and parts in need of correction and discovered during such testing, shall be immediately repaired or replaced with all new equipment and that part of the system shall then be retested. All such replacement or repair shall be done at no additional cost to the Owner.
- C. All circuit(s) shall be tested for continuity and circuit integrity. Adjustments shall be made for circuits not complying with testing criteria.
- D. All test reports, including copies of any required Energy Code Acceptance Forms (e.g. CA Title 24 Acceptance for Code Compliance Forms) should be submitted to the Engineer at completion of project.

1.6 IDENTIFICATION

- A. Nameplates shall be provided for unit substations, switchgear, switchboards, distribution boards, distribution panels, panel boards, motor control centers, transformers, transfer switches, contactors, starters, disconnect switches, enclosed circuit breakers/switches, inverters, UPSs, PDUs, RDCs, SPDs, lighting control panels, dimming panels, door releasing system panels, fire alarm/central monitoring terminal cabinets/power supplies/control panels, and all low voltage system terminal and control cabinets.
 - 1. Nameplate inscriptions shall be identical to the equipment designations indicated in plans and specifications. Nameplates shall be engraved with the device designation/identification on the top line, source identification for the device on the 2nd line per CEC Article 408.4 and load designation for the device on the bottom line. Where load designation consists of a branch circuit, omit bottom line. Where device designation is not indicated on plans/specifications, Contractor shall submit a written clarification request to the Engineer.
 - a. Example: Transformer 1TA
 - b. Source Disconnecting Location: Switchboard MSA located in Rm 110

c. Load: Panels 1LA and 1 LB

2. All circuit breakers/fuses in switchgear, switchboards, distribution boards, distribution panels, UPS output circuit breakers, PDU sub-feed circuit breakers and motor control centers shall have individual nameplates located immediately adjacent to the respective device. Nameplate inscription shall identify the downstream equipment or device served by the circuit breaker or fuse.

B. Identification nameplates, UON, shall be laminated/extruded modified acrylic that is 3/32" thick, UV-stabilized, matte finish, suitable for use in 180 deg. F ambient, with beveled edges and engraved white letters 3/8" high, minimum, on 1-1/2" high black background (utility/normal and optional standby power systems) for single line of text. Where two lines of text are required, provide minimum 2" high nameplate. Where three lines of text are required, provide minimum 2.5" high nameplate. Provide white letters on red background for all CEC Article 517 essential power systems, Article 700 Emergency Systems, Article 701 Legally required standby systems and Article 708 COPS.

C. Identification nameplates for new switchgear, switchboards, distribution boards, distribution panels, panel boards and motor control centers shall be attached with switchgear manufacturer-provided screws via switchgear manufacturer factory pre-drilled holes. A factory option to rivet identification nameplates to the equipment is only acceptable if screw-fastened nameplates are not an available option from the switchgear manufacturer. Field drilling or other mechanical attachment methods that change/void the NEMA or NTRL rating of the enclosure are strictly forbidden.

D. Identification nameplates for transformers, transfer switches, disconnect switches, enclosed circuit breakers/switches, inverters, UPSs, PDUs, RDCs, SPDs, lighting control panels, dimming panels, door releasing system panels, terminal cabinets and all circuit breakers/fuses in switchgear, switchboards, distribution boards, distribution panels, UPS output circuit breakers, PDUs, PDU sub-feed circuit breakers, and motor control centers shall be attached to the equipment by self-adhesive backing integral to the nameplates. When equipment is located outdoors, provide nameplates without self-adhesive backing and attach to equipment using weather-rated, UV-resistant epoxy. In all cases, clean surfaces before applying identification nameplates parallel to equipment lines.

E. Warning Placards, as required by General Single Line Diagram Notes for multiple power sources, or instruction placards, as required for all kirk-key interlock schemes, all UPS bypass procedures or as required elsewhere in the plans/specifications shall be engraved 1/2" high white lettering on a red background using the same material specified for identification nameplates with a self-adhesive backing. Warning/instruction placards shall be attached to the face of the equipment directly related to the placards. Provide a formal placard submittal for review by the Engineer prior to ordering any warning/instruction placards. In all cases, clean surfaces before applying warning/instruction placards parallel to equipment lines.

F. Receptacles that are part of a UL-listed under floor computer room whip assembly, ceiling and/or cable/ladder tray-mounted receptacles used in lab, manufacturing, commercial kitchen environments or that are serving telecom/data/AV racks and cabinets shall have identification nameplates located on the wiring device plate cover. Nameplates shall be self-adhesive, 3/32" thick Micarta with beveled edges, engraved 1/4" high white lettering on black background with serving power source, circuit identification and NEMA/IEC receptacle type. Use of two (2) separate nameplates per device plate cover is acceptable. Affix nameplates to be visible when plugs are occupying receptacles.

G. See wiring device section of this specification for wiring device plate cover labeling requirements.

- H. See drawings for panel board schedule directory installation requirements.
- I. See conduit installation section of this specification for conduit labeling requirements.

1.7 FINAL INSPECTION AND ACCEPTANCE

- A. After all requirements of the Specifications and/or the Drawings have been fully completed; representatives of the Owner will inspect the work. Contractor shall provide competent personnel to demonstrate the operation of any item or system to the full satisfaction of each representative.
- B. Final acceptance of the work will be made by the Owner after receipt of approval and recommendation of acceptance from each representative.

1.8 RECORD DRAWINGS

- A. Drawings of Record: The Contractor shall provide and keep up to date, a complete record set of drawings. These shall be corrected daily and show every change from the original Drawings. This set of prints shall be kept on the job site and shall be used only as a record set. This shall not be construed as authorization for the Contractor to make changes in the layout without definite instruction in each case. Upon completion of the work, a set of reproducible Contract Drawings shall be obtained from the General Contractor and all changes as noted on the record set of prints shall be incorporated thereon with black ink in a neat, legible, understandable and professional manner. Refer to the Supplementary General Conditions for complete requirements.

1.9 APPROVALS, EQUALS, SUBSTITUTIONS, ALTERNATIVES, NO KNOW EQUAL

- A. Approvals: Where the words (or similar terms) "approved", "approval", "acceptable", and "acceptance" are used, it shall be understood that acceptance by the Owner, Architect and Engineer are required.
- B. Equal: Where the words (or similar terms) "equal", "approved equal", "equal to", "or equal by", "or equal" and "equivalent" are used, it shall be understood that these words are followed by the expression "in the opinion of the Owner, Architect, and Engineer." For the purposes of specifying products, the above words shall indicate the same size, made of the same construction materials, manufactured with equivalent life expectancy, having the same aesthetic appearance/style (includes craftsmanship, physical attributes, color and finish), and the same performance.
- C. Substitution: For the purposes of specifying products, "substitution" shall refer to the submittal of a product not explicitly approved by the construction documents/ specifications.
 - 1. Substitutions of specified equipment shall be submitted and received by the Engineer ten (10) days prior to the bid date for review and written approval. Regulatory Agency approval for all substitutions will be the sole responsibility of the Contractor. To receive consideration, requests for substitutions must be accompanied by documentary proof of its equality with the specified material. Documentary proof shall be in letterform and identify the specified values/materials alongside proposed equal values/materials. In addition, catalog brochures and samples, if requested, must be included in the submittal. ONLY PRE-BID APPROVED PRODUCTS, ISSUED VIA A FORMAL BID ADDENDUM TO ALL BIDDERS, WILL BE ALLOWED ON THE PROJECT. REGARDLESS OF THE APPROVAL ON ANY SUBSTITUTION, ALL BIDS SHALL BE BASED ON THE PRODUCTS EXACTLY AS SPECIFIED. PRICING FOR EACH APPROVED SUBSTITUTION SHALL BE INCLUDED IN THE BID SUBMITTAL AS A SEPARATE LINE ITEM.

2. In the event that written authorization is given for a substitution, after award of contract, the Contractor shall submit to the Engineer quotations from suppliers/distributors of both the specified and proposed equal material for price comparison, as well as a verification of delivery dates that conform to the project schedule.
3. In the event of cost reduction, the Owner will be credited with 100 percent of the reduction, arranged by Change Order.
4. The Contractor warrants that substitutions proposed for specified items will fully perform the functions required.

D. Alternates/Alternatives: For the purposes of specifying products, "alternatives/alternates" may be established to enable the Owner/Architect/Engineer to compare costs where alternative materials or methods might be used. An alternate price shall be submitted in addition to the base bid for consideration. If the alternate is deemed acceptable, written authorization will be issued.

E. No Known Equal: For the purposes of specifying products, "No Known Equal" shall mean that the Owner/Architect/Engineer is not aware of an equivalent product. The Contractor will need to submit a "Substitution" item, per the requirements listed above, if a different product is proposed to be utilized.

1.10 SHOP DRAWINGS/SUBMITTALS

- A. Shop Drawings/Submittals, unless required otherwise by general project specifications or instructions to bidders, shall be submitted in electronic format (PDF) to include a Letter of Transmittal (PDF), which shall give a list of the drawings submitted with dates and/or system(s) components contained within the submittal. Drawings and material cut sheets shall be complete in every respect and edited-marked to indicate specific items being provided. Printed/Hard copies are not acceptable.
- B. The Shop Drawings/Submittals shall be marked with the name of the project, numbered consecutively, and bear the approval of the Contractor as evidence that the Contractor has checked the Drawings. Any Drawings submitted without this approval will be returned to the Contractor for resubmission.
- C. If the shop drawings show variations from the requirements of the Contract because of standard shop practice or other reasons, the Contractor shall make specific mention of such variations in the Contractor's letter of transmittal. If the substitution is accepted, the Contractor shall be responsible for proper adjustment that may be caused by the substitution. Samples shall be submitted when requested.
- D. Only products listed as "Equal" within the contract documents, along with formally approved "Substitutions" will be reviewed. Products not conforming to these items will not be reviewed and will be returned to the Contractor for re-submittal.
- E. Review comments used in response to shop drawings/submittals are:
 1. "No Exception Taken" - Product approved as submitted.
 2. "Furnish as Corrected" - Re-submittal not required, although the Contractor shall provide the submitted product with corrections as noted.
 3. "Revise and Resubmit" - Re-submittal required with corrections as noted.
 4. "Rejected" - Re-submittal required based upon the originally specified product.
- F. Shop drawings shall be submitted on the following but not limited to:

1. Fire Alarm System/Central Monitoring System.
2. Wiring Devices.
3. Pullboxes and Underground Vaults.
4. Terminal Cabinets
5. All other products called out on drawings that call for shop drawing submittal.

1.11 MAINTENANCE, SERVICING, INSTRUCTION MANUALS AND WIRING DIAGRAMS

- A. Prior to final acceptance of the job, the Electrical Contractor shall furnish to the Owner at least four (4) copies of operating, maintenance, and servicing instructions, as well as four (4) complete wiring diagrams for the following, but not limited to, items or equipment:
 1. Fire Alarm System.
- B. All wiring diagrams shall specifically cover the system supplied. Typical drawings will not be accepted. Four (4) copies shall be presented to the Owner.

1.12 INTERRUPTION OF SERVICE/SERVICE SHUTDOWN

- A. Any interruption of electrical services, electrical circuits, electrical feeders, signal systems, communication systems, fire alarm systems, etc. required to perform work, shall meet the specific prior-approval requirements of the Owner. Such work shall be scheduled with the Owner to be performed at the Owner's convenience.
- B. Interruptions/outages of any of the Owner's systems and services mentioned above shall be scheduled to occur during other than the Owner's normal business hours. Any overtime costs shall be borne by the Contractor.
- C. See drawings for any additional requirements regarding outages, interruption and any temporary services required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials and Equipment: All electrical materials and equipment, including custom-made equipment, shall be new and shall be listed by Underwriter's Laboratories (UL) and bear their label or be listed and certified by a Nationally Recognized Testing Lab (NRTL) that is also recognized by the local Authority-Having-Jurisdiction (AHJ) .
- B. Wiring Devices:
 1. Provide wiring devices indicated per plan. Devices shall be specification grade. Acceptable manufacturers are Leviton, Pass and Seymour and Hubbell. Provide all similar devices of same manufacturer, unless indicated otherwise. All device colors shall be from the full range of manufacturer standard color options as selected by the Architect. This selection will be made during the shop drawing review process
 - a. Wiring Devices (Decora)

1)	Convenience Receptacle	#16252
2)	Dedicated Receptacle	#16352
3)	Convenience I.G. Receptacle	#16262-IG
4)	Dedicated I.G. Receptacle	#16362-IG

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5)	Convenience G.F.C.I. Receptacle	#GFT1
6)	Dedicated G.F.C.I. Receptacle	#GFNT2
7)	Tamper Resistant Convenience Receptacle	#TDR15
8)	Tamper Resistant Dedicated Receptacle	#TDR20
9)	Tamper Resistant GFCI Receptacle	#GFTR2
10)	Grade Receptacle	#GFTR1-HG
11)	Grade Receptacle	#GFTR2-HG
12)	Weather/Tamper Resistant GFCI Receptacle	#GFWT2
13)	Convenience Simplex Receptacle	#16251
14)	Dedicated Simplex Receptacle	#16351
15)	Single Pole Switch	#5621-2
16)	Double Pole Switch	#5622-2
17)	Three Way Switch	#5623-2
18)	Four Way Switch	#5624-2
19)	Pilot Light Switch "On"	#5628-2
20)	Pilot Light Switch "Off"	#5631-2
21)	Projection Screen Switch	#5657-2
22)	Low Voltage Momentary Switch	#5657-2
23)	Keyed Switch	#1221-2L (Non-Decora)
24)	Door Jam Switch	#1865

b. Use of dedicated receptacles is required where plans depict a branch circuit supplying only a single simplex or duplex receptacle. Use of controlled receptacles is required where depicted on plans - see controlled receptacle specifications for additional information.

2. In addition to other device requirements listed elsewhere in this specification, 125V (Volt), 15A (Amp) and 20A Tamper-Resistant wiring devices shall be provided as follows:

- In dwelling units per CEC Article 210.52 and 406.12(1)
- In pediatric care areas per CEC Article 517.18(C)
- In childcare or day care facilities
- In wet and/or exterior locations

3. Wiring device cover plates located on recessed boxes shall be commercial grade nylon. Plate color shall match wiring device color UON on plans. Cover plates utilized on surface mounted boxes shall be metal. Plastic cover plates are unacceptable.

4. Except as otherwise noted, all wiring device plates on the project shall be labeled with panel and circuit number(s) utilizing a Brother P-Touch labeling system with 1/2" tape (yellow on black) or equal by Herman-Tellerman or Panduit. Locate label on the concealed side of the wiring device plate. Handwritten labels are unacceptable.
5. The Contractor shall provide duplex receptacle outlets in the appropriate configurations necessary to comply with applicable energy code requirements for controlled receptacles and as shown on plans. All wiring devices indicated to be controlled receptacles shall be NEMA-approved, electrical code-compliant with factory markings on the face of the receptacle(s) with the word "Controlled" or utilize further markings and symbols to indicate which receptacles on each outlet is/are controlled. Stickers, field-applied markings or other non-permanent markings are not acceptable. Where a GFCI receptacle outlet is required to be controlled, provide an adjacent controlled duplex receptacle outlet connected on the load side of the GFCI outlet. Generally, one receptacle in a duplex receptacle outlet is required to be controlled. It may be the lower receptacle or upper receptacle based on manufacturer offering. However, the controlled receptacle location within a controlled receptacle outlet shall remain consistent throughout the project. Where an existing duplex receptacle outlet is required to be controlled, provide a new wiring device with the appropriate control configuration necessary to comply with plans. All controlled receptacles shall be connected to a branch circuit controlled by an occupancy sensor-based or relay panel lighting control system. Acceptable manufacturers are Leviton, Pass and Seymour and Hubbell.
6. The following wiring device plates shall have custom engraving:
 - a. Key operated switches, switches with pilot lights, and switches for the control of motors, heaters and ventilators. Engraving shall be black and occur on the exposed side of the plate indicating the motor, heater, or ventilator controlled.
 - b. Receptacles on optional standby generator and/or UPS power shall have custom engraved plates with the words "Generator" or "UPS" in black letters. In addition, where located in telecommunications closets, IDFs, server rooms, data centers, labs (wet, dry or electronic) indicate panel board and circuit number.
 - c. All stainless steel and nylon device plates shall be engraved using a rotary engraving process except for black lettering on stainless steel device plates which may be accomplished via laser etching process. All lettering shall be 3/16" high. Provide a dimensioned submittal drawing detailing a typical device faceplate with engraving.

C. Circuit Breakers:

1. Service entrance circuit breakers smaller than 400A (Amp) frame shall be thermal-magnetic trip with inverse time current characteristics unless otherwise indicated below. Service entrance main circuit breakers and main circuit breakers. 400A frame and larger shall be 100% rated, solid-state type as outlined in this specification. All other service entrance circuit breakers, 400A frame and larger, shall be 100% rated, solid-state type as outlined in this specification.
2. All non-service entrance circuit breakers 225A and larger shall be thermal magnetic type and have continuously adjustable instantaneous pick-ups of approximately 5 to 10 times trip rating. Breakers shall have either tamper-resistant rating dials or easily

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changed trip rating plugs with trip ratings as indicated on the Drawings. Rating plugs shall be interlocked so they are not interchangeable between frames. Additionally, all non-service entrance circuit breakers, 600A frame and larger, located in 480V, 3-phase, 3-wire or 277/480V, 3-phase, 4-wire switchgear, distribution boards, panel boards or busway plugs shall be solid state, 100% rated. Breaker shall have built-in test points for testing long delay, short delay and instantaneous, and ground fault (where shown) functions of the breaker by means of a 120V operated test kit. Contractor shall utilize a test kit capable of testing all breakers 400A and above - at the Engineer's request.

3. All non-service entrance circuit breakers less than 225A shall be molded plastic case, air circuit breakers conforming to UL 489. Provide breakers with thermal magnetic trip units, and a common trip bar for two- or three-pole breakers, connected internally to each pole so tripping of one pole will automatically trip all poles of each breaker. Provide breakers of trip-free and trip-indicating bolt-on type, with quick-make, quick-break contacts. Provide single two- or three-pole breaker interchangeability. Provide padlocking device for circuit breakers as shown on the Drawings.
4. Where a Current Limiting Circuit Breaker (CLCB) is indicated on drawings or as required elsewhere in this specification, provide a UL listed current limiting thermal magnetic circuit breaker(s) UON. An independently operating limiter section within a molded case is not allowed. Coordinate CLCB ratings as required to protect electrical system components on the load side of the CLCB to include, but not limited to, protecting automatic transfer switches, panel boards and lighting control panels.
5. Where a solid-state circuit breaker is indicated on drawings or as required elsewhere in this specification, provide a solid-state circuit breaker with minimum five function complete with built-in current transformers. The five functions shall be independently adjustable and consist of Overload/Long Time Amp Rating, Long Time Delay, Short Time Delay, Short Circuit/Instantaneous Pickup, but may also include Shunt Trip and/or Ground Fault if so indicated on the Drawings. Rating plugs shall be interlocked so they are not interchangeable between frames. Breaker shall have built-in test points for testing long delay and instantaneous, and ground fault (where shown) functions of the breaker by means of a 120V operated test kit. Contractor shall utilize a test kit capable of testing all breakers 400A and above, at the Engineer's request.
6. Circuit breakers, 1200A Frame or larger, or circuit breakers with sensors or adjustable trip settings, 1200A or larger, shall be equipped with an Energy Reducing Maintenance Switch that complies with CEC Article 240.87(B)(3) unless specified elsewhere with an alternate arc energy reduction method allowed by this same code section.
7. Ground Fault Interrupting Breakers: Provide with molded plastic case, air circuit breakers, similar to above with ground fault circuit interrupt capability, conforming to UL Class A, Group 1.
8. Arc Fault Interrupting Breakers: Provide with molded plastic case, air circuit breakers, similar to above with arc fault circuit interrupt capability, conforming to UL 1699. Provide on all dwelling-unit circuits supplying bedrooms, sleeping quarters etc. as required to comply with CEC Article 210.12.
9. Tandem or half-sized circuit breakers are not permitted.

10. Series-Rated Breakers: UL listed series-rated combinations of breakers can be used to obtain panelboard-interrupting ratings shown on Drawings. If series-rated breakers are used, switchboards, distribution boards, and panel boards shall be appropriately labeled to indicate the use of series-rated breakers. Shop drawing submittal shall include chart of UL listed devices, which coordinate to provide series rating.
11. Circuit breakers shall be standard interrupting construction. Panelboard shall accept standard circuit breakers up to 100A.
12. Circuit breaker handle accessories shall provide provisions for locking handle in the on or off position.
13. Shunt-trip equipped circuit breakers shall be provided on all elevator feeders.
14. Temperature compensating circuit breaker(s) shall be provided when located in outdoor enclosure(s) or when located in an enclosure subject to high ambient heat due to due nearby industrial processes, etc.
15. Provide 75 degree Celsius-rated conductor lugs/lug kits as required on all circuit breakers to accept conductor quantities and sizes shown on drawings.
16. All circuit breaker terminations shall be suitable for use with 75-degree Celsius ampacity conductors. Listed, dual-rated pin terminals, straight or offset, are acceptable for use to in accommodating oversized or parallel conductor installations.
17. Circuit breakers serving Fire Alarm or Central Monitoring panels and power supplies shall be red in color and lockable in the "ON" position.

D. Disconnect Switches:

1. Non-fusible or fusible, heavy-duty, externally-operated horsepower-rated, 600V A.C: Provide NEMA 3R, lockable enclosures for all switches located on rooftops, in wet or damp areas and in any area exposed to the elements.
2. Fusible switches shall be Class "R" when 600A or less or Class "L" when greater than 600A.
3. Amperage, Horsepower, Voltage and number of poles per drawings: All shall be clearly marked on the switch nameplate.
4. Provide the Owner's project manager with one (1) spare set of fuses and two (2) sets of fuse clips/fuses for every set of fuses on the project.

E. Fire Alarm System/Central Monitoring System:

1. See drawings for Fire Alarm System or Central Monitoring System specifications.

F. Conduit:

1. Galvanized Rigid Conduit (GRC) shall be full weight threaded type steel. Steel conduit shall be protected by overall zinc coating to inside and outside surfaces, applied by the hot dip, metalizing, or sherardizing process.
2. Intermediate Metal Conduit (IMC), shall be hot-dipped galvanized in accordance with UL 1242, and meet Federal Specification WWC-581 (latest revision).
3. Electrical Metallic Tubing (EMT) shall be zinc-coated steel with baked enamel or plastic finish on inside surfaces. EMT shall be dipped in a chromic acid bath to

chemically form a corrosion-resistant protective coating of zinc chromate over galvanized surface.

4. Flexible metal conduit shall be constructed of aluminum or hot-dipped galvanized steel strips wound spirally with interlocking edges to provide greatest flexibility with maximum strength. Interior surfaces shall be smooth and offer minimum drag to pulling in conductors. Use only as directed in writing by the Engineer with the exception of 400 Hz feeders and 400 Hz branch circuits which shall be run in flexible aluminum conduit.
5. Liquid-tight conduit (Seal-Tite) shall be galvanized steel flexible conduit as above except with moisture and oil-proof jacket, pre-cut lengths and factory-installed fittings. For outdoor installations and motor connections only unless otherwise noted on drawings.
6. Factory assembled, or off-site assembled wiring systems (such as Metal Clad (MC) Cable, Type AC Cable, Type NM Cable, Type BX Cable, etc.) shall not be used unless otherwise indicated in the Allowed Specification Deviations Section or Deductive/Additive Alternate Pricing Section generally located on the symbols list drawing.
7. When approved for use in the Allowed Specification Deviations Section, generally located on the symbols list drawing, MC cables shall be allowed for lighting branch circuits (homeruns shall be EMT), receptacle branch circuits (homeruns shall be EMT) and poke-thru fed systems furniture homeruns. MC shall not be used where exposed, except for a maximum 6' length for final connections to light fixtures, or terminate in electrical panelboards or distribution boards. Equipment ground conductor shall be green. Isolated ground conductor shall be green with yellow stripe. Provide 600V rated aluminum or lightweight steel interlocking armor Metal Clad (MC) cable with copper conductors, THHN (90-degree C) insulation, and integral equipment grounding conductor and isolated grounding conductor as required. Type AC cable listed for use in patient care areas for non-essential electrical system branch circuits per CEC Article 517.13 shall be required in such areas in lieu of MC cable. Type AC and MC cable shall not be used for essential electrical system branch circuits. MC cable shall be manufactured to Underwriter Laboratory Standard 1569. See PART 3 - EXECUTION section of this specification for additional installation requirements.
8. Nonmetallic Flexible Tubing (ENT) shall not be used unless otherwise indicated in the Allowed Specification Deviations Section or Deductive/Additive Alternate Pricing Section generally located on the symbols list drawing. Use of ENT, if allowed, is strictly limited to use in CMU walls and parking structures decks or as directed in writing by the Engineer. See PART 3 - EXECUTION section in this specification for additional installation requirements.
9. Non-Metallic Conduit:
 - a. Polyvinyl chloride (PVC) rigid conduit, Schedule 40, Type II for underground installation only with solvent welded joints, conforming to Underwriters Laboratories, Inc. (UL) requirements, listed for exposed and direct burial application.
 - b. Conduit and fittings shall be produced by the same manufacturer.
10. Fire-rated MC Cable:

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- a. 2-hour fire-rated, polymer insulated 600V MC cable listed and conforming to Underwriters Laboratories, Inc. (UL) 2196 and UL 1569 requirements for installation as an Electrical Circuit Protective System for use in complying with CEC Articles 695 and 700. Cable sheath shall be suitable for use as a CEC equipment grounding conductor and shall be listed for use in wet locations to 90 degrees C (Raychem or equal).
- b. Cable connectors shall be brass MC connectors.

G. Fittings:

1. Condulet type fittings shall be smooth inside and out, taper threaded with integral insulating bushing and of the shapes, sizes and types required to facilitate installation or removal of wires and cables from the conduit and tubing system. These fittings shall be of metal, smooth inside and out, thoroughly galvanized, and sherardized cadmium plated.
2. Metallic condulet covers shall have the same finish as the fitting and shall be provided for the opening of each fitting where conductors do not pass through the cover.
3. Connector, coupling, locknut, bushings and caps used with rigid conduit shall be steel, threaded and thoroughly galvanized. Bushings shall be insulated.
4. UON all EMT fittings, connectors and couplings installed in concealed locations, areas not considered to be wet or damp locations by the AHJ, or areas not subject to physical damage, shall be steel, zinc or cadmium plated, threadless, compression, steel locking ring type with insulated throat. Where suitable for use, steel set screw fittings are allowed for trades sizes of 2" and smaller. Insulated throat is not required for fittings, connectors and couplings 1" and smaller.
5. All interior and exterior EMT fittings, connectors and couplings, 2" and smaller, installed in exposed or concealed locations that are considered by the AHJ to be wet or damp locations, shall be Raintite-listed, steel, zinc or cadmium plated, threadless, compression, steel locking ring type with insulated throat. If Raintite-listed, EMT fittings, connectors and couplings are unavailable for a given trade size or if conduit is installed in an area subject to damage – provide rigid metallic or intermediate metallic conduits, fittings, connectors and couplings as required.
6. Flexible steel conduit connectors shall be a malleable iron clamp or squeeze type or steel twist-in type with insulated throat. The finish shall be zinc or cadmium plating.
7. Conduit unions shall be "Erickson" couplings, or approved equal. The use of running threads will not be permitted.

H. 600 Volt Conductors - Wire and Cable:

1. All conductors shall be copper. Provide stranded conductor for #10 AWG and larger or when making flexible connections to vibrating machinery. Use compression "fork" type connectors or transition to solid conductors when connecting to switches, receptacles, etc.
2. Type THHN/THWN-2 thermoplastic, 600 volt, UL approved, dry and wet locations rated at 90 degrees Celsius, for conductors of all sizes from #12 AWG up to and including 1000 kcmil. RHH/RHW insulation is allowed only to provide an Electrical Circuit Protective System to comply with CEC Articles 695 and 700.

3. Wire and cable shall be new, manufactured not more than six (6) months prior to installation, shall have size, type of insulation, voltage rating and manufacturer's name permanently marked on outer covering at regular intervals.
4. Wire and cable shall be factory color-coded by integral pigmentation with a separate color for each phase and neutral. Each system shall be color-coded and it shall be maintained throughout.
5. Systems Conductor Color Coding:
 - a. Power 208/120V, 3PH, 4W:
 - 1) Phase A = Black
 - 2) Phase B = Red
 - 3) Phase C = Blue
 - 4) Neutral = White or White with Phase Color Tracer
 - 5) Switch legs = Purple (Switch legs shall also be identified separately by numerical tags).
 - 6) Travelers = Purple with Black stripe or Pink.
 - b. Power 480/277V, 3PH, 4W:
 - 1) Phase A = Brown
 - 2) Phase B = Orange
 - 3) Phase C = Yellow
 - 4) Neutral = Grey or Grey with Phase Color Tracer
 - 5) Switch legs = Purple (Switch legs shall also be identified separately by numerical tags).
 - 6) Travelers = Purple with Black stripe or Pink.
 - c. Ground Conductors: Green
 - d. Isolated Ground Conductors: Green with continuous yellow stripe.
 - e. Fire Alarm System: As recommended by the manufacturer.
6. All color-coding for #12 through #6 AWG conductor shall be as identified above. Conductors #4 AWG and larger shall be identified with utilizing phase tape at each termination.
7. No conductors carrying 120V or more shall be smaller than #12 AWG.
8. Aluminum conductors shall not be used.
9. Wire-pulling compounds used as lubricants in installing conductors in raceways shall only be "Polywater J". No oil, grease, graphite, or similar substances may be used. Pulling of #1/0 or larger conductors shall be done with an approved cable pull machine. Other methods; e.g. using vehicles and block and tackle to install conductors are not acceptable.

I. Junction and Pullboxes:

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1. For interior dry locations, boxes shall be NEMA 1 galvanized one-piece drawn steel, knockout type, with removable, machine screw secured covers.
2. For outside, damp or surface locations, boxes shall be NEMA 3R heavy cast aluminum or cast iron with removable, gasketed, non-ferrous machine screw secured covers.
3. For in-grade applications, junction and pull boxes shall be pre-cast concrete or molded fiberglass manufactured by Christy, Brooks-Jensen, or Utility Vault Co. Fiberglass boxes shall:
 - a. Be used only in landscape planter areas that are not subject to damage from lawnmowers, tractors and other machinery.
 - b. Not be used in lawn or turf areas.
 - c. Not exceed 11" W x 17" L in size unless required to be larger to meet code requirements.
4. All boxes shall be sized for the number and sizes of conductors and conduits entering the box and equipped with plaster rings where required.
5. All boxes located in traffic areas shall be traffic rated.

J. Outlet Boxes:

1. For fixtures, boxes shall be galvanized, one-piece drawn steel, knockout type equipped with 3/8" fixture studs and plaster rings where required.
2. For convenience outlets, wall switches, or other devices, outlet boxes shall be galvanized one-piece drawn steel, knockout type 4" x 4" x 2-1/8" minimum size with plaster rings as required.
3. For locations where standard boxes are not suitable due to number and size of conduit to be terminated, special boxes shall be designed to fit space or meet other requirements, and submitted for approval.
4. For exposure to weather, damp locations, or surface mounting, outlet boxes shall be heavy cast aluminum or cast iron with threaded hubs; covers shall be watertight with gaskets and non-ferrous screws.
5. Outlet boxes used for support of ceiling fans shall be galvanized, one-piece drawn steel, knockout type equipped with bracing bars and plaster rings where required and listed for ceiling fan support use. Such boxes shall be labeled and capable of supporting ceiling fan weights up to 70 pounds.
6. See drawings for floor box installation notes and specifications.

K. Plywood Backboards: Where indicated for telephone or communications system terminals or other equipment assemblies, provide backboards of size indicated. Use 3/4" thick x 8' all (length per plans), A/C grade, Douglas Fir, void-free, kiln-dried, fire-rated plywood finished on one side and prime coat painted on all surfaces with finish coat of enamel paint, color by Architect. Leave one (1) fire-rating stamp/sheet exposed for inspection.

L. Terminal Cabinets:

1. Terminal cabinets shall be fabricated of hot dipped galvanized code gauge sheet metal for flush or surface mounting, complete with barriered sections, a door for each vertically barriered section and sizes as indicated on plan. Doors shall be hinged

and lockable. Locks shall be keyed to match the branch circuit panelboards. Terminal cabinet trims shall match the branch circuit panels.

2. Provide each terminal cabinet with a full size mounting backplate.
3. Terminal cabinets shall be installed complete with full-length skirts of the same construction and finish as the terminal cabinet.
4. Where mounted outdoors, terminal cabinets shall be NEMA 3R, weatherproof complete with gaskets and required sealant to prevent moisture from entering the terminal cabinet.
5. All terminal cabinets and terminal cabinet barriered sections shall be labeled by the cabinet or cabinet section use (i.e. CATV, Security, etc.). Labels shall be Micarta type as specified elsewhere in these specifications. Unless otherwise noted, all termination blocks and cables shall be labeled per ANSI/EIA 606 standard.

M. Painting: Terminal cabinets, panels, junction boxes, pull boxes, etc., and conduit installed in public view shall be painted with colors selected by the Architect to match the subject surfaces. Refer to painting section of the specifications for additional requirements.

N. Seismic Design, Certification and Anchoring of Electrical Equipment:

1. Contractor shall include all costs in the base bid for labor, materials, all special inspections and structural engineering design necessary to meet the Seismic Design Requirements for Non-Structural Components (ASCE/SEI 7 Chapter 13 Minimum Design Loads for Buildings and Other Structures) as required by CBC Section 1704A and as related to the installation all electrical equipment furnished under this contract. See Specific Project Site Seismic Criteria on architectural and/or structural plans which include Building Occupancy Category, Seismic Design Category, Design Spectral Response Acceleration (SDS), Height factor ratio (z/h) and Site Class. Non-structural Component Importance Factor (IP) for a particular component shall be determined based on the following criteria:
 - a. z/h - Height factor ratio: See plans for respective equipment locations.
2. Provide a delegated-design submittal for each of the following seismic-restraint systems to be used as required:
 - a. Restraint Channel Bracings consisting of MFMA-4, shop-or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.
 - b. Restraint Cables consisting of ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service, with a minimum of two clamping bolts for cable engagement.
 - c. Seismic-Restraint Accessories consisting of hanger rod/hanger rod stiffener assemblies, multifunctional steel connectors for attaching hangers to rigid channel bracings and/or restraint cables, bushings for floor and wall-mounted equipment anchor bolts and resilient isolation washers and bushings.
 - d. Mechanical Anchor Bolts consisting of drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel

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for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

- e. Adhesive Anchor Bolts consisting of drilled-in and capsule anchor system containing resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide specific LEED-compatible environmentally friendly resins and adhesives on all LEED projects. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.
3. Submittal shall include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the contractor's structural engineer responsible for their preparation. Calculations shall include, but not be limited to, static and dynamic loading caused by equipment weight, operation, and seismic and, if applicable, wind forces required to select seismic and, if applicable, wind restraints and for designing vibration isolation bases. Provide seismic and wind-restraint detailing to support system selection, arrangement of restraints, attachment locations, methods, and spacings with all components identified to include their strengths, directions and values of forces transmitted to the structure during seismic events and association with vibration isolation devices. Sizes of components shall be selected so strength will be adequate to carry present static and seismic loads to accommodate 25% spare future capacity within specified loading limits.
4. Any pre-approval and evaluation documentation shall have a California Office of Statewide Health Planning and Development (HCAi) Special Seismic Certification Preapproval (OPM#) demonstrating horizontal and vertical load testing and analysis showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
5. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified elsewhere in the project specifications.
6. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment. Flexible connection limitations of the CEC shall apply.
7. Install seismic-restraint devices using methods approved by HCAi or an agency acceptable to authorities having jurisdiction providing required submittals for component.
8. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by HCAi or an agency acceptable to authorities having jurisdiction.
9. The contractor shall engage a qualified testing agency to perform tests and inspections as listed in other Project Specifications, but as a minimum shall include

at least four of each type and size of installed anchors and fasteners selected by Architect. Schedule tests with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members as required. Test to 90 percent of rated proof load of device. Prepare and submit test and inspections reports.

O. Trenching and Backfilling: Contractor shall be responsible for trenching and backfilling. Refer to Trenching and Backfilling section of the specifications for complete requirements.

PART 3 - EXECUTION

3.1 PREPARATION AND INSTALLATION

A. Installation of Conduit and Outlet Boxes:

1. All conduit installed in the dry walls or ceilings of a building shall be steel tube (EMT), aluminum tube (EMT), or Intermediate Metal Conduit (IMC). Flexible conduit shall not be used in lieu of EMT, IMC or rigid conduit except as noted herein.
2. Galvanized rigid conduit (GRC) or intermediate metal conduit (IMC) shall be used as follows:
 - a. When noted on the drawings.
 - b. When considered exposed to damage by the local AHJ.
 - c. When installed in wet or damp locations and of a trade size where listed-Raintite fittings, connectors, couplings etc. are unavailable.
 - d. When required by CEC Article 517.13.
 - e. When installed in concrete and masonry. The use of ENT in CMU walls and parking structures may be allowed only as directed in writing by the Engineer. Request for ENT substitution must be made prior to bid and in accordance with pre-bid substitution requests requirements of these specifications.
3. Intermediate metal conduit (IMC), is approved for use in all locations as approved for GRC or steel-tube EMT and in accordance with CEC Article 342.
4. Flexible steel conduit shall only be permitted to be used at light fixture outlets and connections to vibrating electrical equipment. Except when concealed in walls or other structural elements, all flexible steel conduit runs shall be less than 6'-0". All outdoor installation shall be made using liquid-tight flex with approved fittings. Include a separate insulated green ground conductor sized per CEC in each conduit. Other uses of flexible conduit shall be allowed only as approved in writing by the Engineer.
5. Flexible liquidtight conduit shall be installed in lieu of the flexible steel; where required by the CEC in damp and wet location, where exposed to weather, in refrigerated area (65°F or less), and/or between seismic joints. All rotating electrical equipment shall be supplied with flexible, liquid-tight conduit with appropriate slack and shall not exceed thirty-six (36) inches. Include a separate insulated green ground conductor sized per CEC in each conduit. Other uses of liquidtight flexible conduit shall be allowed as approved in writing by the Engineer on a case by case basis.

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6. Rigid metallic conduit installed underground or embedded in concrete shall be 1" trade size minimum and shall be wrapped with 20 mil. Polyvinylchloride plastic tape, PVC conduit installed underground or embedded in concrete shall be 3/4" minimum trade size.
7. Where required for providing an electrical circuit protective system to comply with CEC Articles 695 and 700 utilize UL Listed 2-hour fire-rated, MC cable or UL Listed 2-hour fire-rated RHH/RHW conductors in conduit.
8. Conduit shall be run so as not to interfere with other piping fixtures or equipment.
9. The ends of all conduit shall be cut square, carefully reamed out to full size and shall be shouldered in fitting.
10. No running threads will be permitted in locations exposed to the weather, in concrete or underground. Special union fittings shall be used in these locations.
11. Where conduit is underground, under slabs or grade, exposed to the weather, or in wet locations, make joints liquid tight and gas tight.
12. All metal conduit in masonry and concrete and where concealed under floor slabs shall have joints painted with thread compound prior to makeup.
13. PVC conduit shall not be run in walls except where approved by the Engineer prior to bid in limited instances that may include concrete or CMU walls used in site retaining, parking structures, or exterior equipment yard or enclosure walls, etc.
14. Where conductors enter a raceway or a raceway in a cabinet, pull box, junction box, or auxiliary gutter, the conductors shall be protected by a plastic bushing type fitting providing a smoothly rounded insulating surface.
15. Where conduit extends through roof to equipment on roof area, the Contractor shall provide flashing material compatible with the roofing system as required by the roofing specifications or as required by the Owner's roof warranty. This flashing shall be delivered to the roofing Contractor for installation. The actual location of all such roof penetrations and outlets shall be verified by the Architect/Owner. Contractor to verify type of flashing prior to bid and include all costs.
16. All conduit shall be supported at intervals not less than 6'-0" and within 12" from any outlet and at each side of bends and elbows. Conduit supports shall be galvanized, heavy stamped, two-hole conduit clamp properly secured.
17. Where conduit racks are used the rack shall consist of two-piece conduit clamps attached to galvanized steel slotted channels, properly secured via threaded rods attached directly to the building structure.
18. Nail-in conduit supports, one-piece set screw type conduit clamps or perforated iron for supporting conduit shall not be used.
19. Seismic Conduit Support:
 - a. All conduit shall be supported in such a manner that it is securely attached to the structure of the building. Attachment is to be capable of supporting the tributary weight of conduit and contents in any direction. Maximum spacing of support and braces are to be as follows:

<u>CONDUIT SIZE</u>	<u>MAXIMUM BRACE SPACING</u>
1/2" to 3"	6'-0"
3-1/2" to 4"	8'-0"

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20. All conduit runs shall be installed parallel or perpendicular to walls, structural members, or intersection of vertical planes and ceilings. Field made bends and offset shall be avoided where possible. Crushed or deformed raceway shall not be installed.
21. Open knockouts in outlet boxes only where required for inserting conduit.
22. Locate wall outlet of the same type at same level in all rooms, except where otherwise noted.
23. Outlet boxes on metal studs shall be attached to metal hangers, tack welded or screwed to studs; on wood studs attachment shall be with wood screws, nails are not acceptable.
24. Recessed boxes shall not be mounted back-to-back in any wall; minimum offset shall be 24 inches.
25. Junction Boxes that do not contain any device(s) shall be located in storage rooms, electrical closets, or above accessible ceilings, not in hard lid ceilings or other forms of inaccessible ceilings. Place boxes which must be exposed to public view in a location approved by the Owner's Project Manager. Provide covers or plates to match adjacent surfaces as approved by the Owner's Project manager.
26. Surface mounted pull boxes, terminal cabinets, junction boxes, panel boards etc., shall be attached to walls using appropriate screws, fasteners, backing plates, stud blocking etc., as detailed on architectural and/or structural drawings. If architectural and/or structural drawings are not provided on the project, Contractor shall provide all necessary mounting hardware and backing support to comply with local building code requirements and any additional requirements imposed by the local Authority-Having-Jurisdiction.
27. Sleeves shall be installed where conduit passes through masonry or concrete walls and shall be 24-gauge galvanized steel no more than 1/2" greater in diameter than the outside diameter of the conduit. When located in non-rated structures, caulk conduit sleeve with stone wool and waterproof below grade. When located in fire rated structures, provide UL listed fire stopping system. See fire stopping section of this specification for additional requirements.
28. All boxes shall be covered with outlet box protector, Appleton SB-CK, or similar device/method to keep dirt/debris from entering box, conduit or panels. If dirt/debris does get in, it shall be removed prior to pulling wires.
29. All boxes installed outdoors shall be suitable for outdoor installations, gasketed, screw cover, and painted as directed by the Architect with weatherproof paint to match building.
30. All conduit entries to outdoor mounted panels, cabinets, boxes, etc., shall be made using Myers "SCRU-TITE" hubs Series ST.
31. Provide nylon or a 1/8-inch O.D. polyethylene rope, rated at 250 pounds tensile strength, in all conduits more than 5 feet in length left empty for future use. Not less than 5 feet of rope shall be left at each end of the conduit. Tag all lines with a plastic tag at each end indicating the termination/stub location of the opposite end of the conduit.
32. All multiple conduit runs within suspended ceilings shall be suspended from building structure by means of unistrut hangers/racks, Conduit shall not be allowed to lay on ceiling or be supported from ceiling suspension wires or other suspension system. Support conduit to structure above suspended ceilings 8" minimum above ceiling to

allow removal of ceiling tile. Maintain two-inch clearance above recessed light fixtures

33. All exposed conduits and support hardware shall be painted to match the finish of the wall or ceiling to which it is supported.

34. Where conduits or wireways cross seismic joints, provide approved flexible conduit connection or approved expansion/deflection fitting to allow for displacement of conduit in all three axes. Connection shall allow for movement in accordance with design of seismic joint. Non-flexible raceways crossing expansion joints or other areas of possible structural movement shall make provision for 3-way movement at such points by means of expansion/deflection fittings. Fittings shall be installed in the center of their axes of movement and shall not be deflected to make part of a conduit bend, or compressed or extended to compensate for incorrect conduit expansion/deflection fittings(s) complete with ground jumpers. Where necessary, provide approved expansion joints to allow for thermal expansion and contraction of conduit(s). Install expansion joints complete with ground jumpers.

35. Seal all conduits where termination is subject to moisture or where conduit penetrates exterior wall, floor or roof, in refrigerated areas, classified (hazardous areas) and as indicated on the drawings.

36. Except as otherwise indicated on the Drawings or elsewhere in these specifications, bends in feeder and branch circuit conduit 2 inches or larger shall have a radius or curvature of the inner edge, equal to not less than ten (10) times the internal diameter of the conduit. Except where sweeping vertically into a building, and where sweep radius equals ten (10) times conduit diameter, underground communications and building interconnect conduits 3 inches or larger shall have a minimum 12'-6" radius or curvature of the inner edge. For the serving utilities, radius bends shall be made per their respective specifications.

37. Tag all empty conduits at each accessible end with a permanent tag identifying the purpose of the conduit, footage end-to-end, and the location of the other end. In wet, corrosive outdoor or underground locations, use brass, bronze, or copper 16-gauge tags secured to conduit ends with #16 or larger galvanized wire. Inscribe on the tags, with steel punch dies, clear and complete identifying information.

38. The following additional requirements shall apply to underground conduits:

- a. Underground conduit shall be Schedule 40 PVC (polyvinyl chloride) unless otherwise indicated elsewhere in these specifications or as required per CEC Article 517.13.
- b. For all communications conduits 2" and larger and power feeders 100A or greater, provide with a minimum 3-inch concrete envelope with 2-inch minimum separation between conduits, installed at depth of not less than 24" below grade. Concrete to be used for encasement shall be normal weight concrete with minimum 28-day compressive strength of 2,000 psi. (Provide concrete encasement and/or greater minimum conduit depth as required by the Utility Companies.) Conduit separation within a duct bank shall be maintained using plastic spacers located at 5'-0" intervals. Where power and communication conduits are run in a common trench, a 12-inch minimum separation shall be maintained between power and communication conduits or as required by Utility Companies.

Where concrete encasement is not required by serving utilities for a utility-only duct bank, provide free draining sand bedding suitable to achieve 95%

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relative compaction based on ASTM D1557 using 6" lifts or directed by Utility Company Standards.

- c. In all cases, where any conduit(s) pass under a building slab or footing, the electrical Contractor will provide a Bentonite clay or concrete barrier that conforms to the height and width of the trench excavation extending a minimum of 24" on either side of the foundation. In all cases, where conduit(s) pass through a sleeve in a footing or other foundation element, the electrical Contractor will provide a Bentonite clay or concrete barrier between the sleeve and the conduit(s) surrounding the conduit(s) for the entire depth of the sleeve. The barrier is required to prevent passage of moisture under or through the slab or footing via the trench or sleeve.
- d. Where underground conduit passes under a building slab, concrete encasement may not be required, except as required above, contact the Engineer for written direction prior to omitting any encasement.
- e. Underground conduits, which terminate inside building(s) below grade, such as in a basement level, or which slope so that water might flow into interior building spaces, shall be sealed at the point of penetration with a modular conduit seal (Link-Seal or equal by Rox Systems). Conduit/conduit sealing system penetrations of waterproofing membranes/systems on existing structures shall be completely restored as required to maintain membrane/system manufacturer and installer warranty for the installation. All conduits shall be provided with a 4% slope away from buildings. All conduits shall be installed such that the water cannot accumulate in the conduit and such that water drains into the nearest manhole, pull box or vault – not into the facility. In instances where grade changes or elevation differences prevent sloping of conduit away from a building into the nearest manhole, pull box or vault or where accumulation of water in a manhole, pull box or vault may result in water traveling into the facility, conduits shall be sealed internally at each end of each conduit using conduit sealing bushing, sized as required for the conductors contained within the conduit (O-Z Gedney #CSBG 100psig withstand or equal). In all cases, install plugs or caps in spare (empty) conduits at both ends of each conduit (Jackmoon or equal) preventing both water and gas from entering the facility via the conduits.
- f. Include a separate insulated green ground conductor sized per CEC in each underground electrical feeder/branch circuit.
- g. All underground conduits with circuits rated at 40As or greater and all underground communications conduits shall be provided with a metallic marker tape located 12 inches below the finished grade.
- h. Where underground conduits sweep into/through slabs, utilize PVC 90 degree sweeps that transition, via female PVC adapter to GRC coupling mounted flush in slab. GRC couplings shall be 1/2 lap taped with 20-mil tape. If the distance of the conduit run between a sweep and the next connecting sweep, pullbox, vault or manhole exceeds 150 ft then the sweep shall be concrete encased. Exceptions:
 - 1) Communications conduits shown terminating at a finished floor shall have an additional 4" high GRC nipple equipped with a bushing,

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removable conduit plug, labeling tag and pull rope. Tie off pull rope to conduit plug.

- 2) Utility conduit sweeps shall be installed per the requirements of the respective utility company.

- i. All PVC conduit shall be glued for a water and gas tight installation. The Contractor shall use appropriate solvent on all joints prior to gluing conduit and fittings together.
- j. All underground conduit work shall conform to the Federal, State and Local Safety Orders or Rules regarding excavations, trenches and related earthwork. For projects in California, refer to the California Code of Regulations, Title 8, Construction Code Sections 1540 and 1541 for additional requirements.

B. Installation of 600-Volt Conductors:

1. All electrical wire, including signal circuits, shall be installed in conduit.
2. All circuits and feeder wires for all systems shall be continuous from over current protective device or switch to terminal or farthest outlet. No joints shall be made except in pull, junction or outlet boxes, or in panel or switchboard gutters.
 - a. Utilize pre-insulated "winged" spring type connectors, 3M Company "Performance Plus" #O/B or #R/Y or equal as required for splices and taps in conductors #6 AWG and smaller. When a spring connector is used in an underground environment or when subject to moisture, utilize a 3M Company Scotchcast 3507G epoxy resin connector sealing pack to seal the spring connector. THE USE OF PUSH-WIRE CONNECTORS (e.g. "WAGO" OR EQUIVALENT) IS STRICTLY PROHIBITED.
 - b. Wires #4 AWG and larger AWG shall be joined together as follows:
 - 1) When located in an underground environment or when subject to moisture, the splice shall be made with compression connector and sealed by a 3M, or equal, PST cold shrink connector insulator.
 - 2) When located in an interior environment, the splice shall be made with an Ilasco or equal dual rated, insulated splice-reducer connector or multi-tap connector-listed for use with 75/90-degree Celsius rated conductors.
 - c. Connections to busbar shall be made with dual-rated copper/aluminum one-piece compression lugs. Paralleled conductor connections shall be by mechanical lugs.
3. Thoroughly clean all conduit and wire-ways and see that all parts are perfectly dry before pulling any wires.
4. Install UL approved fixture wire from all lighting fixture lamp sockets into fixture outlet or junction box.
5. For 20A branch circuit wiring, increase #12 conductors to #10 for 120-volt circuits longer than 100 feet and for 277V circuits longer than 150 feet.
6. Conductor Support: Provide conductor supports as required by codes and recommended by cable manufacturer. Where required, provide cable supports in vertical conduits and provide lower end of conduit with a ventilator.

C. Grounding/Bonding:

1. Provide grounding and bonding for entire electric installation as shown on plans, as listed herein, and as required by applicable codes. Included, but not limited to, are items that require grounding/bonding:
 - a. Conduit, Raceways and Cable Trays.
 - b. Neutral or identified conductors of interior wiring system.
 - c. Panel boards, Distribution Boards, Switchgear and Switchboards.
 - d. Non-current carrying metal parts of fixed equipment.
 - e. Telephone distribution equipment.
 - f. Transformers, Inverters, UPS, PDU, RDC, Transfer Switch and Generator Systems.
 - g. Raised Flooring.
 - h. Exposed metal in maintenance holes, hand holes.
 - i. Lightning Protection Systems and Antennas.
 - j. Metal piping installed in or attached to a building/structure.
 - k. Metallically isolated structural steel.
 - l. Metallically isolated underground metal water piping.
 - m. Elevator hydraulic piston/lift case.
2. In multi-occupancy buildings, Contractor shall bond metal water piping systems instated in, under or attached to a building and/or structure serving individual occupancies where the piping system(s) are metallically isolated from each other. Per CEC Article 250.104(A)(2) and (4), the bonding conductor shall be sized per Table 250.122 and connected to the switchboard/panel board serving that suite/occupancy.
3. Use of Ground Rods: Furnish and install required number of 3/4" x 10' copper clad ground rods to meet specified resistance, all required grounding wires, conduit and clamps. The size of the grounding conductors shall be not less than that set forth in the latest edition of the California Code of Regulations, Title 24, State of California and CEC, unless otherwise indicated. Rods shall be installed such that at least 10 feet of length is in contact with the soil. Where rock bottom is encountered, the electrode shall be driven at an oblique angle not to exceed 45 degrees from vertical or shall be buried in a trench that is at least 30 inches deep. The upper end of the electrode shall be flush with or below ground level unless the above ground end and the grounding electrode conductor attachments are protected against physical damage. Unless otherwise noted, connection to the grounding electrode conductor may be by compression type or exothermic process connector. Mechanical connectors shall not be used.
4. Grounding System Connection:
 - a. Compression connectors shall be unplated copper, manufactured by Burndy, or approved equal, designed specifically for the intended connection.

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- b. Exothermic weld-type connectors shall be 'Cadweld' manufactured by Erico Products, or approved equal, designed specifically for the intended connection.
- c. Mechanical connectors shall not be used.

5. Isolated Ground Receptacles shall have an insulated ground wire connected between the receptacle and the panelboard isolated ground bus. Unless otherwise noted, this ground wire shall not be grounded at any other point, and shall be distinguished from other ground wires by a continuous yellow stripe.

6. Provide separate green equipment ground conductor in all electrical raceways to effectively ground all fixtures, panels, controls, motors, disconnect switches, exterior lighting standards, and noncurrent carrying metallic enclosures. Use bonding jumpers, grounding bushings, lugs, busses, etc., for this purpose. Connect the equipment ground to the building system ground. Use the same size equipment ground conductors as phase conductors, up through #10 AWG. Use CEC Table 250.122 for conductor size with phase conductors #8 and larger, if not shown on the Drawings.

7. Clean the contact surfaces of all ground connections prior to making connections.

8. Ductwork: Provide a flexible ground strap, No. 6 AWG equivalent, at each flexible duct connection at each air handler, exhaust fan, and supply fan, and install to preclude vibration.

9. Motors: Connect the ground conductor to the conduit with an approved grounding bushing, and to the metal frame with a bolted solderless lug. Bolts, screws and washers shall be bronze or cadmium plated steel.

10. Building grounding system resistance to ground shall not exceed 25 ohms unless otherwise noted and should be confirmed by testing.

D. Line Voltage and Low Voltage Power Supplies to all Mechanical Equipment Including Plumbing, Heating and Air Conditioning Units:

- 1. An electric power supply, including conduit, any necessary junction and/or outlet boxes and conductors and connection shall be furnished and installed by the Contractor for each item of mechanical equipment.
- 2. Power supplies to individual items of equipment shall be terminated in a suitable outlet or junction box adjacent to the respective item of equipment, or a junction box provided by the manufacturer or the equipment and directed by the Mechanical Contractor. Allow sufficient lengths of conductor at each location to permit connection to the individual equipment without breaking the wire run.
- 3. The location of all conduit terminations to the equipment is approximate. The exact location of these conduit terminations shall be located and installed as directed by the Mechanical and Plumbing Contractor.
- 4. Provide power supplies to all plumbing and mechanical equipment, including but not limited to, equipment furnished and installed by Owner or Contractor such as heating and air conditioning equipment, pumps, boilers, auto valves, water coolers, trap primers etc. The installation shall produce a complete and operable system.
- 5. Unless otherwise noted, the Contractor shall furnish and install all conduit, boxes, wires, etc., for line voltage wiring and low voltage wiring.

6. It is the Contractor's responsibility to verify with the drawings of other trades regarding the extent of his responsibility for mechanical equipment. The bid must include a sum sufficient to cover the cost of the installation.
7. The location of all power supply connection and/or terminations to the mechanical equipment is approximate. The exact locations of these terminations shall be verified with other trades during construction.

E. Prefabricated Equipment: Installation of all prefabricated items and equipment shall conform to the requirements of the manufacturer's specifications and installation instruction pamphlets. Where code requirements affect installation of materials and equipment, the more stringent requirements, code or manufacturer's instructions and/or specifications, shall govern the work.

F. Firestopping:

1. The Contractor shall be responsible for furnishing all material, labor, equipment, and services in conjunction with the selection and installation of a complete, fully functioning, code compliant, UL-listed, fire stop assembly/system(s) as required by project conditions.
2. Each fire stop assembly/system shall have an "F" and/or "T" rating as required by each condition requiring fire stopping. Each fire stop assembly/system shall have a current UL listing, as indicated in the latest edition of the UL Fire Resistance Directory. Contractor shall verify acceptability of all fire stopping methods and system selections with the authority having jurisdiction prior to installation. The Contractor shall install each fire stop assembly/system in accordance with the manufacturer's printed instructions.
3. Each fire stop assembly/system shall be labeled with fire stop manufacturer-furnished label on each side of the fire stopping systems depicting UL # etc.

G. Housekeeping Pads

1. Provide a minimum 3" high housekeeping pad above finished floor/finished grade for all floor-mounted switchgear, switchboards, distribution boards, transformers, motor control centers, etc., flush with the face of the equipment. Located in mechanical central plant(s), other mechanical spaces, and located outdoors, pads shall be flush with the face of the equipment. Confirm pad dimensions with local inspector prior to forming pad to ensure any local code interpretations/conditions are met regarding housekeeping pads.
2. Unless otherwise noted above, provide a minimum 1-1/2" high housekeeping pad above finished floor/finished grade for all interior floor-mounted switchgear, switchboards, distribution boards, transformers, motor control centers, transfer switches etc., flush with the face of the equipment. All housekeeping pad heights are as measured from finished floor or grade. Confirm pad dimensions with local inspector prior to forming pad to ensure any local code interpretations/conditions are met regarding housekeeping pads.
3. Provide a 1-1/2" high housekeeping pad above finished floor/finished for service equipment. Prior to pad rough-in, Contractor shall verify serving utility company's maximum meter height requirements and, if necessary, adjust height of housekeeping pad to comply with those requirements. In indoor applications, the pad shall be flush with the face of the switchgear. In outdoor applications, the housekeeping pad shall extend a minimum of 4 feet from the front of switchgear/switchboard's weatherproof enclosure. Confirm pad dimensions with

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local inspector prior to forming pad to ensure any local code interpretations/conditions are met regarding housekeeping pads.

4. All housekeeping pads located in, on or attached to a building shall be seismically braced/connected to the building structure.

END OF SECTION

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SECTION 27 10 00 - CATEGORY 6 STRUCTURE CABLING SYSTEM (SCS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK

A. All Division 26 as it relates to this scope of work.

1.3 DESCRIPTION

A. Summary of Work:

1. Provide a complete and tested Structured Cabling System (SCS) for the interconnections of the Local Area Network (LAN). The SCS shall include fully terminated unshielded twisted pair cables, fiber optic cabling, raceways, conduit, back boxes, copper/fiber optic termination components, station mounting hardware, fiber optic enclosures, patch panels, copper/fiber optic patch cables, relay racks/cabinets, and other incidental and miscellaneous premises wiring system hardware as required for a complete, tested, and usable system that is in compliance with the latest NEC, ANSI/EIA/TIA, BICSI, and Authorities Having Jurisdiction codes and standards. The installation shall comply with all applicable requirements, design guidelines, and standards in effect at the job site and as indicated in the Drawings and Specifications.
2. Each IDF will connect to the MDF with a 12-strand OS2 Single-Mode armored clad fiber optic cable and a 25-pair, category 5 copper tie cable.
3. If there are any discrepancies between the drawings and specification or among themselves, the contractor shall request clarification prior to providing pricing for the scope of work. If a request is not issued and a response not provided via a posted addendum, the contractor shall provide pricing for the most costly scenario and obtain clarification during the course of the project.

1.4 QUALITY ASSURANCE

A. Acceptable manufacturers:

1. The equipment/products described herein, and furnished per these specifications shall be the product of one manufacturer. All references to model numbers and other detailed descriptive data is intended to establish standards of design performance, and quality, as required
2. The approved manufacturers shall provide a complete category 6 solution with a 40 year performance warranty.

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3. Acceptable product connectivity shall be manufactured by Panduit and the acceptable cable shall be manufactured by Superior Essex. Only the manufacturers listed in this paragraph will be accepted.
- B. Installer Qualifications:
 1. The Data Cable System Installer shall be licensed and shall meet all applicable regulations of the State of California and Department of Labor insofar as they apply to this type of system. The proposer shall be a firm normally employed in the low voltage and data cabling industry and shall provide a reference list of ten
 2. (10) large-scale projects and contact names confirming successful Category 6 premises wiring system installations.
 3. The SCS Installer shall be a Panduit local area, integrator of the manufacturer's product and must be able to provide the manufacturer's maximum available warranty on the entire SCS. The contractor's certification must have been obtained and held within 75 miles of the project's location.
 4. The installing contractor must have a full-time employed RCDD (Registered Communications Distribution Designer) on staff. Current RCDD certification shall be provided in the product submittals.
 5. All individuals installing the SCS must be employees of the certified installer and at least 30% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.
 6. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing SCS contractor will be allowed for any portion of the SCS scope of work.
- C. Pre-Construction Meeting:
 1. The successful Contractor shall attend a mandatory pre-construction meeting with the project's consultant and individuals deemed necessary by the Owner's representative prior to the start of the work. No SCS work shall begin prior to this meeting.
- D. Acceptance:
 1. The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.
- E. Warranty:
 1. The selected system installer shall be a certified installing contractor of product and hold current certification. Contractor shall be shall provide a 40 year end to - end performance warranty on all products installed. The proposer shall provide current

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certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that ALL Enhanced Category 6 cable links have been tested bi-directionally (end to end) using a Level 2 or better tester, per TSB-67, and that all test results conform to the most current TIA/EIA-568-A and/or TSB-67 Link values.

2. The warranty will also cover multimode fiber optic cabling. Performance testing shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, method B.
3. The warranty will stipulate that all products used in this installation meet the prescribed mechanical and transmission specifications for such products as described in ISO/IEC 11801, ANSI/TIA/EIA-568-A, or EN 50173. Quality and workmanship evaluation shall be solely by the Owner/Designer and designated representatives.

1.5 REGULATORY REQUIREMENTS

- A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
 1. Latest Local Codes and Amendments
 2. 2008 National Electrical Code
- B. Other References:
 1. TIA/EIA-568-B Commercial Building Telecommunications Wiring Standard
 2. EIA/TIA-569 Commercial Building Standard for Telecommunication Pathways and Spaces.
 3. TIA/EIA-606 The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
 4. TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications. EIA/TIA 455-A Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.
 5. TIA/EIA TSB 67 Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
 6. TIA/EIA TSB 72 Centralized Optical Fiber Cabling Guidelines
 7. ISO/IEC 11801 Generic Cabling Standard
 8. EN 50173 Generic Cabling Standards for Customer Premises
 9. ANSI/EIA/TIA 526-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plan.

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C. Governing Codes and Conflicts: If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes, regulations, and manufacturer installation requirements.

1.6 ABBREVIATIONS

A. The following abbreviations are used in this document: DC Direct Current IDF Intermediate Distribution Frame MDF Main Distribution Frame PBX Private Branch Exchange UTP Unshielded Twisted Pair

1.7 SUBMITTALS

A. Project Initiation:

1. Within fourteen (14) days of Notice to Proceed, the data network system installer shall furnish the following in a single consolidated submittal:
 - a. Permits: The Contractor shall obtain all required permits and provide copies to the Owner/Architect/Engineer.
 - b. Product Literature: Complete manufacturer's product literature for all cable, patch panels, cross-connect blocks, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicate what specific product is to be provided
 - c. Construction Schedule: A time-scaled Construction Schedule, using PERT/CPM, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 - d. Testing: Proposed Contractor Category 6 UTP cable test result forms, fiber optic cable test result forms and a list of instrumentation to be used for systems testing.
 - e. Specification Compliance: A letter shall be provided stating, by section and subsection, that the SCS installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY OWNER.

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f. Certifications: The contractor shall submit all of the following certifications and the certifications must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project. 1) BICSI RCDD Certification:

- 1) This certification must be held by an on-staff, full-time employee of the SCS installer. The holder must be staffed out of the office that is located within 75 miles of the projected.

2. Fiber Optic Technician Certification: This certification must be held by the on-staff/on-site individual that is supervising the fiber optic installation and performing the fiber optic terminations and testing.

B. Shop Drawings:

1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
 - a. Proposed circuit routing and circuit grouping plan prepared by a BICSI certified RCDD (Registered Communications Distribution Designer). The RCDD certification must be current. Identifiable, separate routing shall be shown for both the station cabling and the MDF-to-IDF tie cabling.
 - b. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - 1) Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - 2) Location of sleeved wall pass-thru
 - 3) Size of sleeve at each location installed
 - 4) Quantity of cable passing through each sleeve
 - 5) Location of drops in each room (quantity or labeling of drops are not required in the submittal plans. Labeling shall be provided in the closeout plans and quantities shall be as per the contract documents, addendums, and issued changes. Each drop shall be labeled for the type of outlet that it is)
 - 6) Conduit routing, size, quantity, and stub-up locations for all floor mounted outlets.
 - c. Drawing Compliance: A letter shall be provided stating that the SCS installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the

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specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE
UNTIL THEY HAVE BEEN ACCEPTED BY THE OWNER.

C. Close-out Procedures:

1. Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. The close out submittals shall include:
 - a. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
 - b. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
 - c. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed, a list of recommended spare parts.
 - d. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 - e. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
 - f. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. The as-built drawings shall be prepared using AutoCad 2013 or later. Provide the Owner with electronic versions of the as-builts on thumb drive media.
 - g. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
 - h. A copy of the manufacturer's warranty on the installed system.

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- i. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
- j. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)
- k. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Minimum amount of training time shall be at least 4 hours.
- l. One (1) 30" x 42" laminated floor plan sheets illustrating technology drops and cable designation. Contractor shall provide one complete floor plan sheet for each telecommunications room (MDF or IDF)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Installation: The cabling shall be installed per requirements of the manufacturer and the Project Documents utilizing materials meeting all applicable TIA/EIA standards. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.
- B. Materials: Materials shall be as listed or shall be approved equivalent products of other manufacturers meeting the intent and quality level of the TIA/EIA specifications. All approved equivalent products will be published by addendum ten days prior to proposal for Architect/Engineer to review.
- C. Testing: All installed cabling shall be tested 100% good after installation by the Contractor. All final test results shall be delivered to owner at completion of project. Refer to closeout requirements listed under section 1.5.
- D. Ratings: All products shall be new and brought to the job site in the original manufacturer's packaging. Electrical components (including innerduct) shall bear the Underwriter's Laboratories label. All communications cable shall bear flammability testing ratings as follows: CM Communications Cable CMP Plenum Rated Communications Cable CMR Riser-Rated Communications Cable
- E. Initial Cable Inspection: The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the reel identification label, that it is of the proper gauge, containing the correct number of pairs, etc. Note any buckling of the jacket that would indicate possible problems. Damaged cable or any other components failing to meet specifications shall not be used in the installation.

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F. Cable Lubricants: Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable into conduit.

1. Approved Products
 - a. Twisted-pair cable: Dyna-Blue American Polywater

G. Fire Wall Penetrations: Any penetration through firewalls (including those in sleeves) will be resealed with an Underwriter Laboratories (UL) approved sealant.

1. Approved Products
 - a. Wiremold Flamestopper - #FS4R-RED
 - b. Precut 4" conduit - #FSPCC4758

2.2 DATA CLOSET (MDF/IDF) CATEGORY 6 TERMINATION HARDWARE

A. Equipment Racks/Cabinets:

1. Provide and install equipment racks and/or cabinets in locations indicated on the attached drawings for the following areas:
 - a. For all IDF locations:
 - 1) Contractor shall provide and install new CPI or equivalent Wall Mount Data Cabinet with plexiglass door. Refer to floor plan for number or racks to provide at each location.
 - 2) Wall Mounted Data Cabinet – Chatsworth #12419-736 (or equal) with plexiglass door and 200 CFM Fan & Filter Kit #11755-003. Mount to E.C. provided painted backboard.

B. Distribution Rack/Cabinet Grounding

1. All Racks and/or Cabinets shall be grounded using stranded #6 AWG insulated copper conductor. Connect to service entrance grounding electrode. Provide all required bonding materials and hardware and bond to building grounding electrode subsystem at building electrical service entrance.

C. Fiber Optic Patch Panels / Enclosures:

1. The enclosures used shall provide termination panels for SC type connectors and be of sufficient size and capacity to terminate 110% of the fiber count of the inside of outside fiber optic cables. Patch panels must be 19" rack mountable. Provide all termination accessories, fiber patch cords, enclosures and test for a complete fiber optic distribution system.
2. Approved Products (for MDF/IDF locations):
3. Rack mount Fiber Cabinets – Panduit or equal.

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- a. Provide a 1RU fiber optic enclosure as designated on the project drawings: Panduit or equal.
- b. Provide 2RU enclosures as required to accommodate fiber counts of 72 or less, Panduit or equal.
- c. Provide 4RU enclosures as required to accommodate larger fiber counts. Panduit or equal.

4. Provide closet connector housing panels, size for 110% of total fiber count to be terminated. Approved products Panduit.

5. Provide new panels for IDF locations as well as new panels required at all IDF locations.

D. Category 6 Patch Panels: The Category 6 data station cable shall be terminated on Category 6 RJ45 patch panels with circuit board construction, T568B terminations. Patch panels shall be 19-inch rack mountable. Workstation patch panels shall terminate all workstation communications outlets. Furnish units that adhere to the performance requirements TIA/EIA-568A standards.

- 1. Approved Products:
 - a. Panduit Category 6 Modular Patch Panels 24 Port
 - b. Panduit Category 6 Modular Patch Panels 48 Port
 - c. (provide cable support bars at the back of all patch panels to provide additional support at rear of rack and panels)

E. Cable Management Panels: Provide cable management panels as required for horizontal and vertical cable management. Provide vertical wire management on ends and in between all racks on entire project.

- 1. Approved Products
 - a. Horizontal – Panduit or equal.
 - b. Rack Vertical – 7' double sided vertical cabling section, Panduit or equal.

F. Network Rack Patch Cables: Cabling Contractor shall provide district with (1) – 5' Category 6 patch cable for each data drop on entire project. These cables will provide connectivity from the front of the network patch panels to the network equipment provided by district upon move-in. The patch cables are to be terminated properly with RJ-45 connections on each end with the proper pin-out assignments per project configuration.

- 1. Approved Products:
 - a. Cat 6 stranded copper Patch Cords. Patch cable colors to be coordinated with jack color of each system type.
 - 1) Provide 75% in 5' lengths and 25% in 7' lengths

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- 2) All patch cables shall be factory terminated. NO EXCEPTIONS.
 - a) Panduit or equal.

2.3 CABLE ROUTING/PATHWAY

- A. Cable Tray: Metal cable tray shall be provided to affix to the top of all floor mount racks.
- B. Cable tray shall be used to brace racks to walls and to route cable from walls to racks in communication closets.
- C. Cable Support System: All low voltage cabling shall be installed and supported using a Caddy Cable Cat or Arlington Loop cable support system at 48" intervals unless installed in conduit. Do not exceed manufacture recommendation for the quantity of cables supported in an individual support.
- D. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.
- E. Innerduct shall be bright orange and shall be labeled fiber optic cables from fiber patch panel to conduit or plenum entrances. Innerduct installed in plenum rated ceilings shall be plenum rated.
 1. Approved products
 - a. Carlon
 - b. Dura-line

2.4 STATION WIRING

- A. Wire: The data and voice wire provided for all outlets shall be (Category 6) unshielded twisted pair, four-pair, 24 AWG solid copper conductor, meeting the intent and quality level of the TIA/EIA-568-B Commercial Building Wiring Standard. Refer to floor plan and data outlet legend for number of active data ports to specified faceplates.
 1. Approved Products: For all voice and data connections:
 - a. Plenum-Rated Panduit Category 6 (blue color for all voice/data drops on entire project)
- B. Testing: The Category 6 four-pair UTP cable must be UL Performance Level tested. Each 1000 foot spool must be individually tested with test results affixed to the spool. ALL CABLE MUST BE PROVIDED ON NEW 1000 FOOT SPOOLS. NO SHORTS WILL BE ALLOWED.
- C. Rating: Cable installed in conduit shall be non-plenum rated. Cable not installed in conduit shall be plenum rated if installed in plenum ceiling space, non plenum rated otherwise.
- D. All cable shall be routed to the center of the room in which it is serving and then route to the outlet location that it is intended for.

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- E. Provide 10' service loop at all headend locations properly supported above ceiling.
- F. Provide 3' service loop at each workstation outlet properly supported above ceiling. All workstation service loops shall be made in figure eight configurations, no exceptions.

2.5 STATION HARDWARE

- A. Flush Mount Jacks: Flush mount jacks shall be high quality Category 6 RJ45 modular jacks with circuit board construction and IDC style or 110-style wire, T568B terminations. Jacks shall meet EIA/TIA TSB40 recommendations for Category 6 connecting hardware.
 - 1. Approved Products – Data, Wireless, Security and Analog Jacks:
 - a. Data (Blue)
 - b. Wireless (Orange)
 - c. Security (Green)
 - d. Analog (Gray)
 - 2. All blank inserts shall be gray.
 - 3. Provide 10% overlap of all colors of TracJack Modules for future expansion of additional network drops
- B. Faceplates: Faceplates shall be a 4-port, flush mounted,
 - 1. 4-Port Single Gang.
 - 2. Provide wall mounted handset faceplates where applicable for wall mounted phone. Refer to floor plan for locations.
 - 3. Provide Mounting Straps (where applicable)
- C. Workstation Patch Cables: Cabling Contractor shall provide district with (1) – 15' Category 6 patch cable for each data drop on entire project. Each cable will be factory terminated with RJ45 connections on each end with appropriate pin-out assignments per project configuration.
 - 1. Approved Products:
 - a. Cat 6 stranded copper Patch Cords. Patch cable colors to be coordinated with jack color of each system type.
 - b. Provide 15' lengths for all drops on the entire project.
 - c. All patch cables shall be factory terminated. NO EXCEPTIONS.
- D. Network Cabinet Patch Cables: Cabling Contractor shall provide owner with Category 6 patch cable for each data drop on entire project. These cables will provide connectivity from the front of the network patch panels to the network equipment provided by owner upon

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move-in. The patch cables are to be terminated properly with RJ-45 connections on each end with the proper pin-out assignments per project configuration.

- E. Cabling Contractor shall provide an extra 50' of each color and length for future expansion purposes.
 1. Approved Products:
 - a. Cat 6 stranded copper Patch Cords. Patch cable colors to be coordinated with jack color of each system type. Provide 75% in 5' lengths and 25% in 7' lengths
 - b. All patch cables shall be factory terminated. NO EXCEPTIONS.

2.6 FIBER OPTIC PRODUCTS

- A. OS2 Single-mode:
 1. Backbone cable shall consist of armored indoor/outdoor (plenum rated only where required by code) OS2 Single Mode fiber optic cable that meets or exceeds ISO/IEC 24702 OS2 and 11801.
 2. Approved Products:
 - a. Intra-building Multimode:
 - 1) New fiber optic backbone cable shall consist of indoor/outdoor plenum rated Single Mode OS2 fiber optic cable.
 - 2) No fusion or mechanical splices will be allowed at any point in the fiber optic runs, unless specifically noted otherwise.
- B. Connectors: Optical Fiber Connectors shall be SC type connectors.
 1. Approved Products:
 - a. OS2 Fiber Optic Cable
 - 1) Corning Freedm One, 12 ST, Indooor/Outdoor, Singlemode, Interlocking Armored, Plenum Rated – 012E8f-31131-29
 - b. Optical Fiber Connectors shall be LC type connectors
 - 1) Single-Mode – Panduit SC Connectors.

2.7 WIRELESS

- A. Contractor to provide wireless access point data outlet per floorplans and detail 7/T3.10.
- B. Contractor to install owner provided wireless access point and ceiling mount brackets in classrooms.

PART 3 - EXECUTION

3.1 GENERAL

- A. Fire Wall Penetrations:
 - 1. The contractor shall avoid penetration of fire-rated walls and floors wherever possible. Where penetrations are necessary, they shall be made using the combination of Pre-Cut Conduit #FSPCC-4758 and Wiremold Flamestopper FS4R-RED fittings. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.
- B. Allowable Cable Bend Radius and Pull Tension
 - 1. In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to the cable manufacturers allowable bend radius and pull tension data for the maximum allowable limits.
- C. Cable Lubricants
 - 1. After installation, exposed cable and other surfaces must be cleaned free of lubricant residue.
- D. Pull Strings
 - 1. Provide pull strings in all new conduits, including all conduits with cable installed as part of this contract. Pull test is not to exceed 200 pounds. Data and video cables can be pulled together with pull strings.
- E. Conduit Fill Conduit fill shall not exceed 40%.
- F. Damage
 - 1. The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over-tightened bindings, loosely twisted and over-twisted pairs at terminals and cable sheath removed too far (over 1-1/2 inches).
 - 2. The Contractor shall replace any damaged ceiling tiles that are broken during cable installation.
- G. Clean Up
 - 1. All clean up activity related to work performed will be the responsibility of the Contractor and must be completed daily before leaving the facility.
- H. No retainage shall be released until Conroe ISD has received all Operations and Maintenance manuals and as-built drawings and first O&M walk.

3.2 DOCUMENTATION

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A. Labels The Contractor will label all outlets using permanent/legible typed or machine engraved labels approved by the Owner (no handwritten labels permitted). Label patch panels in the wiring closet to match those on the corresponding data outlets. The font shall be at least one-eighth inch (1/8") in height, block. All labels shall correspond to as-builts and to final test reports.

1. The following nomenclature should be used when labeling data/voice jacks:
 - a. All cables being served by MDF closet shall begin with 'MDF' all IDF served cables shall begin with 'IDF'# (# designated IDF closet number).
 - b. Next identification letter shall refer to patch panel that is serving outlet (A,B,C...)
 - c. Next identification shall note what # data port on patch panel (1 thru 48).
 - d. Example:
 - 1) Outlet from 23 port of the third patch panel from top of rack located at
 - 2) IDF-2
 - 3) IDF 2 - C23
 - 4) Outlet from the 5th port of the second patch panel from the top of rack located at MDF MDF - B5

B. Floor Plan

1. A floor plan clearly labeled with all outlet jack numbers shall be included in the as-built plans.

C. Cables: All cables shall be labeled at both ends. This includes but not limited to horizontal voice and data cabling, copper backbone tie cables, and fiber optic cables.

D. Fiber Optics: Fiber optic strands shall be labeled at both ends on the fiber distribution panel.

E. Equipment racks: Equipment racks shall bear at least one indicating label indicated MDF or IDF. If rack is installed in IDF, label shall include IDF #.

F. Access Points: Label ceiling grid with digital label according to location installed.

3.3 EQUIPMENT RACK CONFIGURATION

A. Equipment Racks

1. Equipment racks shall be assembled and mounted in locations shown on the Drawings and as detailed. Each rack shall be securely mounted to the floor and braced to the wall with cable tray in accordance with the manufacturer's instructions and recommendations. Racks shall be mounted such that the side rails

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are plumb with vertical cable management panels. Racks to be located such that future expansion can occur without relocating existing racks. Racks shall be grounded in accordance with NEC requirements.

B. Wire Management Components

1. Horizontal cable management panels shall be installed directly above and below each patch panel, also 2 per each 48 port patch panel should be left at site to accommodate the switch gear when they are installed. Vertical cable management panels shall be installed on each side of the rack. In instances where more than one rack is installed in a single location, vertical cable management shall be installed between the racks and on either side.

C. Cable Placement

1. Cable installation in the Wiring Closet must conform to the Project Drawings. All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing area horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings.

D. Cable Routing

1. Cable shall be routed as close as possible to the ceiling, floor or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the Wiring Closet shall be horizontal or vertical within the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.

E. Installation

1. All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels.

F. Hardware

1. Provide rack and jack panel hardware as required for all data station wiring.

3.4 STATION WIRING INSTALLATION

A. General

1. Cabling between wiring closet and workstation locations shall be made as individual home runs. No intermediate punch down blocks or splices may be installed or utilized between the wiring closet and the communications outlet at the workstation location.
2. All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be

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maintained up to the connection points at both ends of the cable. There shall never be more than one and one-half inches of unsheathed enhanced Category 6 UTP cable at either the wiring closet or the workstation termination locations.

B. Exposed Cable

1. All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed cables and/or cables routing through mechanical rooms, electrical rooms, or restrooms shall be installed inside conduits, unless noted otherwise on the project drawings.
2. Additional exposed cable runs will require Owner approval, and will only be allowed when no other options exist.
3. All cable routing through conduits and sleeves shall maintain a 40% maximum conduit fill ratio.

C. Placement

1. All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner's efficient use of their full capacity.

D. Cable Routes

1. All cabling placed in ceiling areas must be in conduit, cable tray or a Caddy Cable Cat or Arlington Loop cable support. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached and that are suitably sized to carry the weight of the cables to be supported. Do not route cable through webbing of structural steel. Cabling must be supported in dedicated supports intended to support cabling as described in this section. Contractor shall adhere to the manufacturer's suggested fill ratio for each size cable support installed.
2. Attaching cable to pipes or other mechanical items is not permitted. Communications cable shall be rerouted so as to provide a minimum of 18 inches spacing from light fixtures, sources of heat, power feeder conduits and EMI sources. Cabling shall not be attached to ceiling. Grid support wires. Cable runs shall be routed down the corridors; parallel or perpendicular to building structure. Multiple cables to be bundled together at and between each cable support installed.
3. Contractor shall be responsible for coordinating with other trades on the project so that the installed cable pathway does not interfere with the installation of other systems to ensure that mechanical ducts, pipes, conduits, or any other above ceiling systems are not putting unnecessary stress on any portion of the install SCS.

3.5 STATION HARDWARE

A. Flush Mount Jacks

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1. Flush mount jacks shall be mounted in a faceplate with back box.
- B. Placement
 1. Where possible, the communications outlet shall be located so that its centerline is 18 inches above floor level or 12 inches above permanent bench surfaces. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches.
 2. Outlets shall be installed within 3'-0" of power outlets
 3. RJ-45 Jack Pin Assignments Pin connections for data station cable outlets and patch panels shall match EIA/TIA 568 modular jack wiring recommendation T568B.
 4. Pin connections at data jack panels shall match pin connections at outlets (straight through wiring)
- C. Faceplate Icons: Contractor shall install faceplate icons.

3.6 CABLE TESTING REQUIREMENTS

- A. Notification: The Owner and Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- B. Inspection: Before requesting a final inspection, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.
- C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.
- D. Errors: When errors are found, the source of each shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Re-test results must be provided on Owner approved forms and witnessed by Owner.
- E. Twisted Pair Cable Testing:
 1. At a minimum, the Contractor shall test all station drop cable pairs from Data Closet termination patch panels to outlet device RJ45 jacks. Category 6 products shall be tested for compliance to ANSI/TIA/EIA 568A and ISO/IES 11801 for a Category 6 rated installation. Test equipment used shall meet TIA/EIA TSB-67, Level II accuracy. Further, the contractor shall have a copy of TSB-67 in their possession and be familiar with its contents.
 2. Each wire/pair shall be tested at both ends for the following:
 - a. Wire map (pin to pin connectivity)

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- b. Length (in feet)
- c. Attenuation
- d. Near end cross talk (NEXT)
- e. Power Sum

3. Test equipment shall provide an electronic and printed record of these tests.
4. Test results for each Category 6 four-pair UTP cable must be submitted with identification to match labels on all patch panel ports and RJ45 jacks and must match as-builts associated with that cable.

F. Fiber Optic Cable Testing

1. Testing device for fiber optic cables shall be a high quality OTDR (Optical Time-Domain Reflectometer) equipped with a printer. The printed data shall show, in addition to any summary information, the complete test trace and all relevant scale settings. The OTDR must have the capability to take measurements from bare fiber strands as well as SC connector terminations.
2. All fiber optic cable shall be tested on the reel before installation to ensure that it meets the specifications outlined herein.
3. After installation the Contractor shall test each fiber strand in accordance the EIA 455-171 Method D procedures (bi-directional testing) at both 850nm and 1300nm for multimode or 1310nm and 1550nm for singlemode. A form shall be completed for each cable showing data recorded for each strand including length, total segment (end-to-end) loss (dB) and connector losses (dB) at each end. In addition, the printed data strip for each strand shall be attached to the form. Patch cables shall also be tested.
4. Acceptable fiber optic connector loss shall not exceed .75dB per mated pair. The Contractor is responsible for obtaining minimum loss in fiber connections and polishing per manufacturer specifications.
5. Singlemode:
 - a. Singlemode fibers shall have a maximum attenuation of 1.0 dB/km at 1310 nm and 1.0 dB/km at 1550 nm.
6. Multimode:
 - a. 50/125um micron multimode fibers shall have a maximum attenuation of 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm. Minimum bandwidth shall be 2000 MHz/km at 850 nm and 500 MHz/km at 1300 nm.
7. OTDR shots shall be provided for each strand of fiber optics completely installed and terminated.

3.7 INSPECTION

A. Conformance to the installation practices covered above are to be verified when completed. In some cases, the Owner/Designer may inspect before acceptance.

1. Written Test Report:
 - a. Complete test results, including actual values associated with tests.
 - b. Show all certifications for telecommunications wiring systems.
 - c. Include cable maps showing each cable route and keyed to cable labels. Provide owner with complete floor plans identifying outlet location and cable routing drawing in AutoCad format. Provide electronic copy of drawings to owner in AutoCad version 2004 or greater.
 - d. Documentation of outlet, cable and rack labeling system.
- B. After performing all tests, tabulate results and bind together in format acceptable to Owner. Installer shall provide written certification in the test report that telecommunications cable is properly installed, and test results certify system to all specified standards.

END OF SECTION

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CATEGORY 6 STRUCTURE CABLING SYSTEM (SCS)

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SECTION 27 51 23
INTEGRATED ELECTRONIC COMMUNICATIONS AND CLOCK NETWORK

SECTION 27 51 23 - INTEGRATED ELECTRONIC COMMUNICATIONS AND CLOCK NETWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The drawings and general provisions of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. This new speaker devices shall connect to the existing Simplex / Johnson Controls Trucom PA system. Provide all wiring, cards, equipment or upgrades as need to integrate new speaker devices into existing PA system.

1.3 DEFINITION OF TERMS

- A. Contractor(s): Shall refer to the company who which actually contracts to perform the work specified herein.
- B. Installer(s) Shall refer to the person, persons, of the company who or which actually contracts to perform the work specified herein.

1.4 SUBMITTALS

- A. Product data for each component.
- B. Shop Drawings: Prior to proceeding with the work: Provide detailed equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, location of each field connection, and a complete schedule of all equipment and materials with associated manufacturer's cuts sheets which are to be used.
 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance. Include a single-line diagram showing cabling interconnection of components and levels throughout system and impedances.
 2. Artwork drawings and lists indicating proposed nameplate nomenclature and arrangements for control panels and plug panels prior to fabrication reflecting equipment used.
 3. Each drawing shall have a descriptive title and all sub-parts of each drawing shall be labeled. All drawings shall have the name and locations of the project, Systems Contractor's name in the title block.
 4. Details and descriptions of any other aspect of the system, which must differ from the contract documents due to field conditions or equipment, furnished.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include record of final matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.
- D. Maintenance Data: For equipment to be included in maintenance manuals specified in Division 1.

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1. Record of Owners equipment-programming option decisions.
2. All instructions necessary for proper operation and manufacturer's instructions.
3. "Proof of Performance" information.
4. Manufacturer's maintenance information.
5. Copies of non-proprietary computer programs and system set up disks documenting all programmable features of the installed system.

E. Record Drawings: Prior to final acceptance, provide three (3) complete sets of drawings indicating all cable numbers and construction details in accordance with the actual system installation. Revise all shop drawings to represent actual installation conditions. These Record Drawings will be used during "Final Acceptance Testing".

F. System Training: Submit the following information describing the training programs and system trainers as outlined in paragraph 1.6 of this specification and in accordance with Division 1 specifications.

1. Include with the submittal a preliminary staff development training program in outline form for review and approval by the owner's representative.
2. Include with the submittal a current copy of the trainer's certification from the manufacturer that certifies and identifies the trainer(s) who are eligible to provide training and support for the project.
3. Include with the submittal a current copy of trainer's needs assessment form which will be reviewed with the owner's designated representative for the system's preliminary system programming and configuration.
4. Include with the submittal copies of all documentation used to identify for the owner those participants attending and completing the training programs.

G. A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications network is covered with the required five-year warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer's stationary.

1.5 QUALITY ASSURANCE

A. Company / Installer Qualifications: An experienced Installer who is an authorized representative of equipment manufacturer for both installation and maintenance of equipment required for this Section. Provide the following within fifteen (15) days after notification to proceed:

1. Provide a list of installations that the Company has specifically installed for verification by the Owner. Random installations from other vendors and/or Installs shall not be accepted. The Company, not its employees, must meet these qualifications.
2. The Company shall be bondable.

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3. The Company shall demonstrate to the satisfaction of the Owner or his representative that he has:
 - a. The Company shall have Adequate plant and equipment to pursue the work properly and expeditiously.
 - b. The Company's shall have Adequate staff (Installers) and technical experience to implement the work.
 - c. Suitable financial status to meet the obligations of the work.
 - d. Technically capable and factory trained service personnel at a local service facility to provide routine and emergency service for all products used in this project.
 - e. The Company's main office of business shall be within 50 miles of the Schools District office.
- B. Any Contractor, who intends to bid on this work and does not meet the requirements of the "Quality Assurance" paragraph(s), shall employ the services of a "Company" who does meet the requirements and who shall provide the equipment, make all connections and continuously supervise the installation. A subcontractor so employed as the "Installer" must be acceptable to the Architect/Engineer/Owner. The "Company" shall be identified within Fifteen (15) days of notification to proceed for acceptance by the Architect/Engineer/Owner.
- C. Because the life expectancy of this type of communications structure normally exceeds 10 years, the owner expects continuity from the service provider. If the installing/servicing company has not been an authorized provider of the manufacturer's product for at least (25) years, the following is required:
 1. A list of (5) systems manufacturers of which they currently are authorized service providers where the relationship exceeds (20) years.
 2. A letter from the manufacturer outlining the details of changes in service providers over the last (15) years and what actions they will take to ensure continuity of service to the customer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- E. Comply with NFPA 70
- F. Comply with NEMA Standard SB-40 for Emergency Communications in K-12 schools.
- G. Comply with UL 60950.

1.6 IN-SERVICE TRAINING

- A. The contractor shall provide and implement a complete and comprehensive staff training program for all administrators, facility staff members, and teachers. This mandatory training program will provide school staff a complete understanding of how to utilize and properly operate all functions. The training program shall be implemented by a staff member/trainer

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employed by the contractor. The trainer must be factory certified to provide training on their product.

- B. All staff development training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all of the staff and faculty members who attended, received, and completed the training program.

1.7 WARRANTY

- A. Provide a Manufacturer's five-year warranty of the school communications network equipment against defects in material and workmanship. This warranty will cover all electronic system components. Additional warranties cover clocks, speakers, and call in switches. If any defects are found within the warranty period, the defective equipment shall be replaced at no cost (equipment only); a one-year warranty shall be provided for labor.
- B. A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications network is covered with the required five-year warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer's stationary. The standard five-year warranty is an important element in establishing a standard in quality. Manufacturers who circumvent the five-year warranty by offering special "extended warranties" that are not part of their normal published warranty will not be accepted.
- C. Contractor shall respond, excluding weekends and holidays, within 24 hours to any warranty service calls. If equipment cannot be repaired within 24 hours of service visit, the contractor shall provide "loaner" equipment to the facility at no charge.
- D. Make available a service contract offering continuing factory authorized service of the system after the initial warranty period.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIAL

- A. Provide Simplex Trucom hardware as needed to support new PA devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with the Installer present, for compliance with requirements and other conditions affecting the performance of the School Communications and School Safety Network Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install system in accordance with NFPA 70 and other applicable codes. Install equipment in accordance with manufacturer's written instructions.
- B. Furnish and install all material, devices, components and equipment for a complete operational system.

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- C. Impedance and Level Matching: Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- D. Control Circuit Wiring: Install control circuits in accordance with NFPA 70 and as indicated. Provide number of conductors as recommended by system manufacturer to provide control functions indicated or specified.
- E. All housings are to be located as indicated.
- F. The Contractor shall provide necessary transient protection on the AC power feed, all copper station lines leaving or entering the building, and all central office trunks. All protection shall be as recommended by the equipment supplier and referenced to earth ground.
- G. Wiring within Enclosures: Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.
- H. Provide physical isolation from speaker-microphone, telephone, line-level wiring, and power wiring. Run in separate raceways, or where exposed or in same enclosure, provide 12 inch minimum separation between conductors to speaker-microphones, telephone wiring and adjacent parallel power. Provide physical separation as recommended by equipment manufacturer for other system conductors.
- I. Identification of Conductors and Cables: Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.
- J. Weatherproofing: Provide **weatherproof enclosures for items to be mounted outdoors or exposed to weather.**

3.3 GROUNDING

- A. Provide equipment grounding connections for Integrated Electronic Communications Network systems as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.
- B. Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.
- C. Provide all necessary transient protection on the AC power feed and on all copper station lines leaving or entering the building. Note in system drawings, the type and location of these protection devices as well as all wiring information.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a duly factory authorized service representative for this project location to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

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- B. Inspection: Make observations to verify that units and controls are properly labeled, and interconnecting wires and terminals are identified. Provide a list of final tap settings of paging speaker line matching transformers.
- C. Testing: Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

3.5 FINAL ACCEPTANCE TESTING

- A. The Final Acceptance Testing shall be provided to the Owner or the Owners designated representative only. Final acceptance testing to any other trade or service provider for the project will not comply with the requirements of this section.
- B. The contractor will provide a Final Acceptance Test record document signed by both the contractor and the Owner or designated Owner's Representative establishing the "In Warranty" date. The warranty period will not commence until the Final Acceptance Test is completed.
- C. Be prepared to verify the performance of any portion of the installation by demonstration, listening and viewing test, and instrumented measurements. Make additional adjustments within the scope of work and which are deemed necessary by the Owner because of the acceptance test.

3.6 COMMISSIONING

- A. The contractor shall train the Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventative maintenance of the system. This training will be in accordance with the training as outlined in Section 1.6 of these specifications. In addition to the Training Materials provided, the contractor will also furnish Operators Manuals and Users Guides at the time of this training. Schedule training with Owner through the owner's representative, with at least seven days advance notice.
- B. Factory Training is available to the Owners personnel as an additional cost.

3.7 OCCUPANCY ADJUSTMENTS

- A. The contractor shall provide Occupancy Adjustments in accordance with Section 1.6 of these specifications. A response scenario amenable to both the owner and the contractor will be established and followed for the first year of service.

3.8 CLEANING AND PROTECTION

- A. Prior to final acceptance, the contractor shall vacuum and clean all system components and protect them from damage and deterioration. All blank spaces in equipment cabinets will be covered with blank panels. Top and side panels, and all cabinet doors will be installed. All general areas within and around all equipment rack/cabinets in the facility will be swept, vacuumed, and cleaned up. No cabinets will be left unlocked, and all cabinet keys will be turned over to the owner or designated owner's representative.

END OF SECTION

SECTION 28 16 00 - INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 RELATED WORK

- A. All Division 26 art relates to this section.

1.2 WORK INCLUDED

- A. The intent of this specification is to add new devices in the new classroom addition. The contractor shall replace the existing head-end panel with a new panel if needed to accommodate new devices. All new and existing devices shall be connected to the new system. Provide new OctoPOPIT units where required. Replace all existing arm/disarm keypads with new devices if needed. The specifications below specify a complete system for reference only and the contractor shall only use the materials required for connection of the new devices.
- B. The system shall include security for all access into portable buildings, including but not limited to doors, roof hatches, windows and interior space motion detection.
- C. The Control System shall be the product of a single manufacturer.
- D. Tag all conductors or cables at each end.
- E. Installation of security panels.
- F. Interconnection of security panels.
- G. Installation of new security devices.
- H. Full coverage of all windows, doors, roof hatches.
- I. Preconstruction meeting with Owner's personnel, installing technician and project superintendent.
- J. The contractor shall connect this location to the district monitoring station as designated by the owner.
- K. Prior to construction, contractor shall perform a test of all existing Intrusion Detection system devices and cabling. Should any faulty devices or cabling be found, contractor shall provide a list of faulty equipment and provide to the Architect and Owner. Contractor shall provide pricing to repair / replace any faulty device / cabling.
- L. Contractor shall integrate the Intrusion Detection system with the Access Control system and the Video Surveillance system. Coordinate with other trades. Provide all licenses required.

1.3 CODES AND STANDARDS

- A. The system shall comply with the applicable Codes and Standards as follows:
- B. National Fire Protection Association Standards:
- C. NFPA 70 National Electric Code
- D. NFPA 72 National Fire Alarm Code

- E. NFPA 101 Life Safety Code
- F. Local & State Building Codes
- G. Requirements of Local Authorities having Jurisdiction
- H. Underwriters Laboratory Requirements and Listings for use in Security Alarm Systems.
- I. Requirements of American Disabilities Act (Public law 101-336).
- J. California Accessibility Standards (C.A.S.)
- K. State Fire Marshall.
- L. California Insurance Code.

1.4 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. The installing contractor shall be the authorized representative of the Security Alarm and Access control system.
 - 2. Manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the security alarm and Access control system manufacturer's product for at least two years.
 - 3. The installing contractor shall be licensed by the State of California as a security services contractor to design, sell, install, and service security alarm systems and access control system.
 - 4. The installing contractor shall provide 24-hour, 365 day per year emergency service with factory trained service technicians.
 - 5. The installing contractor shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least ten (10) years.
 - 6. All Contractors must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the Radionics System. No person is allowed to work on the Radionics system without proper manufacturer's certification.

1.5 SUBMITTALS

- A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
 - 1. Control panel wiring and interconnection schematics.
 - 2. Complete point to point wiring diagrams.
 - 3. Riser diagrams.
 - 4. Complete floor plan drawings locating all system devices.
 - 5. Factory data sheets on each piece of equipment proposed.

6. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
7. Complete system bill of material.
8. Line by line specification review stating compliance or deviation.

B. All submittal data will be in bound form with Contractor's name, supplier's name, project name, and state security license number adequately identified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND INSTALLERS

- A. Radionics as manufactured by BOSCH

2.2 CONTROL COMMUNICATOR (PANEL)

- A. The control communicator shall be Bosch Radionics model number B9512G with latest ROM revision. The unit shall be UL listed for commercial burglar alarm application and shall be FM approved. Contractor shall provide (1) additional B9512G panel for attic stock.
 1. The IDS system is capable of being utilized as a combination Intrusion and Fire system per code. Fully integrated intrusion, access and fire functions allow users to interface with 1 system instead of 3
 2. Integrated Telephone Line Interface with programmable options for signaling and supervision.
 3. Conettix IP based communication option provides high-speed, secure alarm transport and control.
 4. 32 programmable areas with perimeter and interior partitioning.
 5. 8 on-board, class B hardwired points with expansion capability for a total of 246 wired or wireless points.
 6. Compatibility with touch-screen color LCD, vacuum fluorescent, ATM style LCD or LED style Alarm Command Centers.
 7. Local or remote programming, test, and diagnostic capability via a computer running the Remote Programming Software (RPS).
 8. The system shall support the use of an Apple iOS device for control. Functions to include arming, disarming, control of outputs, lock, unlock, cycle and secure access doors.
 9. Integrated real time clock, calendar, test timer and programmable scheduling capability for relay control and automatic execution of system functions based on a time / event.
 10. Provide 1.4 amps of power for standby operation and 2 amps of alarm power, both rated at 12 VDC.
 11. 2 wet-contact relay outputs and 1 Auxiliary wet-contact relay output with expansion capability for up to an additional 128 dry-contact relay outputs.

**SECTION 28 16 00
INTRUSION DETECTION SYSTEM**

12. Integrated battery charger with reverse hook up protection, battery supervision and battery deep discharge protection.
13. Supervision of peripheral devices and communications interface(s).

B. Programmable features shall include:

1. Independently control zones through an independent zone control keypad.
2. Two telephone number dial up for primary and secondary remote receivers.
3. Automatic test reports.
4. Selective zone shunting.
5. Custom text on the associated command centers.

C. Zone Expansion - Expanded to 246 individually annunciated points of protection through the addition of a two-wire multiplex zone expansion system (ZONEX). Points of protection are annunciated with custom text at the D1255B Alpha Command Center and they can be reported to a Radionics D6600 Receiver.

D. User Pass Codes – Nine Hundred nifty-nine (999) user pass codes shall be available to identify the user when arming/disarming the system.

E. Protective Circuits shall consist of zones designed for fire and/or panic (holdup, duress, or emergency) and/or burglary and/or supervisory. Each zone represents a protective circuit and shall accommodate normally opened and closed devices with end-of-line resistor supervision. Each of the 246 points are programmable as to whether they are controlled versus 24 hours; interior versus perimeter; instant versus delayed; silent versus audible (and if audible, pulsed or steady); and local or reporting.

1. Additional programmable parameters for each point include the ability to suppress trouble or restoral reports, designate it as a priority zone (system cannot be armed if this point is off-normal), report two separate telephone numbers and provide for automatic shunting of points from the system in the event that the detection device malfunctions and creates numerous false alarms.
2. Each POPIT shall accommodate normally opened and normally closed devices with end-of-line resistor supervisor.
3. Minimum total points, 248.

F. Entry/exit delays shall be independently programmable from 10 to 150 seconds. A pre-warn audible shall be coincident with the entry delay.

G. Programming of all system functions shall be achievable at system site or remotely via the use of the dial-up telephone network. Minimum programmable functions shall include:

1. User pass codes, entry/exit delay times, master zone personality, day/date/time, telephone numbers, point of protection text labels, and bell time.
2. A programmable system pass code shall be used to prevent unauthorized remote programming attempts.

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3. Remote programming capability shall be automatic or require user enabling at the discretion of the user.
- H. Remote control via the use of the dial-up telephone and owners local area network shall include:
 1. System arming.
 2. Reset of audible signals.
 3. Activation/deactivation of relay contacts.
 4. Interrogation of battery.
 5. Zone and armed status.
 6. Enable/disable of reporting functions and removing reporting devices for servicing while the remainder of the system is operative.
- I. Recognitions shall include UL for central station fire and/or burglary, local burglary and/or fire; FM for fire, California Fire Marshal for fire; and NYBSA for fire.
- J. Miscellaneous built-in features shall include:
 1. Real-time clock.
 2. Interrogator.
 3. Auto-answer modem.
 4. Phone line monitor.
 5. Loop start/ground start telephone interface.
 6. Auto bell test.
 7. Lug-in terminal strips, and user-controlled zone bypass.
- K. Command centers shall be microprocessor-based, UL listed, with built in: Model D1255B White Alpha IV Command Center.
 1. 16 character illuminated alpha-numeric display.
 2. Burglary and fire sounders.
 3. Backlight 15-key touchpad.
 4. Pre-warn tone.
 5. The arming station shall have the ability to annunciate the English language format via the 16-character alphanumeric display by the following:
 6. Master zone (alarm, service, faulted, and function), POPIT (alarm, service, faulted, missing, extra, function, and location), arm/disarm status (system diagnostics, time/day/date, and user prompts).
 7. Additional features shall include local system test, sensor reset, panic and/or medical and/or duress alarm initiation, independent master zone by-pass with automatic restoration to normal status to next system arming, perimeter watch

mode, user changeable pass codes, remote programming initiation, and system/monitoring service test.

8. Radionics/Bosch model D1255B W Alpha IV and shall be functional at each of the locations shown on the floor plans.

L. Modules and Accessories

1. ZONEX (Zone Expansion D8125, D8126)
2. D8132 Battery charger module
3. D8103 Universal enclosure
 - a. D8129 Octo-Relay module - provides eight form "C" dry contact relay outputs for a variety of programmable responses to alarm, trouble and other system conditions. They shall be automatically operated through schedules.
 - b. Auxiliary power supplies as required for powering of motion detectors.
 - c. DX4020 Network Interface module 1ea required.
 - d. D928 Dual Phone Line switcher.

2.3 FIELD DEVICES

A. Ceiling mounted, 360-degree dual technology, infrared sensors/microwave motion sensors. Model DS 9370

1. Bracket for direct mounting to standard 3-1/2" and 4" electrical backboxes.
2. All units to have areas of coverage, which would cause false alarm signals to be generated, masked out and adjusted to reduce false signals.
3. Contractor to provide a dedicated POPIT for each motion detector on the project.

B. Wall mounted, high performance, TriTech PIR/Microwave sensor, Model DS970.

1. Low Profile Bracket for directional mounting to standard 3-1/2" and 4" electrical backboxes.
2. All units to have areas of coverage, which would cause false alarm signals to be generated, masked out and adjusted to reduce false signals.
3. Provide in gymnasiums/cafeteria wall mounted areas. Provide protective wire cover in gymnasium areas.
4. Contractor to provide a dedicated POPIT for each motion detector on the project.

C. Magnetic Door/Hatch Contacts

1. Where exposed contacts are used, they shall be heavy duty switches protected by die cast aluminum housing. The contact leads shall be encased in steel armor jacket.
2. Recessed Steel Door Contacts shall be 1" in diameter, double pole-double throw, white in color. Interlogix Product No. 1076D-N Door Contacts.

3. Surface Mount Steel Door Contacts shall be Aluminum Housing Armored Cable Contact, DPDT, Wide Gap, 1 1/2" Gap Size, Double Pole-Double Throw. Interlogix Product No. 2507AD-L.
4. Overhead Door Contacts shall be Sentrol 2300 Series Panel Door magnetic contacts, Single Pole-Double Throw, with 2' stainless steel armored cable. Interlogix Product No. 2317A
5. Contractor to provide a dedicated POPIT for each motion detector on the project.

D. Glass Break Detector

1. Bracket for direct mounting to standard 3-1/2" and 4" electrical backboxes.
2. Protective wire cage as required in areas where damage to detectors is possible such as athletic corridors, gymnasiums, activity centers, kitchens, etc.
3. GE Solution 2000.

2.4 WIRING

- A. All wiring shall be by the manufacturers (Bosch/Radionics) specifications. All cable shall be shielded as required.
- B. All 120v Power shall be furnished by the Division 26 contractor.
- C. All Security Conduit as shown on the drawings shall be furnished by the Division 26 contractor as part of the scope of work.
- D. Coordination with the Division 26 contractor is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.
- E. All systems shall be connected to an emergency power source as available.
- F. Color code of all security intrusion detection system and access control wiring shall be purple in color.
- G. Approved Products:
 1. 18/2 unshielded:
 2. Belden #6300UE 0071000
 3. Tappan Wire & Cable, Inc. #P40020.122
 4. 18/4 unshielded:
 5. Belden #6302UE 0071000
 6. Tappan Wire & Cable, Inc. #P41387.28
 7. Provide 18/6 cable as required: Belden or Tappan.

PART 3 - EXECUTION

3.1 INSTALLATION

**SECTION 28 16 00
INTRUSION DETECTION SYSTEM**

- A. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
- B. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
- C. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.
- D. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
- E. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
- F. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
- G. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
- H. Telephone Cable: Provide a 4 pair Category 5E telephone cable from the Master Control Panel to the Telephone Equipment Room.
- I. Each motion sensor is to be connected into a dedicated POPIT module for point identification.
- J. Each set of magnetic door contacts that protect one room are to be connected through one POPIT module for point identification of that room.
- K. Magnetic door contacts protecting separate hallways or entry areas to be connected into separate POPIT modules for separate identification.
- L. Provide and install (1) dedicate POPIT for each new device installed on the project. Including, but not limited to glass break detectors.
- M. All POPIT Modules shall be installed inside a 4"x4" junction box with a cover. Junction box shall be mounted on the wall nearest to the device the POPIT Module is associated with and the module shall be mounted to the back box at each location.
- N. Integrate the security system to the remote monitoring station. Provide all hardware and cabling as required. Coordinate with Owner for approved remote monitoring service.
- O. All popits on project shall be mounted above ceiling in easily accessible area. All popit modules are required to be located on as-built drawings delivered to owner at completion of project.
- P. All keypads and sirens shall have dedicated wiring homeruns from each keypad or siren back to panel. Do not daisy chain keypads or sirens.

Q. Contractor shall install communication wire from freezer/cooler control panels to burglar alarm panel to notify panel should freezer/cooler encounter high temperature condition. Coordinate programming and final terminations with Owner.

3.2 CABLE PATHWAYS

A. Cable Support:

1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
2. Approved Cable Support Product:
3. PANDUIT® Corporation J-MOD™ modular support system (sized appropriately for the number of wires being installed. Reference the manufacturer's specifications for the suggested maximum cables per support size.)
4. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the J-MOD™ support hook to the threaded rod.
5. J-MOD™ cable support shall be installed at a maximum of 5' on center.
6. All cable installed shall be attached to the J-MOD™ support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each J-MOD™ cable support to keep wires neatly bundled throughout the entire run. Tiewraps will only be allowed to be used inside the fire alarm panels as required to manage the wires within each type of panel.
7. ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING'S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.
8. IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO INSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON THE INSTALLED WIRING.

B. Conduit / Raceway:

1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.

4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.

3.3 SYSTEM OPERATION

- A. When an alarm condition is detected by any of the alarm initiating devices, the following functions shall occur:
 1. The system keypad's interior audible device shall sound until silenced by using proper security code or after system time out.
 2. A custom system alarm message shall be displayed on the LCD display. This display will show the alarm device location in plain English. Location and partition custom messages shall be field programmable.
 3. The remote signaling tie connection shall be activated at the Owner's approved central security monitoring location and/or other Owner designated location.
 4. Printer shall provide printed copy of events recorded in logger. Install adjacent to security panel.

3.4 SYSTEM ZONING AND PARTITIONING

- A. The system shall employ intelligent initiating devices and interface devices capable of being recognized and enunciated at the main system keypad and devices partition keypad.
- B. All zoning/device locations shall be field programmable.
- C. Input control zones include but are not limited to the following:
 1. Elementary and Junior High Schools
 - a. Kitchen
 - b. Main school areas

3.5 TESTING

- A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, Electrical Contractor and performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to substantial completion. Provide instruction as to proper use and operation of system, for the Owner's designated personnel.

3.6 WARRANTY

- A. Entire system shall be warranted against defects in materials and workmanship for a period of one (1) year from the date of substantial completion.

3.7 SOFTWARE

- A. Provide two electronic copies of the final programming and program software to the Owner's Security Supervisor after final approval.

END OF SECTION

SECTION 28 31 00 – FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division O and Division 1 Specification Sections, apply to work of this Section.

1.2 DESCRIPTION

- A. This section of the specification includes the furnishing, installation, connection and testing of an addition to the Notifier microprocessor controlled, intelligent reporting fire alarm network equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Network Fire Alarm Control Panels (FACP), Network Reporting Terminals (NRT), Network Liquid Crystal Display (NLCD), auxiliary control devices, annunciators, connection to the existing Notifier remote reporting equipment, and wiring as shown on the drawings and specified herein.
- B. The fire alarm system shall comply with requirements of 2019 NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.
- C. The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.
- D. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).
- E. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and shall be in compliance with the U.L. listing.
- F. Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication
- G. The FACPs shall be active/interrogative-type systems where each transponder is repetitively scanned, causing a signal to be transmitted to the local fire alarm control panel node indicating that the transponder and its associated initiating device and notification appliance circuit wiring is functional. Loss of this signal at the local FACP shall result in a trouble indication on both the FACP display and at the network display, as specified hereinafter for the particular input.
- H. The system shall be arranged such that not less than 20 percent additional transponders may be inserted into any network communication loop.

1.3 SCOPE

- A. An addition to the network intelligent reporting, microprocessor-controlled fire detection network shall be installed in accordance with the specifications and drawings.

1.4 BASIC PERFORMANCE

- A. The connection between network control panels shall be a recognized network communication scheme and shall be wired in a Class B, Style 4 fashion.

- B. Alarm and trouble signals from the FACP, NRT, and NLCD network nodes shall be digitally encoded by listed electronic devices onto a NFPA Style 4 looped multiplex communication system.
- C. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto NFPA Style 4 (Class B) Signaling Line Circuits (SLC).
- D. Initiation Device Circuits (IDC) shall be wired NFPA Style B (Class B)
- E. Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y)
- F. Power for initiating devices and notification appliances must be from the main fire alarm control panel, the transponder to which they are connected or to a Field Charging Power Supply (FCPS)
- G. A single ground or open on any system signaling line circuit, initiating device circuit, or notification appliance circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
- H. Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
- I. Digitized electronic signals shall employ check digits or multiple polling
- J. Transponder devices are to consist of low current, solid-state integrated circuits, and shall be powered locally from a primary power and standby power source.

1.5 NETWORK - GENERAL

- A. A node may be an intelligent Fire Alarm Control Panel (FACP), Network Reporting Terminal PC (NRT) or an Intelligent Network LCD Annunciator (INA). The network shall be capable of expansion to at least 103 nodes. Each network node address point shall be capable of processing a minimum of 1,980 analog addressable points. Each network node address shall be software assignable at each node. Systems which utilize a fixed network-addressing scheme are not suitable substitutes. There shall be NO limit to the types, mix, physical location or quantity of any node type below the overall limit of the network node capacity. In addition, each network node shall also act as a signal repeater to reshape and regenerate the network signal.

1.6 BASIC SYSTEM OPERATION

- A. When a fire alarm condition is detected and reported by one of the systems initiating devices or appliances, the following functions shall immediately occur
 - 1. The FACP alarm LED on the FACP shall flash.
 - 2. A local piezo-electric signal in the FACP control panel shall sound
 - 3. The 80-character LCD display on the local FACP node and on the network, displays shall indicate all information associated with the fire alarm condition, including the type of alarm point, and its location within the protected premises.
 - 4. Printing and history storage equipment, located on site as well as at the remote site, shall log the information associated with the fire alarm control panel condition, along with the time and date of occurrence.
 - 5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated on

either local outputs or points located on other network nodes.

B. When a supervisory condition is detected and reported by one of the systems initiating devices or appliances, the following functions shall immediately occur

1. The FACP supervisory LED on the FACP shall flash
2. A local piezo-electric signal in the FACP control panel shall sound
3. The 80-character LCD display on the local FACP node and on the network, displays shall indicate all information associated with the condition, including the type of point, and its location within the protected premises.
4. Printing and history storage equipment shall log the information associated with the fire alarm control panel condition, along with the time and date of occurrence.
5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated on either local outputs or points located on other network nodes.

C. When a trouble condition is detected and reported by one of the systems initiating devices or appliances, the following functions shall immediately occur

1. The FACP trouble LED on the FACP shall flash.
2. A local piezo-electric signal in the FACP control panel shall sound.
3. The 80-character LCD display on the local FACP node and on the network, displays shall indicate all information associated with the condition, including the type of point, and its location within the protected premises.
4. Printing and history storage equipment shall log the information associated with the fire alarm control panel condition, along with the time and date of occurrence.
5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated on either local outputs or points located on other network nodes.

1.7 NETWORK COMMUNICATION

A. The network architecture shall be based on a Local Area Network (LAN), a firmware package which utilizes a peer-to-peer, inherently regenerative communication format and protocol. The protocol shall be based on ARCNET or equivalent. The network shall use a deterministic token-passing method. Collision detection and recovery type protocols are not acceptable substitutes due to life safety requirements. In addition, there shall be no master, polling computer, central file computer, display controller or other central element (weak link) in the network which, on failure, may cause complete loss of network communications or cause major degradation of network capability. There shall be no cascading of CPUs or master-slave relationships at the network level to facilitate network communications. 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. Each node/panel shall communicate on the network at a baud rate of not less than 312 KBPS (kilo bits per second).

B. Each network node address shall be capable of storing Cooperative-Control-By-Event (CCBE) equations. The CCBE shall be used to activate outputs on one network node from

inputs on other network nodes. The CCBE equation shall support the following minimum Boolean operators: AND, OR and NOT.

1.8 SUBMITTALS

- A. General
 - 1. All equipment shall be manufactured by Notifier Systems.
- B. Shop Drawings
 - 1. The Contractor shall provide the following submittal and shop drawing information in 7 copies for review and approval. Any deviations from the specifications shall be noted on the transmittal letters indicating reason for the substitutions.
 - 2. Minimum equipment submissions must include:
 - a. Complete scope of project
 - b. CAD scaled site and building floor plans showing all fire alarm devices. These floor plans are to be limited to fire alarm equipment only. All other signal, fixture, or power references shall not be permitted.
 - c. Single line riser diagram and point to point diagram
 - d. California State Fire Marshal listing sheets showing expiration date for all components
 - e. Manufacturer's specification sheet on all fire alarm equipment.
 - f. DSA project number and school district file number
 - g. Battery and Voltage Drop Calculations for each indicating circuit. Voltage drop shall not exceed 10 percent
 - h. Complete symbol legend for all fire alarm devices being installed
 - i. Elevation detail of manual pull stations, audible and visual devices
 - j. Location of fire/occupancy fire rated walls on floor plan
 - k. Identification of type of wiring used. Must be listed for use as required by Article 760 CEC
 - l. Design number and detail of through penetration firestop system for fire walls
 - m. Floor plan showing room identification
 - n. Details on support and anchorage of fire alarm equipment weighing over 20 pounds
 - o. Sequence of operation/events when alarm system is activated
 - p. Where 2 or more fire alarm panels are interconnected, provide details and data of interface. All panels to report all initiating and supervisory (trouble) functions.
 - 3. Submittals shall be corrected and re-submitted within 14 days when so noted by the Architect until all exceptions are cleared. Material ordered prior to receiving approval is solely at the Contractor's risk.
 - 4. Submit one Operating and Maintenance Manual for each sub-system containing all approved system control loop structures, software support data, zone listings, graphic diagrams, equipment data, spare parts lists, maintenance instructions, and operator and service instruction. After approval and comment by the Architect, furnish 5 complete corrected manuals permanently bound. As-built documentation required below shall be furnished and bound with these manuals.
- C. Alternate Fire Alarm Submittal (Substitutions)
 - 1. Submitter will be responsible to re-engineer the fire alarm system including, but not

limited to, complete fire alarm floor plans, voltage drop calculations, battery calculations, operation matrix, and CSFM listing sheets for all devices. These plans shall be stamped and signed by a registered electrical or fire protection engineer.

2. These new plans must be resubmitted by the Electrical Engineer of Record to DSA for approval.
3. AutoCAD drawing files and PDF files shall be provided to the School District.
4. Any costs associated with project delays, including compensable delays or liquidated damages, must be paid by the submitter.

D. Acceptance and Testing

1. After completion of each sub-system and before final acceptance, provide 6 copies of updated and corrected submittal documentation to record set conditions. One separate set of digital PDF files on a compact disk shall be furnished.
2. Include shop drawings of equipment locations, wiring and piping schematics and details, panel configurations and sizes, and zone analysis. Upon completion of installation and testing, the fire alarm installer shall complete the certification form found in NFPA 72 and submit to the inspector.
3. Final acceptance will be given after successful acceptance testing, and the submission of Owner approved record set documentation and Operation and Maintenance Manuals.
4. Acceptance testing of the life safety system shall be as required by the on-site inspector and the Fire Marshal. The Contractor shall be responsible for identifying the required testing, and coordinate scheduling and conducting the tests necessary to achieve occupancy certification.

E. Training

1. Factory training shall be provided to ten (10) of the owner's personnel. A one-week session on all aspects of the Fire Alarm System shall be conducted at a location that is acceptable to the Kern High School District.

F. Manuals

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets
2. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment
3. Provide a clear and concise description of operation which gives the information required to properly operate the equipment and system
4. Approvals will be based on complete submissions of manuals together with shop drawings

G. Software Modifications

1. Provide the services of an Notifier factory trained and authorized technician to perform all new system software modifications, modifications required to add this site to the existing system, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.

2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm network on 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 modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

H. Certifications

1. Together with the shop drawing submittal, submit a certification from Notifier indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of Notifier and trained on network applications. Include names and addresses in the certification.

1.9 GUARANTEE

- A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one-year period shall be included in the submittal bid.

1.10 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.
- B. The fire alarm system shall comply with requirements of NFPA Standard No. 72 for protected premises signaling systems except as modified and supplemented by this specification. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.

National Fire Protection Association (N.F.P.A.) - USA	
No. 12CO2	Extinguishing Systems (low and high)
No. 12BHalon 1211	Extinguishing Systems
No. 13	Sprinkler Systems
No. 13AHalon 1301	Extinguishing Systems
No. 15	Water Spray Systems
No. 16	Foam/Water Deluge and Spray Systems
No. 17	Dry Chemical Extinguishing Systems
No. 17A	Wet Chemical Extinguishing Systems
Clean Agent Extinguishing Systems	
No 72	National Fire Alarm Code
No. 101	Life Safety Code

Underwriters Laboratories Inc. (UL) – USA	
No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications
No. 521	Heat Detectors for Fire Protective Signaling Systems
No. 464	Audible Signaling Appliances
No. 38	Manually Actuated Signaling Boxes
No. 346	Waterflow Indicators for Fire Protective Signaling Systems
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems

No. 1971 Visual Notification Appliances

C. Local and State Building Codes

1. All requirements of the Authority Having Jurisdiction (AHJ)

1.11 Approvals

A. The system must have proper listing and/or approval from the following nationally recognized agencies:

1. U.L. Underwriters Laboratories Inc
2. FM Factory Mutual
3. MEA Material Equipment Acceptance (NYC)
4. CSFM California State Fire Marshal

B. The fire alarm control panel, shall meet U.L. Standard 864 (Control Units) and U.L. Standard 1076 (Proprietary Burglar Alarm Systems)

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL

- A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.
- B. All equipment and components shall be installed in strict compliance with manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2 CONDUIT AND WIRE

A. Conduit

1. Conduit shall be in accordance with the California Electrical Code (CEC), local and state requirements
2. Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross-sectional area where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per CEC Article 760-29.
4. Wiring for 24-volt control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

5. Conduit shall not enter any FACP or any other remotely mounted control panel equipment or back boxes, except where conduit entry is specified by the FACP manufacturer.
6. Conduit shall be 3/4 inch minimum
7. Conduit must be red.

B. Wire

1. All fire alarm system wiring must be new
2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 16 AWG (1.32 mm) for notification appliance circuits.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system
4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR)
5. Wiring used for the signaling line circuit (SLC) multiplex communication loop shall be twisted and shielded and installed in conduit unless specifically excepted by the fire alarm equipment manufacturer
6. All field wiring shall be completely supervised for open circuit and ground fault
7. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs). Systems that do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps etc., are not acceptable.

C. Terminal Boxes, Junction Boxes and Cabinets

1. All boxes and cabinets shall be U.L. listed for their intended purpose.
2. Initiating circuits shall be arranged to serve like categories (manual, smoke, water flow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.
3. The FACP(s) shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution Panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The FACP cabinet shall be grounded securely to either a cold-water pipe or grounding rod.

2.3 MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE

A. Main FACP or network node shall be a Notifier NFS2-3030, or latest series of panel, and shall contain a microprocessor based Central Processing Unit (CPU) and power supply in an economical space saving single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system-controlled devices.

1. Operator Control

- a. Acknowledge Switch
 - 1) Activation of the control panel acknowledge switch in response to new alarms and/or troubles Notifier shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition.
 - 2) Depression of the Acknowledge switch shall also silence all remote annunciation piezo sounders.
- b. Alarm Silence Switch
 - 1) Activation of the alarm silence switch shall cause all 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 silence able by this switch shall be fully field programmable with the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.
- c. Alarm Activate (Drill) Switch
 - 1) The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.
- d. System Reset Switch
 - 1) Activation of the System Reset switch shall cause all electronically latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.
- e. Lamp Test
 - 1) The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

2. System Capacity and General Operation

- a. The control panel or each network node shall provide or be capable of expansion to 636 intelligent/addressable devices.
- b. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 2.0 amps @ 30 VDC. It shall also include four Class B (N.F.P.A. Style Y) or Class A (N.F.P.A. Style Z) programmable Notification Appliance Circuits.
- c. The control panel or each network node shall support up to 8 additional output modules (signal, speaker, telephone, or relay), each with 8 circuits for an additional 64 circuits. These circuits shall be either Class A (N.F.P.A. Style Z) or Class B (N.F.P.A. Style Y) per the project drawings.
- d. 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.

- e. 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.
- f. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix) or require a laptop personal computer are not considered suitable substitutes.
- g. The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming. Logic equations shall require the use of the PC with a software utility designed for programming.
- h. The FACP or each network node shall provide the following features
- i.
 - 1) Drift compensation, to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
 - 2) Detector sensitivity test, meeting requirement of N.F.P.A. 72, Chapter 7
 - 3) Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
 - 4) Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be .5% to 2.35% per foot for photoelectric detectors and 0.5% to 2.5% per foot for ionization detectors. The system shall also support sensitive advanced detection laser detectors with an alarm level range of .03% per foot to 1.0% per foot. The system shall also include up to nine levels of Pre-alarm, selected by detector, to indicate impending alarms to maintenance personnel.
 - 5) The ability to display or print system reports
 - 6) Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times
 - 7) PAS pre-signal, meeting N.F.P.A. 72 3-8.3 requirements
 - 8) Rapid manual station reporting (under 3 seconds) and shall meet N.F.P.A. 72 Chapter 1 requirements for activation of notification circuits within 10 seconds of initiating device activation
 - 9) Periodic detector test, conducted automatically by the software
 - 10) Self optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks
 - 11) Cross zoning with the capability of counting two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector
 - 12) Walk test, with a check for two detectors set to same address
 - 13) Control-by-time for non-fire operations, with holiday schedules
 - 14) Day/night automatic adjustment of detector sensitivity
 - 15) Device blink control for sleeping areas
 - 16) The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM), Temporal (NFPA 72 A-2-2.2.2), and California Code. Panel notification circuits (NAC 1, 2, 3 and 4) shall also support Two-Stage operation. Two stage operation shall

allow 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. The Panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."

3. 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. The network shall use a deterministic token-passing method. Collision detection and recovery type protocols are not acceptable substitutes due to life safety requirements. In addition, there shall be no master, polling computer, central file computer, display controller or other central element (weak link) in the network which, on failure, may cause complete loss of network communications or cause major degradation of network capability. There shall be no cascading of CPUs or master-slave relationships at the network level to facilitate network communications. 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. Each node/panel shall communicate on the network at a baud rate of not less than 312 KBPS (kilobits per second). A node may be an intelligent Fire Alarm Control Panel (FACP), Network Control Station PC (NCS) or Network Control Annunciator (NCA). The network shall be capable of expansion to at least 103 nodes.
- b. Each network node address shall be capable of storing Event equations. The event equations shall be used to activate outputs on one network node from inputs on other network nodes.
- c. The network shall be capable of communicating via wire or fiber optic medium. A wire network shall include a fail-safe means of isolating the nodes in the unlikely event of complete power loss to a node.
- d. A network repeater shall be available to increase the twisted-pair distance capability in 3,000 ft. increments. As an option, a repeater shall be available for fiber optics that increases the wire distance in 10 dB increments. A mix (Hybrid) fiber/wire network repeater shall also be supported. Systems that have distance limitations and have no available means to regenerate signals are not suitable substitutes.
- e. Fiber Optic Network Communication
 - 1) The network shall support fiber optics with the following specifications
 - a) Size: 50 micrometers/125 micrometers
 - b) Type: Multimode, Dual fiber, Plenum rated
 - c) Distance: maximum 10 dB total attenuation between network nodes
 - d) Connector type: ST or LC

4. Central Microprocessor

- a. The microprocessor shall be a state-of-the-art; high speed, 16-bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage.
- b. Flash memory for building-specific program storage and a "watch dog"

timer circuit to detect and report microprocessor failure.

- c. The microprocessor shall contain and execute all control-by-event
- d. programs for specific action to be taken if an alarm condition is detected by the system.
- e. Control by-event equations shall be held in non-volatile programmable memory and shall not be lost even if system primary and secondary power failure occurs.
- f. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real-time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.
- g. A special program check function shall be provided to detect common operator errors
- h. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational
- i. For flexibility and to ensure program validity, an optional Windows TM based program utility shall be available. This program shall be used to off-line program the system with batch upload/download and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in compliance with the N.F.P.A. 72 requirements for testing after system modification.

5. System Display

- a. The system shall support the following display mode options
 - 1) 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 CPU in place of the standard 80-character display.
- b. The display shall provide all the controls and indicators used by the system operator
 - 1) The 640-character display shall include the following operator control switches
 - a) Acknowledge
 - b) Alarm Silence
 - c) Alarm Activate (drill)
 - d) System Reset
 - e) Lamp Test
- c. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
- d. The display shall also provide Light-Emitting Diodes
 - 1) The 640-character display shall provide 10 Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters
 - a) AC Power & Network Communication

- b) Fire Alarm
- c) Pre-alarm Warning
- d) Security Alarm
- e) Supervisory Event
- f) System Trouble
- g) Alarm Silenced
- h) Disabled Points
- i) Other Events
- j) CPU Failure

2) The 640-character display shall use 10 "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.

6. Network Control Annunciator

- a. A network control annunciator shall be provided to display all system intelligent points. The NCA shall be capable of displaying all information for all 200,000 possible points on the network. Network display devices, which are only capable of displaying a subset of network points, shall not be suitable substitutes.
- b. The NCA shall include a minimum of 640 characters, backlit by a long life, solid state LCD display. It shall also include a full QWERTY style keypad with tactile feel. 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.
- c. The network control annunciator 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 events by type.
- d. The NCA shall mount in any of the network node fire alarm control panels. Optionally, the network display may mount in a backbox designed for the use. The network shall support a minimum of 103 network control annunciators (not to exceed total node capacity) and shall connect to the network over either a wire or fiber interface.
- e. The network control annunciator shall have an event history buffer capable of storing a minimum of 1000 events in non-volatile memory. Additionally, the NCA shall have a fire alarm history buffer capable of storing a minimum of 200 events in non-volatile memory. Systems that do not protect fire alarm events from being overwritten by other events are not suitable substitutes.
- f. The NCA shall include two optically isolated, 9600 baud, industry standard EIA-232 ports for UL 864 listed printers and CTRs. These peripheral devices shall print or display network activity.
- g. The network control annunciator 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 available.
- h. The NCA shall include long life LEDs to display Power, Fire Alarm, Pre-Alarm, Security Alarm, System Trouble, Supervisory, Signals Silenced, Disabled Points, Other (non-fire) Events and CPU Failure.
- i. The network control annunciator shall include a Master password and up to nine User passwords. Each password shall be up to eight alpha-numeric characters in length. The Master password shall be authorized to access

the programming and alter status menus. Each User password may have different levels of authorization assigned by the Master password.

- j. The NCA shall allow editing of labels for all points within the network; control on/off outputs; enable/disable of all 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/Date settings, initiate a Walk Test.
- k. The network control annunciator shall support an optional Windows TM based program utility. This utility shall allow the user to create a NCA database, upload/download an NCA database, and download an upgrade to the NCA executive. To ensure program validity, this utility shall check stored databases for errors. A compare function shall be included to identify differences between databases.
- l. For time keeping purposes the NCA shall include a time-of-day clock
- m. Each NCA shall support up to 32 additional 80-character remote display annunciators for displaying network activity. These "Terminal Mode" displays will mimic the activity appearing on the corresponding NCA.

7. Signaling Line Circuits (SLC)

- a. Each FACP or FACP network node shall support up to two SLCs. 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. The addition of the optional second loop shall double the device capacity, supporting a total of 636 devices. Each SLC shall be capable of N.F.P.A. 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.
- b. CPU shall receive analog information from all 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 detector testing and for the automatic determination of detector maintenance requirements.

8. Serial Interfaces

- a. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting U.L. Listed Information Technology Equipment (ITE) peripherals.

9. Notification Appliance Circuit (NAC) Module

- a. The Notification Appliance Circuit module shall provide four fully supervised Class A or B (N.F.P.A Style Z or Y) notification circuits. An expansion circuit board shall allow expansion to eight circuits per module.
- b. The notification circuit capacity shall be 3.0 amp maximum per circuit and 6.0 amp maximum per module
- c. The module shall not affect other module circuits in any way during a short circuit condition
- d. The module shall provide eight green ON/OFF LEDs and eight yellow TROUBLE LEDs.
- e. The module shall also provide a momentary switch per circuit that may be used to manually turn the particular circuit on or off or to disable the

- circuit.
- f. Each notification circuit shall include a custom label inserted to identify each circuit's location. Labels shall be created using a standard typewriter or word processor.
- g. The notification circuit module shall be provided with removable wiring terminal blocks for ease of installation and service. The terminal strips shall be U.L. listed for use with up to 12 AWG wire.
- h. Each circuit shall be capable of, through system programming, deactivating upon depression of the signal silence switch.

10. Control Relay Module

- a. The control relay module shall provide four Form-C auxiliary relay circuits rated at 5 amps, 28 VDC. An expansion circuit board shall allow expansion to eight Form-C relays per module
- b. Each relay circuit shall be capable of being activated (change in state) by any initiating device or from any combination of initiating devices.
- c. The relay module shall provide 8 green ON/OFF LEDs and 8 yellow LEDs (indicates disabled status of the relay)
- d. The module shall provide a momentary switch per relay circuit that may be used to manually turn the relay ON/OFF or to disable the relay
- e. Each relay circuit shall include a custom label inserted to identify its location. Labels shall be created using a standard typewriter or word processor.
- f. The control relay module shall be provided with removable wiring terminal blocks for ease of installation and service. The terminal blocks shall be U.L. listed for use with up to 12 AWG wire.

11. Enclosures

- a. The control panel shall be housed in a U.L.-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.
- b. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top
- c. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be sight configured for either right- or left-hand hinging.

12. Power Supply

- a. A high-tech off-line switching power supply shall be available for the fire alarm control panel or network node and provide 6.0 amps of available power for the control panel and peripheral devices
- b. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies
- c. Positive-Temperature-Coefficient (PTC thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 60 AH or may be used with an external battery and charger system. Battery arrangement maybe configured in the field.
- d. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators
 - 1) Ground Fault LED

- 2) AC Power Fail LED
- 3) NAC on LED (4)
- e. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP
- f. The main power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge and be capable of charging batteries up to 60 AH
- g. All circuits shall be power-limited, per U.L. 864 requirements.

13. Auxiliary Field Power Supply – Addressable

- a. The auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24 VDC power. The power supply shall also include and charge backup batteries.
- b. The addressable power supply for the fire alarm system shall provide up to a minimum of 6.0 amps of 24-volt DC regulated power for Notification Appliance Circuit (NAC) power or 5 amps of 24-volt DC general power. The power supply shall have an additional .5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 7.0 – 25.0-amp hour batteries.
- c. The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as two Class "A" and two Class "B" or four Class "B" only circuits. All circuits shall be power limited per U.L. 864 requirements.
- d. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.
- e. The addressable power supply shall operate on 120V, 60 Hz.
- f. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC). Other multiplexed means power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire. Data on the SLC shall be transmitted between 24 VDC, 5 VDC and 0 VDC at approximately 3.33k baud.
- g. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.
- h. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of eight or sixteen hours shall be dipswitch selected.
- i. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be Dip-switch selectable
- j. The addressable power supply mounts in either the FACP backbox or its own dedicated surface mounted backbox with cover

- k. Each of the power supply's four output circuits shall be DIP-switch selected for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
- l.
- m. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of an end-of-line resistor. When the power supply's output circuit is selected as General 24 VDC power, the circuit shall be individually supervised when an end-of-line relay is used.
- n. When selected for Notification Appliance Circuits, the output circuits shall be individually DIP-switch selectable for Steady, March Time, Dual Stage or Temporal
- o. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder
- p. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
- q. An individual or multiple interfaced addressable power supply shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

14. Specific System Operations

- a. Smoke Detector Sensitivity Adjust
 - 1) A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed U.L. window and have a minimum of 9 levels.
- b. Alarm Verification
 - 1) Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
- c. Point Disable
 - 1) Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad
- d. Point Read
 - 1) The system shall be able to display or print the following point status diagnostic functions
 - a) Device status
 - b) Device type
 - c) Custom device label
 - d) View analog detector values

- e) Device zone assignments
- f) All program parameters

e. System Status Reports

- 1) Upon command from an operator of the system, a status report will be generated and printed, listing all system status
- 2) System History Recording and Reporting
 - a) The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.

f. Automatic Detector Maintenance Alert

- 1) The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

g. Pre-Alarm Function

- 1) The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.

h. Software Zones

- 1) The FACP shall provide 100 software zones and 10 additional special function zones, 10 releasing zones, and 20 logic zones
- 2) The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows
 - a) Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds

- b) Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds
- c) All devices tested in walk test shall be recorded in the history buffer.
- i. Waterflow Operation
 - 1) An alarm from a waterflow detection device shall activate the appropriate alarm message on the main panel display; turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.
- j. Supervisory Operation
 - 1) An alarm from a supervisory device shall cause the appropriate indication on the system display, light a common supervisory LED, but will not cause the system to enter the trouble mode.
- k. Signal Silence Operation
 - 1) The FACP shall have the ability to program each output circuit (notification, relay, speaker, etc.) to deactivate upon depression of the signal silence switch
- l. Non-Alarm Input Operation
 - 1) Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.
- m. Combo Zone
 - 1) A special type code shall be available to allow waterflow and supervisory devices to share a common addressable module. Waterflow devices shall be wired in parallel, supervisory devices in series.

2.4 SYSTEM COMPONENTS

- A. Programmable Electronic Sounders
 - 1. Electronic sounders shall operate on 24 VDC nominal
 - 2. Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device
 - 3. Shall be flush or surface mounted as shown on plans
- B. Speakers
 - 1. All speakers shall operate on 70.7 VRMS or with field selectable output taps from 0.5 to 2.0 Watts
 - 2. Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10' (3m)
 - 3. Frequency response shall be a minimum of 400 HZ to 4000 HZ
 - 4. The back of each speaker shall be sealed to protect the speaker cone from damage

and dust

5. Strobe lights shall meet the requirements of the ADA, U.L. Standard 1971, be fully synchronized, and shall meet the following criteria
 - a. The maximum pulse duration shall be 2/10 of one second
 - b. Strobe intensity shall meet the requirements of U.L. 1971
 - c. The flash rate shall meet the requirements of U.L. 1971
6. Audible/Visual Combination Devices
 - a. Shall meet the applicable requirements of Section A listed above for audibility
 - b. Shall meet the requirements of Section B listed above for visibility
7. Automatic Conventional Heat Detectors
 - a. Automatic heat detectors shall have a combination rate of rise and fixed temperature rated at 135° Fahrenheit (57.2° C) for areas where ambient temperatures do not exceed 100 °(37.7° C), and 200° (93.33° C) for areas where the temperature does not exceed 150° (65.5° C)
 - b. Automatic heat detectors shall be a low profile, ceiling mount type with positive indication of activation
 - c. The rate of rise element shall consist of an air chamber, a flexible metal diaphragm, and a factory calibrated, moisture-proof, trouble free vent, and shall operate when the rate of temperature rise exceeds 15° F (9.4°C) per minute
 - d. The fixed temperature element shall consist of fusible alloy retainer and actuator shaft
 - e. Automatic heat detectors shall have a smooth ceiling rating of 2500 square feet (762 square meters)
8. Waterflow Indicator
 - a. Waterflow Switches shall be an integral, mechanical, non-coded, non-accumulative retard type
 - b. Waterflow Switches shall have an alarm transmission delay time which is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds
 - c. All waterflow switches shall come from a single manufacturer and series
 - d. Waterflow switches shall be provided and connected under this section but installed by the mechanical contractor
 - e. Where possible, locate waterflow switches a minimum of one (1') foot from a fitting which changes the direction of the flow and a minimum of three (3') feet from a valve
 - f. All interfaces and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with U.L. standard 864
9. Universal Digital Alarm Communicator Transmitter (UDACT)
 - a. The UDACT is an interface for communicating digital information between a fire alarm control panel and a U.L. Listed central station.
 - b. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000' from the fire alarm control panel. The wire connections between the UDACT and the control

panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.

- c. The UDACT shall include connections for two (2) approved means of communications, per U.L./N.F.P.A./FCC requirements. It shall include the ability for split reporting of panel events up to three different telephone numbers.
- d. The UDACT shall be completely field programmable from a built-in keypad and 4-character red, seven segment display
- e. The UDACT shall be capable of transmitting events in at least 15 different formats. This ensures compatibility with existing and future transmission formats
- f. Communication shall include vital system status such as
 - 1) Independent Zone (Alarm, trouble, non-alarm, supervisory)
 - 2) Independent Addressable Device Status
 - 3) AC (Mains) Power Loss
 - 4) Low Battery and Earth Fault
 - 5) System Off Normal
 - 6) 12- and 24-Hour Test Signal
 - 7) Abnormal Test Signal (per UL requirements)
 - 8) EIA-485 Communications Failure
 - 9) Phone Line Failure
- g. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 2,040 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.

10. Field Wiring Terminal Blocks

- a. For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

2.5 SYSTEM COMPONENTS – ADDRESSABLE DEVICES

- A. General
 - 1. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
 - 2. Addressable devices which use a binary-coded address setting method, such as DIP-switch, are not an allowable substitute
 - 3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits
 - 4. Addressable smoke and thermal detectors shall provide dual alarm and power-polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel. Indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.

5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by U.L. as meeting the calibrated sensitivity test requirements of N.F.P.A. Standard 72, Chapter 7.
7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Bases shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.
8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL)
10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
11. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device
12. Addressable modules shall mount in a 4" square (101.6 mm square), 2-1/8" (54mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.

B. Addressable Manual Fire Alarm Box (manual station)

1. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset
3. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger

C. Intelligent Thermal Detectors

1. Thermal detectors shall be intelligent addressable devices rated at 135 °F (58 ° C) and have a rate-of-rise element rated at 15 °F (9.4 ° C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

D. Intelligent Duct Smoke Detector

1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, that provides continuous analog monitoring and alarm verification from the panel.
2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

E. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.
2. The IDC zone shall be suitable for Style D or Style B operation. A LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
3. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4-inch (70 mm) x 1-1/4-inch (31.7mm) x 1/2 inch (12.7mm). This version need not include Style D or an LED.

F. Addressable Relay Module

1. Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 amps resistive or 1.0 amp inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

2.6 BATTERIES

- A. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four (24) hours plus fifteen (15) minutes of alarm upon a normal AC power failure.
- B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills and leakage shall not be required.
- C. If necessary, to meet standby requirements, external battery and charger systems may be used.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, N.F.P.A. 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer
- B. All conduit, junction boxes, conduit supports, and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

- D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans and shall be installed not less than 42" (1067 mm), nor more than 48" (122mm) above the finished floor.
- E. All wiring connections shall be made at the device. Wire between devices shall be continuous no splices will be permitted.

3.2 IDENTIFICATION:

- A. All addressable fire alarm devices shall be labeled on the surface of the device with the fire alarm initiating device designation. Label shall be identifiable by standing on the floor in the room and looking up at the ceiling or through a ceiling/access door in the attic space.

3.3 TEST

- A. The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with N.F.P.A. 72, Chapter 7
- B. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation
- C. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP
- D. Verify activation of all waterflow switches
- E. Open initiating device circuits and verify that the trouble signal actuates
- F. Open and short signaling line circuits and verify that trouble signal actuates
- G. Open and short notification appliance circuits and verify that trouble signal actuates
- H. Ground all circuits and verify response of trouble signals
- I. Check installation, supervision, and operation of all intelligent smoke detectors using walk test
- J. Each of the alarm conditions that the system is required to detect should 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.
- K. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individual addressed or grouped devices, sensitivity monitoring, verification of system function.

3.4 Final Inspection

- A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.5 INSTRUCTION

- A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
- B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

END OF SECTION

SECTION 28 31 00
FIRE ALARM SYSTEM

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SECTION 31 10 00 - SITE CLEARING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Clearing and protection of vegetation.
- B. Grubbing of root systems of trees and shrubs, abandoned utility lines and structures and other below grade obstructions and debris.
- C. Removal of existing debris.

1.2 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- C. Section 01 57 00 - Temporary Controls
- D. Section 01 70 00 – Execution and Closeout Requirements: Project conditions; protection of benchmarks, survey control points, and existing construction to remain; reinstallation of removed products.
- E. Section 01 77 00 – Contract Closeout.
- F. Section 02 41 00 - Demolition: Removal of built elements and utilities.
 - 1. Removal of paving and removal if indicated of abandoned utilities.
 - 2. Within building footprint, removal of designated walls, partitions, and other elements; capping and identifying utilities; and removal of concrete foundations.
 - 3. Sitework (Area of Work), removal of designated fences, walls, and other elements; capping and identifying utilities; landscape paving, and removal of concrete foundations.
- G. Section 31 23 16 - Excavation: Site preparation for structure and paving.
- H. Section 31 23 23 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.
- I. Section 32 93 00 - Plants: Relocation of existing trees, shrubs, and other plants.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Site Plan: Showing:
 - 1. Areas for temporary construction and field offices.

1.4 QUALITY ASSURANCE

- A. Clearing Firm: Company specializing in the type of work required.
 - 1. Minimum of five years of documented experience.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fill Material: As specified in Section 31 23 23 - Fill and Backfill

PART 3 – EXECUTION

3.1 SITE CLEARING

- A. Comply with other requirements specified in Section 01 70 00.
- B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.2 SURVEY STAKING IN UNCLEARED EASEMENTS

- A. Flag centerline of utility lines prior to clearing. Contractor shall set offsets for clearing limits to suit the work.
- B. When the clearing is completed, survey for utility construction in accordance with requirements specified in Section 01 70 00 – Contract Closeout.
- C. Contractor shall replace all controls and stakes damaged or destroyed, at no change in Contract Time or Contract Price.

3.3 EXISTING UTILITIES AND BUILT ELEMENTS

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Protect existing structures and other elements that are not to be removed.

3.4 CLEARING

- A. Perform clearing work within confines of the project area indicated on drawings or specified elsewhere herein and with strict adherence to the Contract Documents and Geotechnical recommendations.

3.5 VEGETATION

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, lawns, and planting beds.
- B. Do not begin clearing until vegetation to be relocated has been removed.

- C. Do not remove or damage vegetation beyond the limits indicated on drawings.
- D. Install substantial, highly visible fences at least 3 feet (1 m) high to prevent inadvertent damage to vegetation to remain:
 - 1. At vegetation removal limits.
- E. Remove only trees within area to be cleared that have been marked for removal. Confirm trees to be removed with Owner and Architect before beginning removal process.
 - 1. Cut trunks close and parallel to ground.
 - 2. Remove roots where under or within five feet of proposed structures.
 - 3. Neither remove nor prune trees and shrubbery in public rights-of-way except by written approval of authorities having jurisdiction.
- F. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.
- G. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
 - 1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
 - 2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches (450 mm).
 - 3. Existing Stumps: Treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches (450 mm).
 - 4. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
- H. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site; treat as specified for vegetation removed.
- I. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.6 GRUBBING

- A. At pipelines, remove all trees or stumps within five feet of the pipeline.
- B. Perform grubbing where indicated on drawings or as specified herein. Grubbing shall include removal from the ground of all stumps, roots, buried logs and other vegetation not otherwise indicated to remain, and removal and disposal of resulting refuse.
- C. Completely grub areas where unsuitable surface material is to be removed.

3.7 DAMAGED VEGETATION

- A. Neatly prune damaged branches and severed roots.

- B. Apply wound paint to above-ground cuts and abrasions.
- C. If trees and shrubs indicated to remain are damaged excessively, as determined by Construction Manager, Architect or authorities having jurisdiction, remove and replace damaged plants with comparable plants.

3.8 DEBRIS

- A. Remove debris, junk, and trash from site.
- B. Remove logs, rocks, and other debris.
- C. Dispose of Debris resulting from clearing and thoroughly clean rights-of-way.
- D. Leave site in clean condition, ready for subsequent work.
- E. Clean up spillage and wind-blown debris from public and private lands.

3.9 DISPOSAL

- A. Debris Disposal: Dispose of all cleared and grubbed materials in a legal manner off site.
- B. Hazardous Materials:
 - 1. Immediately notify the Construction Manager should hazardous materials or suspected hazardous materials be encountered.
 - 2. Dispose of such materials in accordance with all applicable laws and regulations and as directed by authorities having jurisdiction.
 - 3. Unforeseen conditions will be resolved in accordance with the Conditions of the Contract.
- C. Saleable Materials:
 - 1. Unless otherwise indicated, all felled trees from which merchantable lumber or firewood can be produced shall become the property of the Contractor.
 - 2. Unless otherwise indicated, all metallic debris of salvageable value shall become the property of the Contractor.
 - 3. The Contractor shall remove all saleable materials from the site in a timely manner.
 - 4. Sale of salvaged and merchantable materials shall be done on site only with prior approval of the Owner.
- D. Stockpiling Vegetation: Only if specified or indicated under landscape work, stockpile vegetation for subsequent mulching.
- E. Burial and Burning: Debris shall not be buried or burned on site.

3.10 DUST CONTROL

- A. Refer to requirements of:

**SECTION 31 10 00
SITE CLEARING**

1. Section 01 50 00 - Temporary Construction Facilities and Controls.
2. Section 31 22 00 - Grading.
- B. Minimize dust during clearing and grubbing to protect adjoining property and vehicles parked in the vicinity.
- C. Clean-up: Keep public thoroughfares clear of dust and debris by periodic sweeping and washing down, at least daily at the end of working hours.

END OF SECTION

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SECTION 31 22 00 - GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section complements and shall be coordinated with Civil Drawing specifications / requirements. The most stringent requirements shall be utilized.
- B. Removal and storage of topsoil.
- C. Rough grading and consolidation/compaction the site for site structures, building pads, and related site work.
 - 1. Preparation for excavation, trenching, backfilling, and compacting work.
- D. Excavation of subsoil, stockpiling for later reuse, and removal of excess from the site.
- E. Preparing of subgrade for walks, pavements and site retaining walls.
- F. Excavating, backfilling and compaction for wet utility lines.
- G. Finish grading.

1.2 RELATED REQUIREMENTS

- A. Section 01 40 00 - Quality Requirements.
- B. Section 01 45 33 - Code Required Special Inspections and Procedures.
- C. Section 01 77 00 - Execution and Closeout Requirements.
- D. Section 00 31 00 - Available Project Information: Subsurface Investigations.
- E. Section 31 10 00 - Site Clearing.
- F. Section 31 23 16 - Excavation.
- G. Section 31 23 16.13 - Trenching: Trenching and backfilling for utilities.
- H. Section 31 23 23 - Fill: Filling and compaction.
- I. Section 32 12 16 - Asphalt Paving.
- J. Section 32 13 13 - Concrete Paving.
- K. Section 32 93 00 - Plants: Topsoil in beds and pits.

1.3 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1. Accurately record location of all changes in finish elevations and gradients which materially affect drainage.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: For conditions not covered in this section, refer to applicable provisions of the California Building Code (CBC), Chapter 18A - Soils and Foundations, as amended and adopted by authorities having jurisdiction.
- B. Perform Work in accordance with local of, Public Works Department standards.
 1. Maintain one copy on site.

1.5 PROTECTION

- A. Dust Control: Comply with requirements specified in Section 01 50 00 - Temporary Facilities and Controls.
- B. Protection:
 1. Comply with general requirements specified in Section 01 50 00 - Temporary Facilities and Controls.
 2. Provide protection for walks, curbs, drains, and trees and boxing around corners of existing buildings to prevent damage.
 3. Keep adjacent roads, streets and drives clear of dirt and debris from earthwork operations.
- C. Underground Utilities:
 1. Buried utility lines may exist.
 2. If such are encountered, notify Construction Manager, Architect and Owner and for directions to be followed for preservation, relocation, or demolition of utilities.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Topsoil: See Section 31 23 23.
- B. Subsoil: Excavated material, graded free of lumps larger than 3-inches, rocks larger than 6-inches, and debris; or in accordance with trench backfill requirements.
- C. Other Fill Materials: See Section 31 23 23.
- D. Shoring and Bracing: Provide all materials and services necessary to properly engineer and construct shoring for excavations. Selection of materials and design of shoring, underpinning, and bracing of new and existing structures shall be solely the responsibility of the Contractor.
 1. Shoring design shall comply with State of California Trenching and Shoring Manual issued by Offices of Structure Construction; 2011.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that survey benchmark and intended elevations for the work are as indicated.
- B. The drawings do not purport to show all below-grade conditions and objects on the site.
- C. Upon discovery of unknown utility or concealed conditions, discontinue affected work and notify Construction Manager, Architect and Owner for direction. Unforeseen conditions shall be resolved in accordance with the General Conditions.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum. See requirements specified in Section 01 70 00 - Execution.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect from damage above- and below-grade utilities to remain.
 - 1. Maintain and protect remaining existing utilities which pass through the project area.
- D. Notify utility company to remove and relocate utilities, as required.
- E. Protect site features to remain, including but not limited to benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.
- F. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.
- G. Protect plants, lawns, and other features to remain as a portion of final landscaping.

3.3 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. See Section 31 23 23 for filling procedures.
- G. Benching Slopes: Horizontally bench existing slopes greater than 5:1 (H:V) to key fill material to slope for firm bearing.

H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.4 SOIL REMOVAL AND STOCKPILING

A. Topsoil Excavation:

1. Stockpile topsoil to be re-used on site; remove remainder from site.
2. Do not excavate wet topsoil.

B. Subsoil Excavation:

1. Excavate subsoil from areas to be filled with topsoil, to construct foundations, footings, slabs on grade, paving and to achieve final finish grades.
2. Stockpile subsoil to be re-used on site; remove remainder from site.
3. Do not excavate wet subsoil.
4. Over-excavate to working elevations for backfilling and compaction operations.
5. Over-excavate to provide suitable space and access for work. Do not excavate into normal 45-degree influence line of bearing of footings without written direction from the Architect. Generally, footings require additional depth and other provisions to avoid interference.
6. Underpin adjacent structures, paving and other existing features which may be damaged by excavation work, including utilities and pipe chases.
7. Remove all lumped subsoil, boulders, and rock in excess of 6-inch (150 mm) in greatest dimension.
8. Stockpile subsoil on site for backfill if soil is appropriate. Stockpile subsoil to depth not exceeding 8-feet. Remove from the site excess subsoil not to be reused.
9. When excavation through roots is necessary, perform work by hand and cut roots with a sharp axe.
10. Grade top perimeter of excavations to prevent surface water from draining into excavation. Provide dewatering of excavations as required to ensure suitable conditions for concrete and backfilling operations.
11. Hand trim excavations to accurate configurations and depths. Remove loose matter.
12. Machine slope banks of excavations to minimum 1 to 1 ratio horizontal to vertical or angle of repose, if less, until shored. Slope must comply with local codes, ordinances and requirements of agencies having jurisdiction.
13. Where excavations are made to a depth greater than that indicated, such additional depth shall be filled with concrete having the same compressive strength as specified for the footing. Correct unauthorized and erroneous excavation at no change in Contract Time or Contract Sum.

14. Protect excavations from cave-in and from loose soil and other matter from falling in. Comply with all applicable industrial safety regulations.
15. All permanent cut or fill slopes shall have a maximum slope of 2:1 (H:V) ratio, horizontal to vertical and shall comply with applicable requirements of the California Building Code (CBC).

C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet (2.5 m); cover to protect from erosion.

3.5 GRADING

- A. Uniformly grade areas as shown on Drawings to tolerances specified below. Evenly grade between points where elevations are shown or between points of Work and existing grades.
- B. Slope grade away from building perimeter and unpaved areas at gradient indicated.
- C. Make grade changes gradual. Blend slopes into level areas.

3.6 FINISH GRADING

- A. Before Finish Grading:
 1. Verify building and trench backfilling have been inspected.
 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2-inch (13 mm) in size. Remove soil contaminated with petroleum products.
- C. Where topsoil is to be placed, scarify surface to depth of 3-inches (75 mm).
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 6 inches (150 mm).
- E. Place topsoil in areas indicated.
- F. Place topsoil where required to level finish grade.
- G. Place topsoil to thickness as scheduled.
- H. Place topsoil during dry weather.
- I. Remove roots, weeds, rocks, and foreign material while spreading.
- J. Near plants spread topsoil manually to prevent damage.
- K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- L. Lightly compact placed topsoil.

3.7 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16-inches) (30 mm) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2-inch) (13 mm).
- C. Top Surface Under Paving: Plus or minus 1/2-inch (0.05-foot) from required elevation.
- D. Top Surface Under Footings and Foundations: Plus 0, minus 0.2 foot.
- E. Top Surface Under Slabs on Grade: Plus 0, minus 1/2-inch (0.05-foot).

3.8 REPAIR AND RESTORATION

- A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.
- B. Trees to Remain: If damaged due to this work, trim broken branches, and repair bark wounds; if root damage has occurred, obtain instructions from Architect as to remedy.
- C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.9 FIELD QUALITY CONTROL

- A. See Section 31 23 23 for compaction density testing.
- B. Field Quality Control: Field inspections and testing shall be performed in accordance with requirements specified in Section 01 40 00 - Quality Requirements. Make required quality control submittals in accordance with requirements specified.
- C. Non-compliance: Should grade elevations, tests of fill or backfill indicate non-compliance with required elevations or density, Contractor shall over-excavate, recompact and retest until specified grade or density is obtained.
 1. Costs and Time associated with remedial Work and retesting shall be in accordance with provisions of the General Conditions.
 2. Retesting to demonstrate compliance shall be by a testing laboratory acceptable to Owner and shall be at Contractor's expense.

3.10 CLEANING

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

3.11 PROTECTION

- A. Protect completed grading from erosion from weather and traffic.
- B. Over-excavate and recompact areas damaged by construction activities and weather.

SECTION 31 22 00

GRADING

END OF SECTION

SECTION 31 22 00
GRADING

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SECTION 31 23 16 – EXCAVATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Excavating for building volume below grade, footings, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Trenching for utilities outside the building to utility main connections.

1.2 RELATED REQUIREMENTS

- A. Section 01 40 00 - Quality Control: Inspection of bearing surfaces.
- B. Section 01 50 00 - Temporary Construction Facilities and Controls: Dewatering excavations and water control.
- C. Section 01 57 00 - Temporary Erosion and Sedimentation Control: Slope protection and erosion control.
- D. Section 01 70 00 - Execution and Closeout Requirements: General requirements for dewatering of excavations and water control.
- E. Section 01 77 00 – Contract Closeout
- F. Section 02 41 00 - Demolition: Shoring and underpinning.
- G. Section 31 22 00 - Grading: Soil removal from surface of site.
- H. Section 31 22 00 - Grading: Grading.
- I. Section 31 23 16.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.
- J. Section 31 23 23 - Fill: Fill materials, filling, and compacting.
- K. Section 33 41 11 – Sub-Drainage: Filter aggregate and filter for foundation drainage.

1.3 PROJECT CONDITIONS

- A. Verify that survey benchmark and intended elevations for the work are as indicated.

1.4 COORDINATION OF SPECIFICATION REQUIREMENTS

- A. Coordinate these Specification Section requirements with specifications included on Drawings. Comply with more stringent requirements and with those requirements of authorities having jurisdiction.
- B. Comply in full with the recommendations given in the Geotechnical Report.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that survey benchmark and intended elevations for the work are as indicated.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 22 00 for additional requirements.

3.3 EXCAVATING

- A. Underpin adjacent structures that could be damaged by excavating work.
- B. Excavate to accommodate new structures, construction operations, and paving/site structures.
- C. Shoring and Bracing: Provide all materials and services necessary to properly engineer and construct shoring for excavations. Selection of materials and design of shoring, underpinning, and bracing of new and existing structures shall be solely the responsibility of the Contractor.
 - 1. Shoring design shall comply with State of California Trenching and Shoring Manual issued by Offices of Structure Construction; 2011.
- D. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- E. Slope banks of excavations deeper than 4 feet (1.2 meters) to angle of repose or less until shored, per Cal/OSHA requirements for Type C Soil.
 - 1. Machine slope banks to angle of repose or less, until shored.
- F. Do not interfere with 45 degree bearing splay of foundations.
- G. Cut utility trenches wide enough to allow inspection of installed utilities.
- H. Hand trim excavations. Cut through tree roots with a sharp axe. Remove loose matter.
- I. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.
- J. At no additional cost, correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 23 23.
- K. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- L. Remove excavated material that is unsuitable for re-use from site.
- M. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 22 00.

N. Remove excess excavated material from site.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load bearing excavated surfaces before placement of foundations.
- C. Scarification, over excavation and all other excavations will be subject to the approval of the Soils Engineer.

3.5 PROTECTION

- A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION

SECTION 31 23 16
EXCAVATION

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SECTION 31 23 16.13 – TRENCHING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Backfilling and compacting for utilities from 5 feet outside the building to utility main connections.

1.2 RELATED REQUIREMENTS

- A. Section 31 22 00 - Grading: Site grading.
- C. Section 31 23 16 - Excavation: Building and foundation excavating.
- D. Section 31 23 23 - Fill: Backfilling at building and foundations.
- E. Section 33 11 16 - Site Water Distribution Piping: Potable Water Systems.
- F. Section 33 31 11 - Site Sanitary Sewerage Systems: Sewer piping from building to municipal sewer.
- G. Section 33 41 11 - Site Storm Drainage System: Storm drainage piping from building to municipal storm drain system.

1.3 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.

1.4 REFERENCES

- A. Code Compliance: See Section 01 41 00 - Regulatory Requirements
- B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010
- C. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018 is current; use 2018 as indicated in 2022 CBC Referenced Standards.
- D. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- E. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- G. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.

H. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Comply with the requirements listed in Section 31 23 23 - Fill.
- C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

1.6 COORDINATION OF SPECIFICATION REQUIREMENTS

- A. Coordinate these Specification Section requirements with specifications included on Drawings. Comply with more stringent requirements and with those requirements of the authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where designated.
 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 2. Prevent contamination.
 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 – PRODUCTS

2.1 FILL MATERIALS

- A. For fill materials see Section 31 23 23 - Fill.
- B. For bed materials see Section 31 23 23 - Fill.
- C. General Fill: Subsoil excavated on-site.
- D. Structural Fill: Subsoil excavated on-site.
- E. Concrete for Fill: As specified in Section 03 30 00; compressive strength of 2500 psi (17.235 MPa).
- F. Granular Fill - Gravel: Pit run washed stone; free of shale, clay, friable material, and debris.
 1. Graded in accordance with ASTM C136, within the following limits:
 - a. 3/4-inch (19 mm) sieve: 95 to 100 percent passing.
- G. Granular Fill - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter.

1. Grade in accordance with ASTM D2487 Group Symbol GM.
- H. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
 1. Grade in accordance with ASTM D2487 Group Symbol SW.
- I. Topsoil: Topsoil excavated on-site.
 1. Select.
 2. Graded.
 3. Free of roots, rocks larger than 1/2-inch (12 mm), subsoil, debris, large weeds, and foreign matter.
 4. Acidity range (pH) of 5.5 to 7.5.
 5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.
 6. Conforming to ASTM D2487 Group Symbol OH.

2.2 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for **compliance before delivery to site**.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that survey benchmarks and intended elevations for the work are as indicated.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 22 00 for additional requirements.

3.3 TRENCHING

- A. Excavate subsoil required for conduits, storm drain, sanitary sewer, water, and gas piping to municipal utilities.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Slope banks of excavations deeper than 4 feet (1.2 meters) to angle of repose or less until shored.
- D. Do not interfere with 45 degree bearing splay of foundations.

- E. Cut trenches wide enough to allow inspection of installed utilities.
- F. Hand trim excavations. Remove loose matter.
 - 1. Hand trim for bell and spigot pipe joints.
- G. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- H. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd (0.25 cu m) measured by volume.
- I. Remove excavated material that is unsuitable for re-use from site.
- J. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 22 00.
- K. Remove excess excavated material from site.

3.4 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.
- D. Support pipe and conduit during placement and compaction of bedding fill.

3.5 BACKFILLING

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb, or damage installed piping and conduits, or other work.
- D. Systematically fill and compact to achieve 90 percent relative compaction without damaging conduit or pipe. Do not fill over porous, wet, frozen, or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches (150 mm) compacted depth.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8-inches (200 mm) compacted depth or as directed by the Geotechnical Report.
- H. Slope grade away from building minimum 2-inches in 10 ft (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- I. Correct areas that are over-excavated.

1. Thrust bearing surfaces: Fill with concrete.
2. Other areas: Use general fill, flush to required elevation, compacted to minimum 90 or 95 percent of maximum dry density as applicable for the fill area.

J. Compaction Density Unless Otherwise Specified or Indicated:

1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.
2. At other locations: 90 percent of maximum dry density.

K. Reshape and re-compact fills subjected to vehicular traffic.

3.6 BEDDING AND FILL AT SPECIFIC LOCATIONS

- A. Use general fill unless otherwise specified or indicated.
- B. Utility Piping, Conduits, and Duct Bank:
 1. Bedding: Use Fill Type SP or SW (ASTM D2487) or SM with sand equivalent of 30 or greater per ASTM D2419, 3 inches thick, compacted to 90 percent.
 2. Cover with Fill Type SP, SW, SM, GM per ASTM D2487.
 3. Fill up to subgrade elevation.
 4. Compact in maximum 8-inch (200 mm) lifts to 95 percent of maximum dry density.
 5. Gas Piping: As required by the Gas Company.
- C. Power Conduits Beyond Power Co. Transformer:
 1. Bedding: Use Fill Type SP or SW (ASTM D2487) or SM with sand equivalent of 30 or greater per ASTM D2419, 3 inches thick, compacted to 90 percent.
 2. Cover with Fill Type SP, SW, SM, GM per ASTM D2487.
 3. Fill up to subgrade elevation.
 4. Compact in maximum 8-inch (200 mm) lifts to 95 percent of maximum dry density.
- D. Over Sub-Drainage Piping at Foundation Perimeter and Under Slabs:
 1. Drainage fill and geotextile fabric: Section 33 41 11.
 2. Cover drainage fill with general fill.
 3. Compact to 95 percent of maximum dry density.

3.7 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 1.2 inch (30 mm) from required elevations.

- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1.2 inch (30 mm) from required elevations.

3.8 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Control, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556 or ASTM D6938.
- C. See Section 31 23 23 for compaction density testing.
- D. Correct unauthorized excavation at no cost to Owner.
- E. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 1557 ("modified Proctor") or AASHTO T 180.
- F. If tests indicate work does not meet specified requirements, remove work, replace, and retest at no additional cost to Owner.
- G. Correct areas over excavated by error in accordance with Section 31 23 23 - Fill.
- H. Frequency of Tests: See Section 31 22 00 - Grading.

3.9 CLEANING

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

3.10 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01 50 00 - Temporary Construction Facilities and Controls.
- B. Recompact fills subjected to vehicular traffic.

END OF SECTION

SECTION 31 23 23 – FILL

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Filling, backfilling, and compacting for building volume below grade, footings, slabs-on-grade, paving, and site structures.
- B. Backfilling and compacting for utilities outside the building to utility main connections.
- C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.2 RELATED REQUIREMENTS

- A. Document 00 31 00 - Available Project Information: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 31 22 00 - Grading: Site grading.
- D. Section 31 23 16 - Excavation: Removal and handling of soil to be re-used.
- E. Section 31 23 16.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.

1.3 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.

1.4 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010
- B. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013 is current; use 2003 as indicated in 2013 CBC Referenced Standards.
- C. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- D. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- E. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.

- F. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.
- G. Geotechnical Report.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Samples: 10 lb (4.5 kg) sample of each type of fill; submit in air-tight containers to testing laboratory.
- 1. Submit samples directly to Geotechnical Engineer for testing and analysis copy transmittals to Architect and Owner.
- C. Materials Sources: Submit name of imported materials source.
- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where agreed to.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 – PRODUCTS

2.1 FILL MATERIALS

- A. All fill materials shall be in conformance with the approved Soils Report, addenda and geotechnical data.
- B. General Fill: Subsoil excavated on-site.
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches, rocks larger than 6 inches (150 mm), and debris.
 - 3. Conforming to ASTM D2487 Group Symbol SP, SW, SM, or GM.
- C. Structural Fill: Subsoil excavated on-site.
 - 1. Graded.

2. Free of organic matter, debris, and lumps larger than 3 inches (75 mm), rocks larger than 6 inches (150 mm). Fill shall contain at least fifty percent of material smaller than 1/4-inch in size.
3. Imported fill materials: The soil shall be tested for potential contamination in accordance with DTSC protocols.
4. On-site soils should only be used as specified in the Soils Report.
5. Conforming to ASTM D2487 Group Symbol SP, SW, SM, or GM.
6. Fill (SP, SW per ASTM D2487) may be used for structural backfill at the Contractor's option. However, sand shall not be placed within one foot of finished surface elevation. Material shall be free of perishable or spongy matter, trash, and all other vegetation.

D. Concrete for Fill: As specified in Section 03 30 00; compressive strength of 2500 psi (17.235 MPa); except concrete used under footings and foundations to correct over-excavation shall be same as for footings and foundation.

E. Granular Fill - Gravel - Fill Type GM, GW: Angular crushed washed stone; free of shale, clay, friable material and debris.

1. Class 2 Aggregate base per CT202 and Section 26-1.02B.
2. Graded in accordance with ASTM D2487 Group Symbol GM or GW.

F. Granular Fill - Pea Gravel: No. 84 or 89 stone per ASTM C33.

G. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.

1. Grade in accordance with ASTM D2487 Group Symbol SP or SW.

H. Topsoil: Topsoil excavated on-site.

1. Select.
 - a. The soil shall be tested for potential contamination in accordance with DTSC protocols.
 2. Graded.
 3. Free of roots, rocks larger than 1/2 inch (12 mm), subsoil, debris, large weeds, and foreign matter.
 4. Acidity range (pH) of 5.5 to 7.5.
 5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.
 6. Conforming to ASTM D2487 Group Symbol OH.
7. Limit decaying matter to 5 percent of total content by volume.

- I. Blended Material: Conforming to type II material per the Uniform Standard Specifications for Public Works Construction, Off-Site Improvements.
- J. Select Fill: Excavated granular materials with not more than 10% passing the No. 200 sieve; free from lumps, clay, organic materials, and rocks greater than 3 inches.
- K. Type F - Subsoil: Reused, free of rocks larger than 3-inch size, and debris.

2.2 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.
- E. Comply with EPA/DTSC requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify structural or other backfill materials to be reused or imported are acceptable to the satisfaction of the Geotechnical Engineer. Approval shall be obtained in advance of re-use or importation onto the site.
 - 1. The soil shall be tested for potential contamination in accordance with DTSC protocols.
 - 2. Imported fill materials shall be compatible with on-site soils in addition to being suitable for its intended use.
 - 3. Imported fill soil shall contain no rocks larger than 6-inch (150 mm) maximum dimension or as allowed by the Geotechnical Report and shall be predominantly granular in nature.
- B. Verify that survey benchmarks and intended elevations for the Work are as indicated.
- C. Identify required lines, levels, contours, and datum locations.
- D. See Section 31 22 00 for additional requirements.
- E. Verify sub-drainage, damp-proofing, or waterproofing installation has been inspected.
- F. Verify structural ability of unsupported walls to support imposed loads by the fill.
- G. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.

3.2 PREPARATION

- A. Scarify subgrade surface to a depth of 6-inches (150 mm) to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Type II (Greenbook) or concrete fill and compact to density equal to or greater than requirements for subsequent backfill material.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Prior to placement of aggregate base course material at paved areas, compact subsoil to 95 percent of its maximum dry density in accordance with ANSI/ASTM D1557.
- E. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.3 FILLING

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.
1. Do not disturb or damage foundation perimeter drainage and foundation waterproofing and protective cover utilities in trenches.
- D. Systematically fill and compact per geotechnical report. Do not fill over porous, wet, frozen, or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6-inches (150 mm) compacted depth.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8-inches (200 mm) compacted depth.
- H. Slope grade away from building minimum 2-inches in 10 ft (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- I. Correct areas that are over-excavated.
1. Load-bearing foundation surfaces: Fill with concrete.
2. Other areas: Use general fill, flush to required elevation, compacted to minimum 90 or 95 percent of maximum dry density in subgrade zone.
- J. Compaction Density Unless Otherwise Specified or Indicated:
 1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.
 2. At other locations: 90 percent of maximum dry density.

- K. Reshape and re-compact fills subjected to vehicular traffic.
- L. Remove surplus fill and backfill materials from site.

3.4 FILL AT SPECIFIC LOCATIONS

- A. Use general fill unless otherwise specified or indicated.
- B. Structural Fill:
 - 1. Use general fill.
 - 2. Fill up to subgrade elevations.
 - 3. Maximum depth per lift: 6-inches (150 mm), compacted.
 - 4. Compact to minimum 95 percent of maximum dry density.
- C. Under Interior Slabs-On-Grade:
 - 1. Use granular fill. Type A or B.
 - 2. Depth: 4-inches (100 mm) deep.
 - 3. Compact to 95 percent of maximum dry density.
 - 4. Cover with sand.
 - a. Depth: 2-inches (50 mm).
 - b. Compact to 95 percent of maximum dry density.
- D. At Footings:
 - 1. Use general fill.
 - 2. Fill up to subgrade elevation.
 - 3. Compact each lift to 90 percent of maximum dry density.
 - 4. Do not backfill against unsupported foundation walls.
 - 5. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
- E. Over Buried Utility Piping, Conduits, and Duct Bank in Trenches:
 - 1. Bedding: Use general fill.
 - 2. Cover with general fill.

3. Fill up to subgrade elevation.
4. Compact in maximum 8-inch (200 mm) lifts to 95 percent of maximum dry density.

F. At Lawn Areas:

1. Use general fill.
2. Compact to 90 percent of maximum dry density.
3. See Section 31 22 00 for topsoil placement.

G. At Planting Areas Other Than Lawns:

1. Use general fill.
2. Compact to 90 percent of maximum dry density.
3. See Section 31 22 00 for topsoil placement.

H. Under Monolithic Paving:

1. Compact subsoil to 95 percent of its maximum dry density before placing fill.
2. Use general fill.
3. Fill up to subgrade elevation.
4. Compact to 95 percent of maximum dry density.
5. See Section 32 11 23 for aggregate base course placed over fill.

3.5 TOLERANCES

- A. Top Surface of General Filling: Plus or minus 1 inch (25 mm) from required elevations.
- B. Top Surface of Filling Under Paved Areas: Plus or minus 1/2 inch (12 mm) from required elevations.

3.6 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556 or ASTM D6938.
 1. Field inspections and testing shall be performed and submitted in accordance with requirements specified in Section 01 40 00 - Quality Requirements.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 1557 ("modified Proctor") or AASHTO T 180.

- D. Laboratory Tests and Analyses: Where backfill is required to be compacted to a specified density, tests for compliance shall be made in accordance with requirements specified in Section 01 40 00 - Quality Requirements.
- E. Density Test Method: Density tests shall be in accordance with ASTM D1556 (Sand Cone Method) procedures. Allow testing service to inspect and approve each subgrade and fill layer before further fill, backfill or construction Work is performed.
- F. Alternate Density Test Method: Field density tests may also be performed by the nuclear method in accordance with ASTM D6938, providing that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D1556.
- 1. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gages in accordance with ASTM D6938.
- 2. If field 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 Architect or Owner's testing and inspection agency.
- G. Non-compliance: If tests indicate work does not meet specified requirements, remove work, replace, and retest.
- H. Should tests of fill or backfill indicate non-compliance with required density, Contractor shall over-excavate, recompact and retest until specified density is obtained.
- 1. Costs and Time associated with remedial Work and retesting shall be in accordance with provisions of the General Conditions.
 - a. Retesting to demonstrate compliance shall be by a testing laboratory acceptable to Owner and shall be at Contractor's expense.
- I. Frequency of Tests:
 - 1. Footing Subgrade Testing: For each strata of soil on which footings will be placed, perform at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata when acceptable to Geotechnical Engineer.
 - 2. Paved Areas and Building Slab Subgrade Testing:
 - a. Perform at least one field density test of subgrade for every 2,000 sf of paved area or building slab, but in no case fewer than three tests.
 - b. In each compacted fill layer, perform one field density test for every 2,000 sf of overlaying building slab or paved area, but in no case fewer than three tests.
- J. Proof roll compacted fill at surfaces that will be under slabs-on-grade.

3.7 CLEANING

- A. Leave unused materials in a neat, compact stockpile.

- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 31 32 11 – SOIL SURFACE EROSION CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Liquid applied soil erosion control system.
- B. Mulch for erosion control.
- C. Hydraulic seeding and mulch for erosion control.

1.2 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Contract descriptions, description of alterations work, work by others, future work, occupancy conditions, use of site and premises, work sequence.
- B. Section 01 20 00 - Price and Payment Procedures: Applications for payment, Schedule of Values, modifications procedures, closeout procedures.

1.3 REFERENCE STANDARDS

- A. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN·m/m³)); 2012.
- B. ASTM D1560 - Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus; 2009a.
- C. ASTM D2844/D2844M - Standard Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils; 2013.
- D. ASTM D4972 - Standard Test Method for pH of Soils; 2001 (Reapproved 2007).
- E. ASTM D5268 - Standard Specification for Topsoil Used for Landscaping Purposes; 2007.
- F. ASTM D5852 - Standard Test Method for Erodibility Determination of Soil in the Field or in the Laboratory by the Jet Index Method; 2000 (Reapproved 2007).
- G. ASTM D6629 - Standard Guide for Selection of Methods for Estimating Soil Loss by Erosion; 2001 (Re-approved 2012) e1
- H. USDA - United States Department Of Agriculture
 - 1. AMS Seed Act (1940; R 1988; R 1998) Federal Seed Act.

1.4 SYSTEM DESCRIPTION

- A. The work consists of furnishing and installing temporary and permanent soil surface erosion control materials to prevent the pollution of air, water, and land, including fine grading, blanketing, stapling, mulching, vegetative measures, and miscellaneous related work, within project limits and in areas outside the project limits where the soil surface is disturbed from work under this contract at the designated locations. This work includes all necessary materials, labor, supervision, and equipment for installation of a complete system.
 - 1. Coordinate this section with the requirements of:
 - a. Section 31 10 00 - Site Clearing and Grubbing
 - b. Section 31 22 00 - Rough Grading.

1.5 SUBMITTALS

- A. Preconstruction Submittals
 - 1. Work sequence schedule.
 - 2. Erosion control plan.

- B. Shop Drawings
 - 1. Layout;
 - 2. Obstructions Below Ground;
 - 3. Erosion Control;
 - a. Scale drawings defining areas to receive recommended materials as required by federal, state, or local regulations.
 - 4. Seed Establishment Period
 - a. Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.
 - 5. Maintenance Record
 - a. Record of maintenance work performed, of measurements and findings for product failure, recommendations for repair, and products replaced.
- C. Product Data
 - 1. Biobased Materials Documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.
 - 2. Geosynthetic Binders
 - 3. Wood Cellulose Fiber;
 - 4. Paper Fiber;
 - 5. Mulch Control Netting and Filter Fabric;
 - 6. Hydraulic Mulch;
 - 7. Aggregate;
 - 8. Manufacturer's literature including physical characteristics, application, and installation instructions.
 - 9. Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.
 - 10. Equipment
 - a. A listing of equipment to be used for the application of erosion control materials.
 - 11. Finished Grade
 - 12. Erosion Control Blankets
 - a. Condition of finish grade status prior to installation; location of underground utilities and facilities.
- D. Samples
 - 1. Materials
 - a. Geosynthetic and synthetic binding material; 1.13L (1 quart).
 - b. Standard mulch; 0.74 k (2 pounds).
 - c. Hydraulic mulch; 0.74 k (2 pounds).
- E. Test Reports
 - 1. Geosynthetic Binders
 - 2. Hydraulic Mulch

- a. Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.
- b. Sand
- c. Gravel
- d. Sieve test results. Sand shall be uniformly graded.

F. Certificates

- 1. Fill Material
- 2. Mulch
 - a. Hydraulic Mulch
 - 1) Prior to delivery of materials, certificates of compliance attesting the materials meet the specified requirements. Certified copies of the material certificates shall include the following.
 - 2) For items listed in this section:
 - (a) Certification of recycled content or,
 - (b) Statement of recycled content.
 - (c) Certification of origin including the name, address, and telephone number of the manufacturer.
- 3. Geosynthetic Binders
 - a. Synthetic Soil Binders
 - 1) Certification for binders showing EPA registered uses, toxicity levels, and application hazards.
 - b. Installer's Qualification
 - 1) The installer's company name and address; training and experience and or certification.
- 4. Seed
 - a. Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.
- 5. Wood By-Products
 - a. Composition, source, and particle size. Products shall be free from toxic chemicals or hazardous material.
- 6. Wood Cellulose Fiber
 - a. Certification stating that wood components were obtained from managed forests.

G. Operation and Maintenance Data

- 1. Maintenance Instructions
 - a. Instruction for year-round care of installed material. The Contractor shall include manufacturer supplied spare parts.

H. Closeout Submittals

1.6 QUALITY ASSURANCE

- A. Installer's Qualification
 - 1. The installer shall be certified by the manufacturer for training and experience installing the material.
- B. Erosion Potential

1. Assess potential effects of soil management practices on soil loss in accordance with ASTM D 6629. Assess erodibility of soil with dominant soil structure less than 70 to 80 mm (2.8 to 3.1 inches) in accordance with ASTM D 5852.
- C. Substitutions
 1. Substitutions will not be allowed without written request and approval from the Architect.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in designated areas and as recommended by the manufacturer protected from the elements, direct exposure, and damage. Do not drop containers from trucks. Material shall be free of defects that would void required performance or warranty. Deliver geosynthetic binders and synthetic soil binders in the manufacturer's original sealed containers and stored in a secure area.
 1. Inspect seed upon arrival at the jobsite for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected.

1.8 WARRANTY

- A. Erosion control material shall have a warranty for use and durable condition for project specific installations. Temporary erosion control materials shall carry a minimum eighteen- month warranty. Permanent erosion control materials shall carry a minimum three-year warranty.

PART 2 - PRODUCTS

2.1 BINDERS

- A. Synthetic Soil Binders
 1. Calcium chloride, or other standard manufacturer's spray on adhesives designed for dust suppression.
 2. BASE BID MANUFACTURER
 - a. Soilworks LLC; www.soilworks.com Model Durasoil; www.durasoil.com.
 - b. Other Acceptable Manufacturers:
 - 1) none identified.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
- B. Geosynthetic Binders
 1. Geosynthetic binders shall be manufactured in accordance with ASTM D 1560, ASTM D 2844; and shall be referred to as products manufactured for use as modified emulsions for the purpose of erosion control and soil stabilization. Emulsions shall be manufactured from all natural materials and provide a hard durable finish.
 2. BASE BID MANUFACTURER
 - a. Soilworks, LLC; www.soilworks.com Model Gorilla Snot; www.gorillasnot.com.
 - b. Other Acceptable Manufacturers:
 - 1) none identified.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MULCH

- A. Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region.
- B. Straw:

1. Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.
- C. Hay
 1. Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.
- D. Wood Cellulose Fiber
 1. Wood cellulose fiber shall be 100 percent recycled material and shall not contain any growth or germination-inhibiting factors and shall be dyed with non-toxic, biodegradable dye an appropriate color to facilitate placement during application. Composition on air-dry weight basis: a minimum 9 to a maximum 15 percent moisture, and between a minimum 4.5 to a maximum 6.0 pH.
 - a. Wood cellulose fiber shall not contain environmentally hazardous levels of heavy metals. Materials may be bulk tested or tested by toxicity characteristic leaching procedure (TCLP).
- E. Paper Fiber
 1. Paper fiber mulch shall be 100 percent post-consumer recycled newsprint that is shredded for the purpose of mulching seed.
- F. Shredded Bark
 1. Locally shredded material shall be treated to retard the growth of mold and fungi.
- G. Wood By-Products
 1. Wood locally chipped or ground bark shall be treated to retard the growth of mold and fungi. Gradation: A maximum 50 mm (2-inch) wide by 100 mm (4-inch) long.
- H. Coir
 1. Coir shall be manufactured from 100 percent coconut fiber cured in fresh water for a minimum of 6 months.
- I. Mulch Control Netting and Filter Fabric
 1. Mulch control netting and filter fabric may be constructed of lightweight recycled plastic, cotton, or paper or organic fiber. The recycled plastic shall be a woven or nonwoven polypropylene, nylon, or polyester containing stabilizers and/or inhibitors to make the fabric resistant to deterioration from UV, and with the following properties:
 - a. Minimum grab tensile strength (TF 25 #1/ASTM D 4632), 0.8 kN (180 pounds).
 - b. Minimum Puncture (TF 25 #4/ASTM D 3787), 0.52 MPa (75 psi) in the weakest direction.
 - c. Apparent opening sieve size of a minimum 40 and maximum 80 (U.S. Sieve Size).
 - d. Minimum Trapezoidal tear strength (TF 25 #2/ASTM D 4533), 0.22 kN (50 pounds).
- J. Hydraulic Mulch
 1. Hydraulic mulch shall be made of 100 percent (recycled material), (virgin aspen wood fibers). Wood shall be naturally air-dried to a moisture content of 10.0 percent, plus or minus 3.0 percent. A minimum of 50 percent of the fibers shall be equal to or greater than 5 mm (0.15 inch) in length and a minimum of 75 percent of the fibers shall be retained on a 28-mesh screen. No reprocessed paper fibers shall be included in the hydraulic mulch. Hydraulic mulch shall have the following mixture characteristics:

CHARACTERISTIC	(typical) VALUE
pH	5.4 + 0.1
Organic Matter (oven dried basis), percent	99.3 within + 0.2
Inorganic Ash (oven dried basis), percent	0.7 within + 0.2
Water Holding Capacity, percent	1,401

K. Dye

1. Dye shall be a water-activated, green color. Pre-package dye in water dissolvable packets in the hydraulic mulch.

2.3 AGGREGATE

- A. Aggregate shall be onsite or offsite material generated from grading and demolition operations, as available. Recycled crushed concrete shall be free of steel, free-draining and graded between a minimum (3/4 inch) and a maximum (1.5 inches). Crushed rock shall be crushed run between a minimum (3/4 inch) and a maximum (1.5 inches). Gravel shall be river run between a minimum (3/4 inch) and a maximum (1.5 inches). Submit sieve test results for both gravel and sand.

2.4 WATER

- A. Unless otherwise directed, water is the responsibility of the Contractor. Water shall be collected rainwater, greywater, potable, supplied by an existing irrigation system or local water purveyor.

PART 3 - EXECUTION

3.1 WEATHER CONDITIONS

- A. Perform erosion control operations under favorable weather conditions; when excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped as directed. When special conditions warrant a variance to earthwork operations, submit a revised construction schedule for approval. Do not apply erosion control materials in adverse weather conditions which could affect their performance.
- B. Finished Grade
 1. Verify that finished grades are as indicated on the drawings; complete finish grading and compaction in accordance with Division 31 Section - Rough Grading, prior to the commencement of the work. Verify and mark the location of underground utilities and facilities in the area of the work. Repair damage to underground utilities and facilities at the Contractor's expense.

3.2 SITE PREPARATION

- A. Soil Test
 1. Test soil in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size and mechanical analysis. Sample collection onsite shall be random over the entire site. The test shall determine the soil particle size as compatible for the specified material.
- B. Protecting Existing Vegetation
 1. When there are established lawns in the work area, the turf shall be covered and/or protected or replaced after construction operations. Identify existing trees, shrubs, plant beds, and landscape features that are to be preserved on site by appropriate tags and barricade with reusable, high visibility fencing along the dripline.

Mitigate damage to existing trees at no additional cost to the Government. Damage shall be assessed by a state certified arborist or other approved professional using the National Arborist Association's tree valuation guideline.

C. Obstructions Below Ground

1. When obstructions below ground affect the work, submit shop drawings showing proposed adjustments to placement of erosion control material for approval.

3.3 INSTALLATION

- A. Immediately stabilize exposed soil using stabilizer, mulch, compost, and seed. Stabilize areas for construction access immediately. Install principal sediment basins and traps before any major site grading takes place. Provide additional sediment traps and sediment fences as grading progresses. Provide inlet and outlet protection at the ends of new drainage systems. Remove temporary erosion control measures at the end of construction.
- B. Synthetic Binders
 1. Apply synthetic binders heaviest at edges of areas and at crests of ridges and banks to prevent displacement. Apply binders to the remainder of the area evenly at the rate as recommended by the manufacturer.
- C. Seeding
 1. When seeding is required prior to installing mulch on synthetic grid systems verify that seeding will be completed in accordance with Sections 31 22 00 Grading.
- D. Mulch Installation
 1. Install mulch in the areas indicated. Apply mulch evenly at 3-inches thick.
- E. Mulch Control Netting
 1. Netting may be stapled over mulch according to manufacturer's recommendations.
- F. Mechanical Anchor
 1. Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.
- G. Wood Cellulose Fiber, Paper Fiber, and Recycled Paper
 1. Apply wood cellulose fiber, paper fiber, or recycled paper as part of the hydraulic mulch operation.
- H. Hydraulic Mulch Application
 1. Unseeded Area
 - a. Install hydraulic mulch as indicated and in accordance with manufacturer's recommendations. Mix hydraulic mulch with water at the rate recommended by the manufacturer for the area to be covered. Mixing shall be done in equipment manufactured specifically for hydraulic mulching work, including an agitator in the mixing tank to keep the mulch evenly disbursed.
 2. Seeded Area
 - a. For 2-step hydraulic seeded areas, apply mulch, seed, and fertilizer at the rate of 0.15 lbs. per square yard, and at the rate of 0.52 lbs. per square yard in a second application of mulch only.
- I. Sediment Fencing
 1. Install posts at the spacing indicated on drawings and at an angle between 2 degrees and 20 degrees towards the potential silt load area. Sediment fence height shall be approximately 406 mm (16-inches). Do not attach filter fabric to existing trees. Secure filter fabric to the post and wire fabric using staples, tie wire, or hog rings.

Imbed the filter fabric into the ground as indicated on drawings. Splice filter fabric at support pole using a 152 mm (6-inches) overlap and securely seal.

3.4 CLEAN-UP

- A. Dispose of excess material, debris, and waste materials offsite at an approved landfill or recycling center. Clear adjacent paved areas. Immediately upon completion of the installation in an area, protect the area against traffic or other use by erecting barricades and providing signage as required, or as directed.

3.5 WATERING SEED

- A. Watering immediately after installing erosion control blanket type XI (revegetation mat). Apply water to supplement rainfall at a sufficient rate to ensure moist soil conditions to a minimum 25 mm (1-inch) depth. Prevent run-off and puddling. Do not drive watering trucks over turf areas, unless otherwise directed. Prevent watering of other adjacent areas or plant material.

3.6 MAINTENANCE RECORD

- A. Furnish a record describing the maintenance work performed, record of measurements and findings for product failure, recommendations for repair, and products replaced.
- B. Maintenance
 - 1. Maintenance shall include eradicating weeds; protecting embankments and ditches from surface erosion; maintaining the performance of the erosion control materials and mulch; protecting installed areas from traffic.
- C. Maintenance Instructions
 - 1. Furnish written instructions containing drawings and other necessary information, describing the care of the installed material; including, when and where maintenance should occur, and the procedures for material replacement.

END OF SECTION

SECTION 32 11 23 - AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Aggregate base course.
- B. Paving aggregates.
- C. Soil sterilization.

1.2 RELATED REQUIREMENTS

- A. Section 31 22 00 - Grading: Preparation of site for base course.
- B. Section 31 23 23 - Fill: Topsoil fill at areas adjacent to aggregate base course.
- D. Section 31 23 23 - Fill: Compacted fill under base course.
- E. Section 32 12 16 - Asphalt Paving: Binder and finish asphalt courses.
- F. Section 31 23 16.13 - Trenching: Compacted fill over utility trenches under base course.
- G. Section 32 13 13 - Concrete Paving: Finish concrete surface course.

1.3 REFERENCE STANDARDS

- A. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- B. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- C. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- D. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.
- E. Standard Specifications for Public Works Construction, latest edition.
 - 1. Standard Specifications shall be as amended and adopted by authorities having jurisdiction, including the City or County.
 - 2. Where reference is made to Standard Details, such reference shall be to the Standard Details accompanying the Standard Specifications, as amended, and adopted by the authorities having jurisdiction.
 - 3. Wherever term "Agency" occurs in Standard Specifications, it shall be understood to mean Owner for purposes of the Contract.
 - 4. Wherever term "Engineer" occurs in Standard Specifications, it shall be understood to mean Architect for purposes of the Contract.

1.4 SUBMITTALS

- A. See Section 01 33 00 – Submittal Procedures.
- B. Samples: 10 lb (4.5 kg) sample of each type of aggregate; submit in air-tight containers to testing laboratory.
- C. Materials Sources: Submit name of imported materials source.
- D. Certificates of Conformance: Aggregate and sterilant materials.
- E. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- F. Compaction Density Test Reports.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Where reference is made to Standard Specifications, the following shall apply.
 - 1. Perform off-site work in public rights-of-way in accordance with requirements of authorities having jurisdiction, including Standard Specifications for Public Works Construction, as amended and adopted by those authorities. For conditions not indicated otherwise on Contract Drawings, conform to Standard Details adopted by authorities having jurisdiction, including Standard Details for Public Works Construction, as amended and adopted by those authorities.
 - 2. Perform on-site Work as indicated and referenced on Contract Drawings and as specified herein.
- B. The quantity of volatile organic compounds (VOC) used in weed killer, tack coat, primer and other materials shall not exceed limits permitted under current regulations of:
 - 1. South Coast Air Quality Management District (AQMD).
 - C. Source Quality Control: Obtain materials from one source throughout.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. Aggregate Storage, General:
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Sub-Base Material: Existing or imported materials as recommended in geotechnical report. Refer to Document 00 31 00 - Available Project Information.
- B. Aggregate: Coarse or crushed aggregate, conforming to the City or County Public Works Department standard.
 - 1. Green Book Standard Specifications 200-2.2.
- C. Coarse Aggregate: Angular crushed stone; free of shale, clay, friable material, and debris.
 - 1. Graded in accordance with ASTM D2487 Group Symbol GW.
- D. Blended Aggregate: Pit run washed stone; free of shale, clay, friable material, and debris.
 - 1. Graded in accordance with ASTM D2487 Group Symbol GW.
- E. Medium Aggregate: Natural stone, pea gravel; washed, free of clay, shale, organic matter.
 - 1. Grade in accordance with ASTM D2487 Group Symbol GM.
- F. Fine Aggregate: Sand; conforming to City or County Public Works Department standard.
- G. Herbicide: Comply with all applicable environmental protection and hazardous materials laws and regulations.
 - 1. Monobor-Chlorate non-selective weed and grass killer, by J.R. Simplot Co., Lathrop, CA;
 - 2. Poly-Bor Chlorate or Mono-Bor-Chlorate by United States Borax.
 - 3. Monobar-Chlorate by Occidental Chemical.
 - 4. Casoron 50W by Uniroyal Chemical Co., Inc.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Geotextile Fabric: Non-biodegradable, non-woven.

2.2 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D2487 classification, testing of samples for compliance shall be provided before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that survey benchmarks and intended elevations for the work are as indicated.
- B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.2 PREPARATION

- A. Stockpiling:
 1. Clear and level storage sites prior to stockpiling of material.
 2. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated.
 3. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Construction Manager to prevent segregation.
 4. Materials obtained from different sources shall be stockpiled separately.
- B. Soil Sterilant: Sterilize soil areas to receive paving. Apply soil sterilant in accordance with manufacturer's instructions and applicable environmental regulations. Take care to confine application to the areas to be paved.
- C. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- D. Do not place aggregate on soft, muddy, or frozen surfaces.

3.3 INSTALLATION

- A. Place and compact aggregate base material in accordance with Standard Specifications, Subsection 301-2. Place aggregate base below curbs and gutters and paving also, compacted to 95 percent at vehicular traffic and 90 percent at pedestrian-only traffic.
- B. Under Bituminous Concrete Paving:
 1. Compact to 95 percent of maximum dry density and 90 percent at pedestrian-only traffic.
- C. Under Portland Cement Concrete Paving:
 1. Compact to 95 percent of maximum dry density and 90 percent at pedestrian-only traffic.
- D. Place aggregate in maximum 4-inch (100 mm) layers and roller compact to specified density.
- E. Level and contour surfaces to elevations and gradients indicated.
- F. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

- G. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- H. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- I. Apply herbicide to finished surface.

3.4 TOLERANCES

- A. Flatness: Maximum variation of 1/4-inch (6.4 mm) measured with 10 foot (3 m) straight edge.
- B. Scheduled compacted thickness: Within 1/4-inch (6.4 mm).
- C. Variation from design elevation: Within 1/2 -inch (12.8 mm).

3.5 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Compaction density testing shall be performed on compacted aggregate base course in accordance with ASTM D1556 or ASTM D6938.
- C. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace, and retest.
- E. Proof roll compacted aggregate at surfaces that are under slabs-on-grade and paving.

3.6 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSE

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SECTION 32 12 16 - ASPHALT PAVING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Asphaltic Concrete Paving
- B. Aggregates
- C. Surface Sealer
- D. Patching and Repair
- E. Weed Killer
- F. Headers and Stakes
- G. Concrete Wheel Stops
- H. Pavement Striping

1.2 RELATED REQUIREMENTS

- A. Section 31 22 00 - Grading: Preparation of site for paving and base.
- B. Section 31 23 23 - Fill: Compacted subgrade for paving.
- C. Section 32 11 23 - Aggregate Base Courses: Aggregate base course.
- D. Section 32 13 13 - Concrete Paving: Concrete curbs.
- E. Section 32 17 23.13 - Painted Pavement Markings: Concrete bumpers.
 - 1. Parking and Traffic Control Pavement Markings.
- G. Section 33 05 13 - Manholes and Structures: Manholes, including frames; gutter drainage grilles, covers, and frames for placement by this section.

1.3 REFERENCE STANDARDS

- A. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; The Asphalt Institute; 1997.
- B. AI MS-19 - A Basic Asphalt Emulsion Manual; The Asphalt Institute; Fourth Edition.
- C. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 2009a.
- D. Standard Specifications for Public Works Construction (Greenbook), latest edition.
 - 1. Standard Specifications shall be as amended and adopted by authorities having jurisdiction, including the City or County.

2. Where reference is made to Standard Details, such reference shall be to the Standard Details accompanying the Standard Specifications, as amended, and adopted by the authorities having jurisdiction.
3. Wherever term "Agency" occurs in Standard Specifications, it shall be understood to mean Owner for purposes of the Contract.
4. Wherever term "Engineer" occurs in Standard Specifications, it shall be understood to mean Architect for purposes of the Contract.

1.4 SUBMITTALS

- A. Materials List: List source and quality standard for all asphaltic concrete materials.
- B. Weighmaster's Certificates or certified delivery tickets for each truckload of bituminous material delivered to site.
- C. Certificates of Conformance: Asphalt, aggregate and sterilant materials.
- D. Mix Designs: Submit designs for asphaltic concrete prepared by a materials laboratory under direct supervision of a Civil Engineer licensed in the State of California or a standard mix design proven in actual performance.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with Local Public Works Standards.
- B. Mixing Plant: Conform to Local Public Work Standards.
- C. Testing and analysis of granular base material and asphaltic concrete paving mix shall be performed under provisions of Division 1.
- D. Obtain materials from same source throughout.

1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable code for paving work on public property.
- B. Where reference is made to Standard Specifications, the following shall apply.
 1. Perform off-site work in the public right-of-way in accordance with requirements of authorities having jurisdiction.
 - a. Including Standard Specifications for Public Works Construction (Greenbook), as amended and adopted by those authorities.
 - b. For conditions not indicated otherwise on Contract Drawings, conform to Standard Details adopted by authorities having jurisdiction, including Standard Plans for Public Works Construction, as amended, and adopted by those authorities.
 2. Perform on-site work as indicated and referenced on Contract Drawings and as specified herein.

C. The quantity of volatile organic compounds (VOC) used in weed killer, tack coat, primer and other materials shall not exceed limits permitted under current regulations of South Coast Air Quality Management District (AQMD).

1.7 FIELD CONDITIONS

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen; or when rain is imminent.
- B. Place bitumen mixture when temperature is not more than 15 F degrees (9 C degrees) below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General: Aggregate base, prime coat paint binder, bituminous surface course and other materials shall be as noted on the Contract Drawings and shall comply with requirements of authorities having jurisdiction.
- B. Asphalt Cement: ASTM D 946.
- C. Aggregate for Base Course: Angular crushed washed stone; free of shale, clay, friable material and debris.
 1. Graded in accordance with ASTM D2487 Group Symbol GW.
 2. Crushed Aggregate Base in accordance with Standard Specifications (Greenbook), Sub-Section 200-2.2.
- D. Asphalt Concrete Materials: Standard Specifications (Greenbook), Sub-Section 203-6.
- E. Aggregate for Binder Course: Angular crushed washed stone; free of shale, clay, friable material and debris.
 1. Graded in accordance with ASTM D2487 Group Symbol GW.
- F. Aggregate for Wearing Course: Angular crushed washed stone; free of shale, clay, friable material and debris.
 1. Graded in accordance with ASTM D2487 Group Symbol GW.
- G. Fine Aggregate: Sand
- H. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.
- I. Primer: Homogeneous, medium curing, liquid asphalt.
- J. Tack Coat: Emulsified asphalt.
- K. Seal Coat: AI MS-19, slurry type.
 1. Guard Top by Industrial Asphalt Inc., Irwindale, CA.

2. Satin Seal by Blue Diamond Co., Long Beach, CA.
3. OverKote by Diversified Asphalt Products, Anaheim, CA.
4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Asphalt Paving Mix:
 1. Standard Specifications, C2-AR-4000.
 2. Standard Specifications, C2-PG-64-10.
 3. Standard Specifications, C2-PG 70-10.
- B. Use dry material to avoid foaming. Mix uniformly.
- C. Base Course: 3.0 to 6 percent of asphalt cement by weight in mixture in accordance with AI MS-2.
- D. Binder Course: 4.5 to 6 percent of asphalt cement by weight in mixture in accordance with AI MS-2.
- E. Wearing Course: 5 to 7 percent of asphalt cement by weight in mixture in accordance with AI MS-2.

2.3 SOURCE QUALITY CONTROL

- A. Test mix design and samples in accordance with AI MS-2.

2.4 ACCESSORIES

- A. Headers and Stakes: 2 x 6 inch (50 x 305 mm) nominal preservative treated Douglas Fir (PTDF), except at curves provide laminated 1 x 6 inch (25 x 305 mm) nominal preservative treated Douglas Fir. Stakes, 2 x 3 x 18 inch (50 x 150 x 457 mm) long PTDF at 48 inch (1219 mm) on center maximum. Use hot dipped galvanized nails only.
- B. Pavement Reinforcing Fabric: Petromat by Amoco Fabrics and Fibers Co., Austell, GA (800) 445-7732, or approved equal. Non-woven polypropylene fabric conforming to Standard Specifications, Sub-Section 213-1.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Refer to Geotechnical Report referenced in notes on Contract Drawings, and requirements of authorities having jurisdiction.
- B. Verify that compacted subgrade and granular base is dry and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.

- D. Fine grading, checking, shaping, and compacting of subgrade shall be complete before start of asphaltic concrete work.
- E. Soil Sterilant: Sterilize soil areas to receive asphaltic concrete paving. Apply soil sterilant in accordance with manufacturer's instructions and applicable environmental regulations. Take care to confine application to the areas to be paved. See Section 32 11 23 - Aggregate Base Courses for product information.
- F. Curbs and Gutters: Gutters shall be in place and cured prior to start of asphaltic concrete work. Provide lumber ramping at all locations where rolling equipment or vehicles cross new concrete paving, curbs and gutters.
- G. Headers: Place headers with tops flush with finish asphaltic concrete surfaces. Back headers with stakes.

3.2 BASE COURSE

- A. Place and compact base course.

3.3 PREPARATION – PRIMER

- A. Apply primer in accordance with Local Municipality Public Work's Standards.
- B. Apply primer on aggregate base or subbase at uniform rate of 0.25 gal/sq yd (0.80 L/sq m).
- C. Apply primer to contact surfaces of curbs and/or gutters.
- D. Use clean sand to blot excess primer.

3.4 PREPARATION - TACK COAT

- A. Apply tack coat in accordance with manufacturer's instructions.
- B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 0.10 gal/sq yd (0.32 L/sq m).
- C. Apply tack coat to contact surfaces of curbs, gutters and previously placed or existing paving.
- D. Coat surfaces of manhole frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.
- E. Joining Pavement: Expose, cut and clean edges of existing pavement to straight, vertical surfaces for full depth of existing pavement. Paint edge with asphalt emulsion before placing new asphaltic concrete. Joints in new paving shall be in accordance with Standard Specifications.

3.5 PLACING ASPHALT PAVEMENT - SINGLE COURSE

- A. Install work in accordance with the Municipality of the City or County Public Work's Standards.
- B. Place asphalt within 24 hours of applying primer or tack coat.

- C. Place thickness as indicated on Civil Drawings to minimum 2 inch (51 mm) compacted thickness.
- D. Install gutter drainage grates and frames and manhole frames in correct position and elevation.
- E. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position.
 - 1. Compact (roll) asphaltic concrete in accordance with Standard Specifications (Greenbook), Sub-Section 302-5.6, using machine rollers.
 - a. Compaction by vehicular traffic is prohibited.
 - b. Compact areas inaccessible to rolling equipment with machine-powered tamper.
- F. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.6 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

- A. Install work in accordance with Standard Specifications (Greenbook), Sub-Section 302-5.
- B. Place asphalt binder course within 24 hours of applying primer or tack coat.
- C. Place binder course to thickness of 2 inches minimum (51 mm) compacted thickness.
- D. Place wearing course within two hours of placing and compacting binder course.
- E. Place wearing course to thickness of 2 inches minimum (51 mm) compacted thickness.
- F. Install gutter drainage grates and frames and manhole frames in correct position and elevation.
- G. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position.
 - 1. Compact (roll) asphaltic concrete in accordance with Standard Specifications (Greenbook), Sub-Section 302-5.6, using machine rollers.
 - a. Compaction by vehicular traffic is prohibited.
 - b. Compact areas inaccessible to rolling equipment with machine-powered tamper.
- H. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.7 CURBS

- A. Install extruded asphalt curbs of standard profile as indicated by plan detail or referenced standard detail.

3.8 SEAL COAT

- A. Apply seal coat after surface course application, in accordance with manufacturer's recommendations.
- B. Apply seal coat to surface course and asphalt curbs in accordance with Standard Specifications (Greenbook), Sub-Section 302-8.2.
- C. Add water to specified seal coat material. When air temperatures of 90 degrees F or more are encountered during application, consult manufacturer for recommendations.
- D. If pavement surface exhibits imperfections of roller marks, rock pockets, ridges or depressions as determined by the Architect, the addition of sand aggregate to seal coat, and amounts thereof, shall be as recommended by the manufacturer.
- E. A second application shall be made after first coat has dried to the touch. When sand is added to the first seal coat, two additional coats without extra sand shall be applied.
- F. Allow seal coat to dry before permitting traffic or striping.

3.9 PAVEMENT REPAIR AND PAVING

- A. Preparation of existing pavement: Where indicated, remove loose asphaltic concrete, cleanout "potholes" and cracks, remove dirt, oil and other foreign materials.
- B. Repair holes with full paving section as specified. Repair "alligatoring" with asphalt "skin-patch". Fill all cracks larger than 1/4 inch (6 mm) wide with asphalt emulsion slurry.
- C. Tack Coat: Apply asphalt oil AR-4000 or AR-8000, as required for jobsite condition, at metered application rate of no less than a range from 0.2 to 0.3 gallons per square yard of fabric or as directed by manufacturer and to provide 100 percent fabric saturation and ample bonding for paving section.
- D. Fabric Reinforcement: Place fabric smooth side up in tack coat with 2 to 4 inch overlap. Hand-broom to remove wrinkles. Apply addition tack coat to joints and between overlapped fabric layers.
- E. Overlay Asphalt: Place single course asphalt, 1-1/2 inch (38 mm) compacted thickness, in conformance with specified standards in this section.

3.10 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch (6 mm) measured with 10 foot (3 m) straight edge.
- B. Compacted Thickness: Within 1/4 inch (6 mm) of specified or indicated thickness.
- C. Variation from True Elevation: Within 1/2 inch (12 mm).

3.11 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for quality control.
- B. Provide field inspection and testing. Take samples and perform tests in accordance with AI MS-2.

- C. Test: Flood test all paving to demonstrate positive drainage. No standing water shall remain 1 hour after test.

3.12 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 2 days or until surface temperature is less than 140 degrees F (60 degrees C).
 - 1. After final rolling, prohibit all traffic on asphaltic concrete until mix has fully cooled and set. Minimum time, in all cases shall be 6 hours.

3.13 CLEANING

- A. After completion of paving operations, clean all existing and new improvements that have been soiled, especially by oil tracking from asphalt tanks or placement in general.
- B. For Substantial Completion review, broom clean and wash paving with hoses. Clean residue from landscaping installation.

END OF SECTION

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Concrete sidewalks, integral curbs, and gutters.
- B. Integrally colored Portland cement concrete paving.

1.2 RELATED REQUIREMENTS

- A. Section 31 22 00 - Grading: Preparation of site for paving and base.
- B. Section 31 23 23 - Fill: Compacted subbase for paving.
- C. Section 32 17 23.13 - Painted Pavement Markings: Pavement markings.

1.3 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).
- B. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010 (Errata 2012).
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- D. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.
- E. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2014 is current; use 2004a as indicated in 2019 CBC Referenced Standards.
- G. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2011a is current; use 2003 as indicated in 2019 CBC Referenced Standards.
- H. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2014.
- I. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2014 is current; use 2004a as indicated in 2019 CBC Referenced Standards.
- J. ASTM C150/C150M - Standard Specification for Portland Cement; 2012 is current; use 2007 as indicated in 2019 CBC Referenced Standards.
- K. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- L. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.

- M. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types); 2004 (Reapproved 2013).
- N. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2004a (Reapproved 2013).
- O. Standard Specifications for Public Works Construction, San Bernardino County, latest edition.
 - 1. Standard Specifications shall be as amended and adopted by authorities having jurisdiction, including San Bernardino County.
 - 2. Where reference is made to Standard Details, such reference shall be to the Standard Details accompanying the Standard Specifications, as amended and adopted by the authorities having jurisdiction.
 - 3. Wherever term "Agency" occurs in Standard Specifications, it shall be understood to mean Owner for purposes of the Contract.
 - 4. Wherever term "Engineer" occurs in Standard Specifications, it shall be understood to mean Architect for purposes of the Contract.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Mix Design: Design mixes for each concrete mix.
- C. Product Data: Provide data on joint filler, admixtures, and curing compound.
 - 1. Material Certificates signed by manufacturers for each of the following:
 - a. Cementitious materials and aggregates.
 - b. Steel reinforcement and reinforcement accessories.
 - c. Admixtures.
 - d. Curing compounds.
 - e. Joint fillers.
 - 2. Colored concrete product data and color selections.
- D. Samples: Submit two sample panels, 12 x 12 inch (300 x 300 mm) in size illustrating exposed aggregate finish.
- E. Shop drawings: For pattern layout and verification.

1.5 QUALITY ASSURANCE

- A. Industry Standard: Perform concrete paving Work in accordance with ACI 301.
- B. Regulatory Requirements: Where reference is made to Standard Specifications, the following shall apply:
 - 1. Where reference is made to Standard Specifications, the following shall apply:

- a. Perform off-site Work in public rights-of-way as indicated on the Contract Drawings and in accordance with requirements of authorities having jurisdiction, including Standard Specifications for Public Works Construction, as amended and adopted those authorities.
 - 1) For conditions not indicated otherwise on Contract Drawings, conform to Standard Details adopted by authorities having jurisdiction, including Standard Details for Public Works Construction, as amended and adopted those authorities.
 - b. Perform on-site work as indicated and referenced on the Contract Drawings and as specified herein.
- 2. Conform to Standard Specifications for Public Works Construction.
- 3. Conform to California Code of Regulations (CCR), Volume 2, Part 2, Chapters 18A and 19A.
- 4. Conform to California Building Code (CBC), Chapter 11B and ADAAG for accessibility requirements.
 - a. Concrete paving and concrete finishes along accessible routes of travel shall be at least as slip-resistant as that described as a medium salted finish for slopes of less than 6%, and slip resistant at slopes of 6% or greater; CBC 11B-403.2.
- 5. Comply with OSHA and Cal-OSHA requirements.
- 6. Continuous surfaces, including walks and sidewalks, shall have a continuous common surface, not interrupted by steps or by abrupt changes in level exceeding 1/4 inch (3 mm) vertical (CBC 11B-303.2), or beveled at 1:2 slope to a maximum height of 1/2 inch (12 mm) (CBC 11B-303.3) and shall have a minimum width of 48 inches (1219 mm); CBC 11B-403.5.1.
- 7. Surface cross slopes shall not exceed 2 percent on any accessible path of travel.
- 8. Surface slopes shall not exceed 2 percent in any direction for areas of flatwork that have no discernable path of travel. These areas are also known as plaza areas.

C. Source Quality Control: Obtain like materials from one source throughout.

D. Lines and Levels: Established by State of California licensed Surveyor or registered Civil Engineer. Costs of surveying services shall be included in the Contract Sum.

1.6 MOCK-UP

- A. Install minimum 48 x 48 inch (1219 x 1219 mm) mock-up of concrete flatwork for each texture or color specified.
- B. Install mock-up one month prior to installation, located where directed by Architect.
- C. Use identical forming system, subgrade type, reinforcing, expansion joints, score joints, finishing and edge trim as specified for installation.
- D. Architect approval required prior to proceeding with finish installation. Acceptable sample shall serve as quality basis for evaluating subsequent work.

1. Refinish mock-up area as required to produce acceptable work.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.

E. Mock-up may not be used in final installation. Remove mock-up materials from site and dispose of legally.

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery, Storage and Handling: Comply with requirements specified for regular concrete in Section 03 30 00 - Cast in Place Concrete.

PART 2 – PRODUCTS

2.1 PAVING ASSEMBLIES

- A. Comply with applicable requirements of ACI 301.
- B. Concrete Sidewalks: 2,500 psi (17.2 MPa) 28-day concrete, thickness as indicated on Civil drawings, minimum 4 inches (100 mm), natural grey color Portland cement. Concrete thickness and psi recommended in Geotechnical Report shall be used if thicker and stronger.
- C. Parking Area Pavement: 3,000 psi (20.7 MPa) 28-day concrete, thickness as indicated on Civil drawings, #4 reinforcing bars, 18 inches on-center, each direction at the mid-height of the slab, finish as indicated on drawings. Concrete thickness and psi recommended in Geotechnical Report shall be used if thicker and stronger.

2.2 FORM MATERIALS

- A. Wood form material, profiled to suit conditions.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D 1751) or sponge rubber or cork (ASTM D 1752).
 1. Thickness: 1/2 inch (12 mm).

2.3 REINFORCEMENT

- A. General: As indicated on drawings. Reinforcement for portland cement concrete paving in public rights-of-way shall comply with all applicable requirements in the Standard Specifications for Public Works Construction and Standard Details, as adopted by local authorities having jurisdiction.
- B. Reinforcing Steel: ASTM A615/A615M Grade 60 (420); deformed billet steel bars; unfinished finish.
 1. Unless detailed otherwise on drawings, provide number 4 reinforcing bars at 24 inches (610 mm) on center, each way.
- C. Tie Wires: 18 gage minimum, black annealed steel.
- D. Construction Joint Reinforcing:

1. Dowels: ASTM A615/A615M, Grade 60 - 60,000 psi (420 MPa) yield strength; deformed billet steel bars; unfinished finish.

2.4 PERFORMANCE REQUIREMENTS

- A. Albedo reflectance of finish concrete shall be minimum 0.30.

2.5 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Cement: ASTM C150/C150M Sulfate Resistant - Type V portland type, grey color.
- C. Fine and Coarse Mix Aggregates: ASTM C33/C33M.
- D. Water: Clean, and not detrimental to concrete.
- E. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979.
 1. Concentration: Base dosage rates on weight of Portland cement, fly ash, silica fume, and other cementitious materials but not aggregate or sand.
 2. Packaging: If pigments are to be added to mix at site, furnish pigments in premeasured disintegrating bags to minimize job site waste.
 3. Color(s): As selected by Architect from manufacturer's full range.
 - a. Allow for three different pigment colors.
 4. Products:
 - a. BRICKFORM; BRICKFORM Liquid Integral Color: www.brickform.com.
 - b. Butterfield Color: www.butterfieldcolor.com.
 - c. Davis Colors: www.daviscolors.com.
 - d. Lambert Corporation: www.lambertusa.com.
 - e. L.M. Scofield Company: www.scofield.com.
 - f. Solomon Colors: www.solomoncolors.com.
 - g. Substitutions: See Section 01 60 00 - Product Requirements.
 - F. Chemical Admixtures: ASTM C494/C494M, Type A - Water Reducing, Type B - Retarding, Type D - Water Reducing and Retarding, Type F - Water Reducing, High Range, and Type G - Water Reducing, High Range and Retarding.
 1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

2.6 ACCESSORIES

- A. Liquid Curing Compound: ASTM C 309, Type 1, Class A. Comply with all applicable air pollution requirements.
- B. Liquid Surface Sealer:

1. High solids, acrylic curing and sealing compound: Minimum 30% non-yellowing, acrylic solids curing compound; shall conform to ASTM C 309 and ASTM C 1315, Type I, Class A, VOC compliant.
 - a. Acceptable Products:
 - 1) L&M Construction Chemicals, Inc.; Dress & Seal WB: www.lmcc.com.
 - 2) L.M. Scofield Company; Cureseal-W: www.scofield.com.
 - 3) W. R. Meadows Company; Decra-Seal W/B: www.wrmeadows.com.
 - 4) Substitutions: See Section 01 60 00 - Product Requirements.
- C. Surface Retarder:
 1. Color: As selected by Architect from manufacturer's custom range.
 2. Acceptable Products:
 - a. Preco EAC-S, manufactured by Fosroc, Inc., Georgetown, KY, or approved equal.
 - b. WR Grace; Grace Top Cast: www.graceconstruction.com
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Detectable Warning Surface: See Section 32 17 26.
- E. Concrete Paving Joint Sealant: Polyurethane, self-leveling; ASTM C920, Class 25, Uses T, I, M and A; single component.
 1. Color: Gray.
 - a. Joints in sidewalks and vehicular paving.
 2. Products:
 - a. Pecora Corporation; NR-201 Self-Leveling Traffic and Loop Sealant: www.pecora.com.
 - b. BASF Construction Chemicals-Building Systems: www.buildingsystems.bASF.com.
 - c. Sherwin-Williams Company; Stampede 1SL Polyurethane Sealant: www.sherwin-williams.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Soil Sterilant: As specified in Standard Specifications for Public Works Construction. Soil sterilant shall comply with all applicable environmental protection and hazardous materials laws and regulations.
 1. See Section 32 11 23 - Aggregate Base Course for product.
- G. Headers and Stakes: Pressure preservative treated Douglas Fir, 2 x 6 inch (50 x 150 mm) nominal size except at curves provide laminated 1 x 6 inch (25 x 150 mm). Use hot dipped galvanized nails only.
- H. Expansion Joint Filler: ASTM D1751, pre-molded, compressible 1/2 inch (12 mm) thick non-extruding bituminous type resilient filler, compatible with joint backing and sealing products.

2.7 PATTERN STAMPED CONCRETE:

- A. Stamping Patterns: Lithotex Pavecrafters by L.M. Scofield Company, Los Angeles, CA (800/800-9900); www.scofield.com.
 - 1. Alternate Manufacturers:
 - a. The Bomanite Company; www.bomanite.com
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Pattern-matched interlocking tools, manufacturer's rigid design.
- C. Pattern as indicated.
 - 1. Provide custom pattern where indicated or not included in manufacturer's standard selections.

2.8 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Concrete Mix for Pedestrian (Sidewalk) Pavements, Natural Color, unless indicated otherwise: Standard Specification for Public Works Construction, Section 201-1.1.2 - Class 520-C-2500, with minimum slump of 4-inches, except concrete paving in public rights of way shall be as required authorities having jurisdiction.
- C. Concrete Mix for Trash Enclosure and other Exterior Slabs on Grade: ASTM C94 - Ready-Mixed Concrete, Alternative No. 2, minimum 2- day compressive strength as indicated on Drawings or, if not indicated, 3,000 psi.
- D. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- E. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
 - 1. Use accelerating admixtures in cold weather or set retarding admixtures in hot weather only when approved by Architect. Do not use calcium chloride.
- F. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch.
- G. Concrete Properties:
 - 1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; As scheduled.
 - 2. Water-Cement Ratio: Maximum 50 percent by weight.
 - 3. Maximum Slump: 4 inches (100 mm).

2.9 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify compacted stabilized soil is acceptable and ready to support paving and imposed loads.
 - 1. Provide as indicated on Civil Drawings, as specified in Earthwork Sections.
- B. Fine grading, checking, shaping, and compacting of subgrade shall be complete before start of concrete paving Work.
- C. Verify gradients and elevations of base are correct.

3.2 SUBBASE

- A. See Section 32 11 23 Aggregate Base Course for construction of base course for work of this Section.
- B. For pavement subject to vehicular traffic, provide sub-base and aggregate base material specified in Section 32 11 23 - Aggregate Base Courses and as indicated on the Drawings.
- C. Aggregate base is not required under Portland cement concrete paving subject only to pedestrian traffic in normal use.

3.3 PREPARATION

- A. Project Conditions:
 - 1. Water and Dust Control: Maintain control of concrete dust and water at all times. Do not allow adjacent planting areas to be contaminated.
 - 2. Do not place pavement when base surface or ambient temperature is less than 40 degrees F (4 degrees C) or if base surface is wet or frozen.
 - 3. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Moisten base to minimize absorption of water from fresh concrete. Do not place concrete on standing water.
- C. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.
- D. Notify Architect a minimum of 24 hours prior to commencement of concreting operations.
- E. Curbs and Gutters: Schedule Portland cement concrete curbs and gutters to be in place and cured prior to start of adjoining asphaltic concrete and Portland cement concrete paving work.

3.4 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
 - 1. Surfaces and Edges: Except where special finishes and tooled edges are indicated, provide all exposed finish surfaces of dense concrete with sharp arises and outside corners.
 - 2. Recesses and Openings: As indicated on Drawings or as directed.
- B. Concrete Formwork:
 - 1. Construct formwork accurately and to configurations and dimensions indicated for finish concrete Work.
 - 2. Formwork shall be substantial, mortar-tight and braced to maintain position and shape during placement of reinforcing and concrete.
 - 3. Hold forms rigidly in place by stakes, clamps, spreaders and braces where required to ensure rigidity.
 - 4. Curbs:
 - a. Construct curb forms with smooth side placed next to exposed concrete face.
 - b. Curb forms shall have true, smooth upper edge.
 - c. Depth of curb forms at back of curbs shall be equal to full depth of curb.
 - d. Depth of face forms shall be equal to full face height of curb.
 - e. Benders or thin plank forms may be used to form curves and at grade changes and curb returns.
 - f. Back forms for curb returns may be made of 1/2 inch (12 mm) thick benders cleated together for full depth of the curb.
 - 5. Formwork shall not deviate more than 1/4 inch (6 mm) maximum from required positions and levels.
 - 6. Verify formwork alignment and levels as Work proceeds, promptly making adjustments and adding bracing as necessary.
- C. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
 - 1. Remove the form on the front of curbs in not less than one hour nor more than 6 hours after the concrete has been placed.
 - 2. Remove side forms for sidewalks, gutter depressions, island paving and driveways, not less than 12 hours after the finishing has been completed.
- D. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.5 REINFORCEMENT

- A. Place reinforcement at mid-height of slabs-on-grade.

- B. Reinforcement Placement, General: Locate reinforcement as indicated on Drawings or in Standard Specifications, whichever is more stringent.
 - 1. Locate reinforcement to provide required cover by concrete. If not otherwise indicated on Drawings or in Standard Specifications, provide concrete cover in compliance with ACI 318, Table 3.3.2.3.
 - 2. Place, support and secure reinforcement against displacement.
- C. Reinforcement Spacing: Space reinforcement as indicated on Drawings or in Standard Specifications, whichever is more stringent. If not indicated, maintain clear spacing of two times bar diameter but not less than 1-1/2 inch (38 mm) nor less than 1-1/3 times maximum size aggregate.
- D. Coordination: Locate reinforcement to accommodate embedded products and formed openings and recesses.
- E. Reinforcement Supports: Provide load bearing pads under supports or provide precast concrete block bar supports.
- F. Interrupt reinforcement at contraction and expansion joints.
 - 1. Provide doweled joints 24" O.C. with one end of dowel set in capped sleeve to allow longitudinal movement.
- G. Place dowels to achieve pavement and curb alignment as detailed.
 - 1. Secure tie dowels in place before depositing concrete. Provide No. 3 bars, 18 inch (457 mm) long at 24 inches (610 mm) O.C. for securing dowels where no other reinforcement is provided.

3.6 COLD AND HOT WEATHER CONCRETING

- A. Follow recommendations of ACI 305R when concreting during hot weather.
- B. Follow recommendations of ACI 306R when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen.

3.7 PLACING CONCRETE

- A. Mixing: If batch plant is within travel time not exceeding maximum limits, transit mix concrete in accordance with ASTM C94. If travel time exceeds limits, provide alternative means for mixing and submit for review and approval.
- B. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch.
- C. Place concrete in accordance with ACI 304R.
- D. Do not place concrete when base surface is wet.
- E. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.

- F. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- G. Use internal vibration to consolidate concrete around reinforcing per industry guidelines.
- H. Place concrete to pattern indicated.

3.8 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place 1/2 inch (12 mm) wide expansion joints as indicated on Drawings (if not indicated provide at 20 foot (6 m) intervals) and to separate paving from vertical surfaces and other components and in pattern indicated.
 - 1. Place in all concrete walks, other exterior flatwork and concrete curbs and gutters.
 - 2. If expansion joints are not indicated, comply with standard details and specifications of authorities having jurisdiction, including Standard Details for Public Works Construction and Standard Specification for Public Works Construction, as applicable.
 - 3. Place expansion control filler to correct elevation and profile. Form joints with joint filler extending from bottom of pavement to within 1/2 inch (13 mm) of finished surface.
 - 4. Secure to resist movement by wet concrete.
 - 5. Coordinate locations to align expansion joints in adjoining concrete walks, curbs, gutters and other exterior flatwork.
 - 6. Provide expansion joints also at beginning and end of all curved segments.
 - 7. Provide expansion joints also at intersections of concrete curbs and gutters and building footing.
 - 8. Provide expansion joints also at intersections of concrete paving and building footing.
 - 9. Lay out expansion joint locations to occur where possible at penetrations such as handrail posts and columns.
 - 10. Place expansion control filler to correct elevation and profile.
- C. Provide scored joints:
 - 1. As indicated on Drawings. If not indicated, locate joints in compliance with Standard Details and as indicated below.
 - 2. Evenly spaced at maximum 5 feet (1.5 m) intervals for vehicular paving and 5 feet (1.5 m) for pedestrian paving.
 - 3. Between sidewalks and curbs.

4. Between curbs and pavement.
5. Lay out control joint locations to occur at penetrations such as handrail posts and columns and where shown on Drawings.
6. Refer to Architectural, Landscape and Civil Drawings for additional information and joint locations.

D. Provide keyed joints as indicated.

E. Saw cut contraction joints 1/8 inch (3 mm) wide at an optimum time after finishing. Cut 1/3 into depth of slab.

3.9 EXPOSED AGGREGATE

- A. Wash scheduled concrete surfaces with acid etch solution exposing aggregate to match sample panel.
- B. Decorative Scoring at Exposed Aggregate Flatwork: Pattern as indicated.
 1. Use saw-cuts 1/8-inch wide by one-fourth of slab depth, unless otherwise indicated. Commence work as soon as possible after concrete placement as recommended by Soff-Cut International, Corona, CA (800/776-3328).

3.10 FINISHING

- A. Concrete Paving Finish: ACI 301, two-step trowel finish, followed after surface has achieved initial set by flooding of surface and light rubbing with bristle brush so that concrete fines are exposed slightly.
 1. Finish surface less than 6 percent shall receive medium broom finish resembling medium grit sandpaper. CBC 11B-403 and 11B-302.1.
 2. Finish surface greater than 6 percent shall receive heavy broom finish. CBC 11B-403 and 11B-302.1.
 3. Surfaces shall have static coefficients of friction of 1.3 to 1.6 (dry) and 1.2 to 1.4 (wet) when field tested in accordance with ASTM C1028.
 4. Portland cement concrete paving shall be stable, firm, and slip resistant and shall comply with CBC Sections 11B-302 and 11B-403.
- B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/8 inch (3 mm) radius.
 1. Broomed: Pull broom across freshly floated concrete to produce medium texture in straight lines perpendicular to main line of traffic. Do not dampen brooms.
 2. Tooled Joints: 1-inch deep by 3/16-inch wide tooled joints with 1/8-inch radius corners.
- C. Enhanced Sidewalk Paving: Light sandblast look finish using surface retarder.

1. Apply surface retarder in strict compliance with manufacturer's specifications and instructions.
2. Surface retarder shall be applied after concrete surface has been finished and while concrete is still moist.
 - a. Apply with a Hudson type sprayer with an adjustable or fan type nozzle with a .3-.5 gpm flow rate.
 - 1) Apply at the rate of 175-350 sf/gal.
 - b. Once surface retarder is applied, protect per manufacturer's specifications.
 - c. Begin washing surface retarder off surface of concrete after 12 to 16 hours.
 - 1) Wash with a power washer with 1500 psi and a 25 degree fan nozzle.
 - 2) Keep power washer tip 6 to 10 inches away from surface of concrete to avoid deep scour marks.
 - 3) A stiff bristle brush may be used to help achieve the desired finish.
 - 4) Wash until clear water runs off the surface of the concrete paving.
 - d. Allow concrete to dry and cure before applying sealer.
 - e. Apply sealer per sealer manufacturer's specifications.
- D. Curbs and Gutters: Comply with Standard Specifications.
- E. Specific Finishes:
 1. Salt Finish (Rock Salt):
 - a. Tamp concrete sufficiently to bring fines to surface. Bring to required grade with wood floats and steel trowel smooth.
 - b. Apply heavy textured salt finish, composed of particles 1/4-inch to 3/8-inch in size on approximately 80 percent of each square foot of concrete surface.
 - 1) Sprinkle salt on concrete and press into surface leaving only tops of salt grains exposed.
 - c. After 24 hours, wash salt away with water and brush.
 - d. Allow surface and impressions to dry before applying curing compound.
 - e. Match approved mock-up sample panel.
 2. Trowel: Precautions should be taken to ensure that the surface is uniformly troweled so that it is not slippery. Do not over-trowel or burnish the surface.
- F. Curing and Sealing:
 1. Place sealer on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.
 2. Precautions shall be taken in hot weather to prevent plastic cracking resulting from excessively rapid drying at surface as described in CIP 5 Plastic Shrinkage Cracking published by the National Ready Mixed Concrete Association.
 3. Do not cover concrete with plastic sheeting.

3.11 JOINT SEALING

- A. See Section 07 92 00 - Joint Sealants for joint sealer requirements.

3.12 TOLERANCES

- A. ACI 301, Class B, except paving in public rights-of-way shall comply with the Standard Specifications.
- B. Maximum Variation of Surface Flatness: 1/4 inch (6 mm) in 10 ft (3 m).
- C. Maximum Variation from True Position: 1/4 inch (6 mm).

3.13 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00.
 - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
 - 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
 - 3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- B. Compressive Strength Tests: ASTM C 39/C 39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 75 cu yd (57 cu m) or less of each class of concrete placed each day.
 - 1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
 - 2. Perform one slump test for each set of test cylinders taken.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.14 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian or vehicular traffic over pavement until 75 percent design strength of concrete has been achieved.
- C. Prohibit all vehicular traffic across pedestrian paving unless suitable base and reinforcement have been added.
- D. Provide lumber ramping and plywood covering where curbs and gutters are subject to vehicular and equipment traffic during construction.
- E. Provide protection of colored concrete in accordance with colored concrete manufacturer's instructions and recommendations.

END OF SECTION

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SECTION 32 17 23.13 PAINTED PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Playground markings.

1.2 RELATED REQUIREMENTS

- A. Section 32 13 13 - Concrete Paving: Surface for painting.

1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
- B. AMS-STD-595 - Colors Used in Government Procurement.
- C. FS TT-B-1325 - Beads (Glass Spheres); Retro-Reflective.
- D. FS TT-P-1952 - Paint, Traffic and Airfield Marking, Waterborne.
- E. SSPWC (Greenbook) - Standard Specifications for Public Works Construction.
- F. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association.
- G. FHWA MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration.
- H. SCAQMD 1113 - Architectural Coatings.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Certificates: Submit for each batch of paint and glass beads stating compliance with specified requirements.
- D. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Paint: 1 container, 1 gallon size, of each type and color.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:

- 1. See Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions regarding CalGreen requirements.
 - a. Comply at time of installation with Air Quality standards of:

- 1) South Coast Air Quality Management District, SCAQMD 1113.
- 2) California Air Resources Board (CARB).
2. For accessibility markings see Part 3 Article "Installation".
3. Conform to State of California, Department of Transportation (CALTRANS) Standard Specifications, Section 84, Traffic Control Markings, as amended and adopted by authorities having jurisdiction.
4. Where reference is made to Standard Specifications, the following shall apply.
 - a. Perform off-site Work in public rights-of-way in accordance with requirements of authorities having jurisdiction. For conditions not indicated otherwise on Contract Drawings, conform to Standard Details adopted by authorities having jurisdiction, including SSPWC (Greenbook).
 - b. Perform on-site Work as indicated and referenced on the Contract Drawings and as specified herein.

B. Applicator Qualifications: Company regularly engaged in pavement marking, well-experienced in use of machine-applied painted stripes and other markings, with three years of verifiable experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.
- B. Deliver glass beads in containers suitable for handling and strong enough to prevent loss during shipment accompanied by batch certificate.
- C. Store products in manufacturer's unopened packaging until ready for installation.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside paint manufacturer's absolute limits.
 1. Do not apply marking paint when weather is foggy or rainy, or when ambient or pavement temperatures are below 40 degrees F., or when such conditions are anticipated within eight hours of application.
- B. Do not apply marking paint when wind velocity causes uncontrollable overspray or excessively rapid drying.
- C. Sequence and Schedule: Apply pavement markings after asphaltic concrete and portland cement concrete and interlocking concrete paving Work are complete and properly cured and, if applicable, sealer has been applied to asphaltic concrete and landscaping Work is complete.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide standard factory-mixed, quick drying and non-bleeding colors, conforming to

Standard Specifications, as amended and adopted by the AHJ, City, and County, as applicable.

B. Line and Zone Marking Paint: MPI (APL) No. 97 Latex Traffic Marking Paint; color(s) as indicated.

1. Parking Lots: Fast-dry type. If required by authorities having jurisdiction for Work in public rights-of-way, include reflective material in paint. Paint for marking curbs shall not require reflective material. See Color Schedule in Part 3.
2. Accessibility Symbols: Blue shall conform to Color No. 15090, FED-STD-595C. (SAE AMS- STD-595)
3. Substitutions: See Section 01 60 00 - Product Requirements.

C. Recreational Area Paint:

1. Paint: Water emulsion-based traffic paint; FS TT-P-1952.
2. Color: To be selected by Architect from full range.
3. Basis of Design Product: 6700 100%Acrylic Traffic Marking Paint as manufactured by Vista Paint, or approved equal.
4. Products:
 - a. Vista Paint Corporation: www.vistapaint.com
 - b. Dunn Edwards: www.dunnedwards.com.
 - c. Sherwin Williams; 2 Coats of SW Armorseal 8100 with Armorseal High Wear Additive in second coat: www.sherwin.com.
 - d. Behr: www.behr.com
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

D. Paint For Obliterating Existing Markings: FS TT-P-1952; black for bituminous pavements, gray for portland cement pavements.

E. Reflective Glass Beads at Accessible Parking Spaces: FS TT-B-1325, Type I (low index of refraction), Gradation A (coarse, drop-on); with silicone or other suitable waterproofing coating to ensure free flow.

1. Comply with CBC Section 11B-502.6.4 Marking.

F. Temporary Marking Tape: Preformed, reflective, pressure sensitive adhesive tape in color(s) required; Contractor is responsible for selection of material of sufficient durability as to perform satisfactorily during period for which its use is required.

G. Raised Reflective Pavement Markers:

1. Specified Manufacturer: Pac-Tec, Inc., Heath, OH; local source Western Highway Products.
2. Ray-O-Lite Raised Reflective Pavement Markers:
 - a. Molded optic grade Methyl Methacrylate conforming to ASTM D4802 with fill material consisting of thermosetting compound designed for impact and wear resistance.
 - b. Optical Performance: Reflective intensity of reflecting surface at 1/5 degree divergence angle shall be not less than the following when the incident light is parallel.

Horiz. Eng. Angle	Blue
0 Degrees	3.0
20 Degrees	1.5

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Clean surfaces thoroughly prior to installation.
 - 1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
 - 2. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement, by scraping, wire brushing, sandblasting, mechanical abrasion, or approved chemicals.
- C. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.
- D. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.
 - 1. Lay out markings as shown on Drawings. Use guide lines, templates and forms for precise edges and spacings.
 - a. At off-site and on-site public rights-of-way, obtain review and approval of layout by authorities having jurisdiction.
- E. Temporary Pavement Markings: When required or directed by Architect, apply temporary markings of the color(s), width(s) and length(s) as indicated or directed.
 - 1. After temporary marking has served its purpose, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that surface to which the marking was applied will not be damaged.
 - 2. At Contractor's option, temporary marking tape may be used in lieu of temporary painted marking; remove unsatisfactory tape and replace with painted markings at no additional cost to District.

3.3 INSTALLATION

- A. Regulatory Accessibility Requirements for Installation:
 - 1. Pavement markings for disability requirements shall meet requirements of California Building Code (CBC), Title 24, Part 2, Chapter 11B and ADA Accessibility Guidelines

for Buildings and Facilities, per latest amendments.

- a. Accessible parking spaces serving a particular building or facility shall be located, and dispersed if serving more than one accessible entrance, on the shortest accessible route to an entrance or to multiple accessible entrances. CBC Sections 11B-208.3.1
- b. Accessible parking spaces in a parking facility not serving a particular building or facility shall be located on the shortest accessible route to an accessible pedestrian entrance of the parking facility. CBC Sections 11B-208.3.1
- c. Minimum number of required accessible parking spaces shall be provided in accordance with CBC Table 11B-208.2 for each parking facility provided.
- d. For every six or fraction of six accessible parking spaces, at least one shall be an accessible van parking space. CBC Section 11B-208.2.4
- e. Accessible parking spaces and access aisles shall comply with CBC Section 11B-502 and shall be dimensioned to the centerline of the marked lines as follows:
 - 1) Parking spaces and access aisles shall be marked according to CBC Figures 11B-502.2, 11B-502.3, and 11B-502.3.3.
 - (a) Their surfaces shall comply with CBC Section 11B-302 and shall be at the same level with slopes not steeper than 1:48 in any direction. CBC Section 11B-502.4.
 - 2) Parking spaces shall be 9 x 18 feet minimum and van parking spaces shall be 12 x 18 feet minimum with an adjacent access aisle of 5 x 18 feet minimum.
 - (a) Access aisles shall be placed on either side of the parking spaces except be located on the passenger side for van parking spaces.
 - (b) Van parking spaces shall be permitted to be 9 x 18 feet minimum where the access aisle is 8 x 18 feet minimum.
 - 3) Access aisles shall be marked by a blue painted borderline around their perimeter.
 - (a) The area within the blue borderlines shall be marked with hatched lines a maximum of 36 inches on center in a color contrasting with that of the aisle surface, preferably blue or white.
 - (b) Access aisle markings may extend beyond the minimum required length. CBC Section 11B-502.3.3
 - (c) At drive aisle provide minimum 12 inch high white letters with the text "NO PARKING" per CBC Figure 11B-502.3.3.
 - 4) Access aisles (parking spaces as well- similar application) shall not overlap the vehicular way. CBC Section 11B-502.3.4
 - 5) A vertical clearance of 98 inches minimum shall be provided for accessible parking spaces, access aisles, and vehicular routes serving them. CBC Section 11B-502.5

2. At least one passenger loading zone shall be provided in every continuous 100 linear feet of loading zone space, or fraction thereof, complying with CBC Sections 11B-209 and 11B-503 as follows:

- a. Vehicle pull-up spaces shall be 9 x 20 feet minimum.
 - 1) Access aisles shall be 5 x 20 feet minimum and shall be adjacent and

parallel to the vehicular pull-up spaces.

2) They shall be at the same level with slopes not steeper than 1:48 in any direction. CBC Section 11B-503.4

b. Access aisles for passenger drop-off and loading zone shall be marked with a painted borderline around their perimeter.

1) The area within the borderlines shall be marked with hatched lines a maximum of 36 inches on center in a color contrasting with that of the aisle surface. CBC Section 11B-503.3

c. A vertical clearance of 114 inches minimum shall be provided for vehicle pull-up spaces, access aisles, and a vehicular route serving them connecting a vehicular entrance and a vehicular exit. CBC Section 11B-503.5

3. Bus loading zones and bus stops shall comply with CBC Sections 11B-209 and 11B-810.2 as follows:

a. Boarding and alighting areas shall be of 8 x 5 feet minimum, with 8 feet measured perpendicular to the curb or vehicle roadway edge, and with 5 feet measured parallel to the vehicle roadway.

1) Slopes in 8 foot direction shall be 1:48 maximum.

2) Slopes in 5 foot direction shall be the same as that of the roadway, to the maximum extent practicable. CBC Figure 11B-810.2.2.

b. Bus shelters shall provide a minimum 30 x 48 inches clear floor or ground space (36 x 48 inches or 36 x 60 inches as applicable in an alcove), with slopes not steeper than 1:48 in any direction, entirely within the shelter complying with CBC Section 11B-305.

c. Bus shelters shall be connected by an accessible route complying with CBC Section 11B-402 to a boarding and alighting area complying with CBC Section 11B-810.2; CBC Figure 11B-810.3.

d. Newly constructed bus stop boarding and alighting areas shall provide a detectable transition between the boarding/alighting area and the roadway; the detectable transition shall consist of a curb with the face sloped at 35 degrees maximum from vertical or detectable warnings complying with CBC Sections 11B-705.1.1 and 11B-705.1.2.4.

4. Electric Vehicle Charging Stations:

a. Where Electric Vehicle Charging Stations are provided, they shall be provided in accordance with CBC Section 11B-228.3, Table 11B-228.3.2.1 and CBC Section 11B-812 (see 111136.13 - Electric Vehicle Charging Equipment for additional requirements).

b. Accessibility requirements for Public Use or Common Use EVCS facilities:

1) Vehicle spaces and access aisles serving them shall comply with CBC Section 11B-302. Access aisles shall be at the same level as the vehicle space they serve. Changes in level, slopes exceeding 1:48, and detectable warnings shall not be permitted in vehicle spaces and access aisles. CBC Section 11B-8J2.3

2) Vehicle spaces, access aisles serving them and vehicular routes serving them shall provide a vertical clearance of 98 inches minimum. CBC Section 11B-812.4

3) Accessible routes between EVCS parking, equipment and the building or facility served shall be provided per CBC Section 11B-812.5

4) Vehicle spaces for van accessible, standard accessible,

ambulatory and drive-up EVCS shall meet minimum length and width requirements per CBC Section 11B-812.6. All EVCS stalls shall be marked "EV Charging Only" per CBC Section 11B-812.9 and Figure 11B-812. 9.

- 5) Access aisles for van accessible and standard accessible EVCS shall meet minimum length and width requirements and be marked per CBC Section 11B-812.7 the color of the perimeter, hatch lines and "No Parking" letters shall contrast with the surface color (blue color required for use at non-EVCS accessible parking shall not be used).
- 6) ISA Signs:
 - (a) Where four or fewer total EVCS are provided, identification with an International Symbol of Accessibility (ISA) shall not be required.
 - (1) Where five to twenty-five total EVCS are provided, one van-accessible EVCS shall be identified with an ISA complying with section CBS Section 11B-703.7.2.1. The required standard accessible EVCS shall not be required to be marked with an ISA.
 - (2) Where twenty-six or more EVCS are provided, all required van-accessible and all required standard accessible EVCS shall be identified with an ISA.
 - (3) The required ISA identification sign shall be reflective with a minimum 70 square inches, shall be visible from the EVCS it serves. The sign shall be permanently posted either immediately adjacent to the vehicle space or within the projected vehicle space at the head end of the vehicle space. Signs identifying van accessible vehicle spaces shall contain the designation "Van Accessible".
Signs shall be minimum 60 inches above the finish surface except that if the sign projects into a pedestrian circulation area, they shall be minimum 80 inches above finish surface CBC Section 11B-812.8
 - 7) Ambulatory EVCS complying with CBS Section 11B-812.6.3 shall be required where 26 or more EVCS are provided. CBC table 11B-228.3.2.1

B. General: Using proper masking, stencils and application equipment, apply marking paint at rate recommended by paint manufacturer or approximately one gallon per 150 square feet (equivalent to approximately one gallon for 450 lineal feet of 4-inch wide stripe), whichever is greater.

1. Equipment shall be capable of operating at 125 psi air pressure, agitate paint constantly and hold exactly to the alignment.
2. Equipment used for applying reflectorized striping shall be equipped with a bead dispenser capable of applying beads at the specified rate.

C. Begin pavement marking as soon as practicable after surface has been cleaned and dried.

D. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.

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- E. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.
- F. Comply with FHWA MUTCD manual (<http://mutcd.fhwa.dot.gov>) for details not shown.
- G. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.
- H. Apply uniformly painted markings of color(s), lengths, and widths as indicated on drawings
 - 1. Apply paint in one coat only.
 - 2. Wet Film Thickness: 0.015 inch, minimum.
 - 3. Length Tolerance: Plus or minus 3 inches.
 - 4. Width Tolerance: Plus or minus 1/8 inch.
- I. Curbs: Paint full vertical face and first 6-inches of horizontal plane at top of curb or combination curb/paving. Provide minimum 2 coats paint.
 - 1. Provide stenciled text in the height, spacing and typeface as indicated on Drawings.
- J. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on drawings.
 - 1. Mark the International Symbol of Accessibility at indicated parking spaces.
 - a. Accessibility Logo: Provide minimum of 2 coats paint.
 - 1) Comply with CBC Figure 11B-703.7.2.1.
 - b. Stall Marking:
 - 1) Use single-line style striping between parking stalls, unless otherwise indicated.
 - 2) Comply with local agency regulatory requirements.
 - 3) Accessible Stalls: Comply with ADA Standards and local agency regulatory requirements.
 - (a) Painted lines and markings on pavement shall be minimum 4 inches wide, color as indicated on Drawings
 - (b) Tactile warning lines shall comply with CBC Section 11B-705.1.2.5 Hazardous Vehicular Areas.
 - (c) Tactile warning devices shall comply with CBC, see Section 32 17 26 - Detectable Warning Surface.
 - c. Hatching: Provide hatching in parking areas, including accessible parking stalls, as indicated on Contract Drawings or as required by Standard Details. Should Contract Drawings and Standard Details conflict, comply with the more stringent.
 - 2. Hand application by pneumatic spray is acceptable.
 - K. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.
 - L. Speed Bumps: Provide minimum 2 coats paint on raised portion.

M. Recreational Areas: Provide minimum 2 coats paint.

3.4 DRYING, PROTECTION, AND REPLACEMENT

- A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.
 - 1. Prevent construction activities over completed markings, except light vehicular and pedestrian traffic.
- B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.
- C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.
- D. Touch-up paint as required to provide clean, straight lines and full coverage of surfaces.
- E. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.
- F. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.
- G. Replace removed markings at no additional cost to District.
 - 1. Clean up all oil, paint splatters and other stains from surfaces in preparation for Substantial Completion review.

3.5 COLOR SCHEDULE

A. Parking and On-Site Roadways

<u>Location</u>	<u>Color</u>	<u>Reflectance</u> **
Driving lane striping	White	82%
Parking space striping	White	82%
Accessible Parking, ISA, and zone markings	Blue No. 15090 per FED-STD-595C (SAE AMS-STD-595)	52%
Accessible loading and cross-hatching	A. White with Blue perimeter at Asphalt Paving. B. Blue at Concrete Paving*	82% / 52% 52%
12 inch high Text: "NO PARKING", "LOADING ZONE", and "FIRE LANE", etc.	White	82%
Firelanes / No Parking zone markings Special Use Markings	Red No. 31350 per FED-STD-595C (SAE AMS-STD-595)	52%
Loading zone markings	Orange Yellow No. 33538 per FED-STD-595C (SAE AMS- STD-595)	52%

Directional arrows	White	82%
Speed Bumps	Orange Yellow No. 33538 per FED-STD-595C (SAE AMS-STD-595)	52%
Black special-use pavement markings, if indicated on Drawings	Black No. 37038 per FED-STD-595C (SAE AMS-STD-595)	NA

*Contrasting color per CBC.

a. See also Division of the State Architect IR 11B-7.

**Daylight directional reflectance (without glass beads) , when tested in accordance with Federal Test Method Standard 141A, Method 612.

B. Electrical Vehicle Charging Station (EVCS):

<u>Location</u>	<u>Color</u>	<u>Reflectance</u> *
EVCS Parking space striping	Yellow No. 33655 per FED-STD-595C (SAE AMS-STD-595)	52%
12 inch high Text: "EV CHARGING ONLY" CBC 11B-812.9	Yellow No. 33655 per FED-STD-595C (SAE AMS-STD-595)	52%
EVCS Accessible Parking, ISA, and zone markings. CBC Table 11B-228.3.2.1 1-4 EVCS Spaces: Provide space sized for van accessible use. Signage not required. CBC 11B-812.8.1 5-25 EVCS spaces: Provide one van and one standard accessible signage and ISA. >25 EVCS Spaces: Provide at each required accessible space.	Yellow No. 33655 per FED-STD-595C (SAE AMS- STD-595)	52%
Accessible loading and cross-hatching. 12 inch high Text: "EV CHARGING ONLY" CBC 11B-812.8 "NO PARKING" CBC Figure 11B-812.9	Yellow No. 33655 per FED-STD-595C (SAE AMS-STD-595) Do not use blue.	52%

*Daylight directional reflectance (without glass beads) , when tested in accordance with Federal Test Method Standard 141A, Method 612.

C. Athletic Courts and Recreational Areas

<u>Location</u>	<u>Color</u>
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Athletic Court Lines on asphalt	White*
Athletic Court Lines on concrete	Yellow*

*Exterior Recreational Use: Marking Width and Color; Unless indicated otherwise on Drawings.

- a. Athletic Court Lines: 2 inches White
- b. Where two sets of lines overlap, one set provide one in white and the other set yellow or as indicated on Drawings.

END OF SECTION

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SECTION 32 17 26 – TACTILE WARNING SURFACING

SECTION 1 – GENERAL

1.1 DESCRIPTION

- A. This Section includes Specifications for furnishing and installing embedded Cast-In-Place Replaceable Detectable Warning Surface Panels (CIP REP) with an in-line truncated dome pattern embedded in concrete at pedestrian crossings, boarding platforms, and rail crossing locations to the dimensions shown on the Drawings, in accordance with the Contract Documents and as directed by the Engineer.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division 1 Specifications Section, apply to this Section.
- B. Department of Justice ADA Standards (2010)
- C. Department of Transportation ADA Standards for Transportation Facilities (2006)
- D. Proposed Guidelines for Accessible Public Rights-of-Way (2011)
- E. California Title 24
- F. ISO 23599:2019-01 – Assistive products for blind and vision-impaired persons – Tactile walking surface indicators
- G. ISO 21542:2011 – Building Construction – Accessibility and Usability of the Built Environment
- H. ISO 9001 – Certificate No. 0502011, ISO 1409 and ISO/B 16949 Certified Manufacturing Facility located in Jefferson, Ohio
- I. Accessibility for Ontarians with Disabilities Act - (AODA)
- J. Canadian Standards Association – (CSA)

1.3 SUBMITTALS

- A. Product Data Sheet: Submit ADA Solutions literature describing products, installation procedures and routine maintenance.
- B. Samples for Verification Purposes: Submit two (2) detectable warning surface panel samples. Samples shall be properly labeled and shall contain the following information: Name of Project, Submitted By, Date of Submittal, and Manufacturer's Name.
- C. Shop Drawings: Submit the Standard Manufacturer Shop Drawings showing all pertinent characteristics of the Cast-In-Place Replaceable Detectable Warning Surface Panels (CIP

REP) including profile, panel surface profile, plans of panel placement including joints, and material to be used as well as outlining installation materials and procedures.

- D. Material Test Reports: Submit all completed current test results from qualified, accredited independent testing laboratories by ASTM and UL/Canada guidelines and indicating that materials proposed for use follow specification requirements and meet or exceed the properties indicated on these specifications.
- E. Maintenance Instructions: Submit copies of the manufacturer's specified installation and maintenance practices for each type of Detectable Warning Surface panels and accessories as required.

1.4 QUALITY ASSURANCE

- A. Provide Cast-In-Place Replaceable Detectable Warning Surface Panels (CIP REP) and accessories as produced by a single manufacturer with a minimum of five years of experience in manufacturing Cast-In-Place Replaceable Detectable Warning Surface Panels.
- B. Installer's Qualifications: Engage an experienced installer certified in writing by Cast-In-Place Replaceable Detectable Warning Surface Panel (CIP REP) manufacturer as qualified for installation, who has completed installations similar in material, design, and extent to that indicated for the Contract.
- C. Cast-In-Place Replaceable Detectable Warning Surface Panels (CIP REP) must be compliant with the following guidelines and requirements (applicability may be dependent on project location):
 - 1. American Barriers Act (ABA) Accessibility Standards
 - 2. ADA Accessibility Guidelines (ADAAG)
 - 3. Department of Transportation ADA Standards for Transportation Facilities (2006)
 - 4. Department of Justice ADA Standards (2010)
 - 5. Public Rights-of-Way Accessibility Guidelines (PROWAG)
 - 6. California Building Standards Code, Title 24, California Code of Regulations
 - 7. Texas Accessibility Standards (TAS) 2012
 - 8. AASHTO M 333 Standard Specification for Detectable Warning Surfaces
 - 9. International Code Council (ICC) A117.1 Accessible and Usable Buildings and Facilities
- D. Cast-In-Place Replaceable Detectable Warning Surface Panels (CIP REP) shall meet or exceed the following test criteria using the most current test methods:

Standard	Standard Description	Value
ASTM D695	Compressive Strength	28,900 psi minimum
ASTM D790	Flexural Strength	29,300 psi minimum

ASTM D 638	Tensile Strength	11,600 psi minimum
ASTM C 1028	Standard Test Method for Determining the Static Coefficient of Friction (Slip Resistance)	1.18 Dry / 1.05 Wet
AS HB198:2014 (AS/NZS 4586)	Pendulum Sustainable Slip Resistance (SSR)	Pendulum Test Value (PTV), with Four S (96) hard rubber slider: 56 Dry / 44 Wet; After 500 cycles of abrasion: 34 Wet
ASTM C501	Abrasion Resistance	Minimum 500
FM 5-594	Abrasion Resistance, Florida Method	Average Volume Loss: no more than 0.03 cm ³
NTPEP TP103 (2015)	High Temperature Thermal Cycling Exposure, (Sect 14) and Resistance to Impact from Falling Tup (Sect 10)	Min. 60 thermal cycles at 200°F (93.33°C) = maximum damage classification of 'C' at 20 ft-lb impact
ASTM G155	Accelerated Weathering	ΔE<5.0 at 2,000 hours min.
ASTM D570	Water Absorption	0.07%
ASTM C1026	Freeze/Thaw/Heat	No deterioration
ASTM D1037	Freeze/Thaw	No deterioration
ASTM D543	Chemical Stain Resistance	No reaction
ASTM D1308	Chemical Stain Resistance	No reaction
ASTM-B117	Salt and Spray	No change after 200 hours
ASTM E84	Flame Spread Index	20
AASHTO H20	Load Bearing Test	No Damage at 16,000 lbs.

E. Stamped concrete, polymer concrete, concrete pavers/tile, or brick products are not acceptable for use on this project.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Cast-In-Place Replaceable Detectable Warning Surface Panels (CIP REP) shall be suitably packaged or crated to prevent damage in shipment and handling. Finished surfaces shall be protected by sturdy plastic wrappings to protect the panel from concrete residue during installation.
- B. Cast-In-Place Replaceable Detectable Warning Surface Panels (CIP REP) shall be delivered to a location at the building site for storage before installation. Store panels in an area that is within an acceptable temperature range 40°F - 90°F (and maintain the storage facility in a clean, dry condition to prevent contamination or damage to the panels.

1.6 SITE CONDITIONS

- A. Environmental Conditions and Protection: Maintain a minimum temperature of 40°F in spaces to receive Cast-In-Place Replaceable Detectable Warning Surface Panels (CIP REP) for at least 24 hours before installation, during installation, and for not less than 24 hours after installation.
- B. The use of water for work, cleaning, or dust control, etc. shall be contained and controlled and shall not be allowed to come in to contact with the general public. Provide barricades or screens to protect pedestrians.

1.7 MANUFACTURER'S WARRANTY

A. Cast-In-Place Replaceable Detectable Warning Surface Panels (CIP REP) shall be guaranteed in writing for a period of seven (7) years from date of Contract's final completion. The guarantee includes manufacturing defects, breakage, and deformation.

1.8 INSTALLATION WARRANTY

A. Cast-In-Place Replaceable Detectable Warning Surface Panels (CIP REP) installation shall be warranted in writing for two (2) years by the installer. Products must be guaranteed from defective work and loosening of panels.

SECTION 2 – PRODUCTS

2.1 MANUFACTURERS

A. Cast-In-Place Replaceable Detectable Warning Surface Panels (CIP REP) by ADA Solutions, 323 Andover Street, Suite 3, Wilmington, MA 01887. Toll-Free: 800-372-0519, sales@adatile.com, www.adatile.com.

B. Panel Sizes

1. Heavy Duty Rectangular Panels, 0.375" top thickness
 - a. 36" x 48"
 - b. 36" x 60"

C. Existing engineered and field-tested products, which have been in successful service for five (5) years are subject to specification compliance, may be incorporated in the project and shall meet or exceed the specified test criteria and characteristics. Requests for Approved Equal status must be submitted and approved by the Owner before the Tender Phase of the project.

2.2 MATERIALS

A. Composition: Cast-In-Place Replaceable Detectable Warning Surface Panels (CIP REP) shall be manufactured using a matte finish exterior grade homogeneous (uniform color throughout thickness of product) glass and carbon reinforced polyester based Sheet Molding Compound (SMC) composite material. Truncated domes must contain fiberglass reinforcement within the truncated dome for superior structural integrity and impact resistance. A matte finish will be required on the Tactile Warning Surface for superior slip resistance performance superior to that offered by a gloss finish. Use of Tactile Warning Surface Products employing coatings or featuring layers of material with differing composition, performance, or color properties is expressly prohibited under this Section.

B. Color: Color shall be single, homogeneous color throughout panel

1. Federal Yellow (Y), Federal Standard Color No. 33538

C. Domes: Raised truncated domes of 0.2" nominal height, base diameter of 0.9" (and top diameter of 0.45"). ADA Standards and Public Rights-of-Way Accessibility Guidelines require truncated dome spacing range of 1.6"-2.4".

Designer Note: For superior wheelchair, walker and shopping cart mobility, the preferred truncated dome spacing shall have a center-to-center (horizontally and vertically) spacing of nominal 2.35" measured between the most adjacent domes on square grid.

- D. Dome Spacing:
 - 1. Heavy Duty Rectangular Panels: 2.35" dome spacing in square grid pattern
- E. CIP REP panels shall feature a minimum of eight (8) corrosion resistant concrete anchor inserts minimum 1.5" long with 0.5" x 1.5" long corrosion resistance bolts. Anchor bolts locations must be covered with structural water-tight caps. Anchor locations shall not be at truncated domes locations.
- F. CIP REP panels shall include a perimeter structural flange minimum 0.70" in depth with gaps to prevent air entrapment.
- G. Truncated Dome Surface of CIP REP panels shall be protected with factory installed plastic sheeting for cleanliness during the installation process. Basic Installation Guidelines shall be printed on the plastic sheeting in both English and Spanish for customer convenience.
- H. Cleaning materials used on site shall have code acceptable low VOC solvent content and low flammability.
- I. The Specifications of the concrete, sealants and related materials shall be in accordance with the Contract Documents and the guidelines set by their respective manufacturers.

SECTION 3 – EXECUTION

3.1 PREPARATION

- A. During all concrete pouring and CIP REP panel installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards.
- B. The physical characteristics of the concrete shall be consistent with the Contract Specifications while maintaining a slump range of 4 - 7 to permit solid placement of the CIP REP panel. An overly wet mix will cause the panel to float. Under these conditions, suitable weights such as 2 concrete blocks or sandbags (25 pounds) shall be placed on each panel.
- C. The concrete shall be poured and finished, true and smooth to the required dimensions and slope prior to CIP REP panel placement.

3.2 EQUIPMENT

- A. Contractor shall provide all tools, equipment, and services required for satisfactory installation per manufacturer's instruction as Incidental Work. Equipment which may be required include typical mason's tools, a 4-foot level with electronic slope readout, 25 lb. weights, vibrator, rubber mallet with 2" x 4" x 10" wood tamping plate, and a device for cutting the Detectable Warning Surface Panels.

3.3 INSTALLATION

- A. Contractor will not be allowed to install CIP REP panels until all submittals have been reviewed and approved by the Engineer. Panels shall be installed per manufacturer's instructions.
- B. To the maximum extent possible, the CIP REP panels shall be oriented such that the rows of in-line truncated domes are parallel with the direction of the ramp. When multiple panels regardless of size are used, the truncated domes shall be aligned between the panels and throughout the entire tactile warning surface installation.
- C. In accordance with the Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Rights of Way 2011, panels shall be located relative to the curb line as shown within Sections 304 and 305 of the Guidelines.
- D. CIP REP panels shall be tamped or vibrated into the fresh concrete to ensure that there are no voids or air pockets, and the field level of the panel is flush to the adjacent concrete surface or as the Drawings indicate to permit proper water drainage and eliminate tripping hazards between adjacent finishes.
- E. Cutting and Setting of CIP REP panels shall be cut into size and configuration indicated on the Drawings using a 60 tooth carbide blade on a table saw or equivalent cutting device. Minimize any cantilever effect (to the maximum extent practicable) when cutting between successive embedment ribs as concrete will tend to flow up and over the panels. The top of the body of the panel shall be fully seated and flush with the adjacent concrete substrate. For specific instructions for cutting and setting refer to Detectable Warning Surface manufacturer's written instructions.

3.4 CLEANING AND PROTECTING

- A. Protect CIP REP panels against damage during construction period to comply with panel manufacturer's Specifications.
- B. During and after the CIP REP panel installation and the concrete curing stage, it is imperative that there are no walking, leaning or external forces placed on the panel to rock the panel, causing a void between the underside of the panel and the concrete.
- C. Remove Protective Plastic Sheeting from CIP REP panel within 24 hours of installation of the panel. Particularly under hot weather conditions (80 degrees or higher), plastic sheeting will adhere strongly (resulting in difficult removal of same) to Detectable Warning Surface panel when not removed quickly.
- D. If requested by the Project Manager, clean CIP REP panels not more than four (4) days prior to date scheduled for inspection intended to establish date of substantial completion in each area of project. Clean panel by method specified by Detectable Warning Surface panel manufacturer.

END OF SECTION

SECTION 32 18 13 - SYNTHETIC GRASS SURFACING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Included: Synthetic grass playing field system consisting of, but not necessarily be limited to, the following:
 - 1. Synthetic grass system consisting of 1.25-inch-tall polyethylene slit film and nylon root zone.
 - 2. A resilient infill system consisting of zeolites and sand.
- B. Related Requirements:
 - 1. Section 32 18 14 - Synthetic Turf Base

1.2 REFERENCES

- A. ASTM Standard Test Methods:
 - 1. D1335: "Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings."
 - 2. D5848: "Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Covering."
 - 3. F355: "Standard Test Method for Shock-Absorbing Properties of Playing Surfaces."

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures: Action and Informational Submittals shall be submitted in accordance with Section 01 33 00 - Submittal Procedures.

1.4 ACTION SUBMITTALS

- A. Samples:
 - 1. Turf, 4" x 4" in size, illustrating details of finished product.
 - 2. Loose samples, 1-foot square of the turf backing and tufted fibers.
 - 3. One-quart samples of the following:
 - a. Specified infill.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's installation instructions.
- B. Certifications:
 - 1. Project specific letter from turf manufacturer on the company letterhead certifying that the products to be provided meet or exceed all specified requirements, and state that the installer meets the specified qualifications above and is certified by the manufacturer to install the synthetic turf specified and to be provided.
- C. Certified copies from an independent third-party laboratory reports for results of the following tests:
 - 1. Pile Height, face width & total fabric weight, ASTM D5848.

2. Primary and secondary backing weights, ASTM D5848.
3. Tuft bind, ASTM D1335.
4. Grab tear strength, ASTM D5034.
5. Water permeability, ASTM D1551.
6. Flame resistance, ASTM F1551.
7. Tuft yarn tensile strength and elongation, ASTM D2256.

D. Copy of the manufacturers' minimum 8-year, prepaid, non-prorated, third-party insured warranty and insurance policy information.

E. Qualifications: A list providing project name, date the field installation was approved, contact names and telephone numbers for each project that meets the experience and qualification requirements specified.

1.6 CLOSEOUT SUBMITTALS

A. The Contractor shall provide the following prior to Final Acceptance and the Owner filing the Project Notice of Completion:

1. Written warranty as specified with forms completed in Owner's name and registered with manufacturer and insurance carrier.
2. Information confirming that the third-party insurance policy, non-cancelable and pre-paid, is in effect covering this installation, and underwritten by a Best "A" Rated Insurance Carrier. Insurance carrier shall confirm that the policy is in force and premiums paid.
3. Three copies of Maintenance Manuals, which will include all necessary instructions for the proper care and preventive maintenance of the turf system, including painting and markings.
4. Project Record Documents, in accordance with Section 01 78 39 – Project Record Documents with plans showing actual locations of seams and other pertinent information.

1.7 QUALITY ASSURANCE

A. The manufacturer shall have a representative on site to certify the installation and warranty compliance.

B. Materials shall conform to all current NCAA standards as specified that may apply to this type of synthetic turf installation.

C. Quality Assurance Testing: Prior to shipment of the synthetic turf and components to the job site, the synthetic turf rolls should be randomly sampled and tested by the manufacturer who will certify that they meet the specification.

1. Testing shall be conducted and may include pile composition, pile weight, total weight, pile height, tuft bind, and grab/tear strength.
2. Test results of the relevant characteristics and certification turf meets or exceeds the specified requirements shall be submitted as specified.

1.8 TURF COMPANY QUALIFICATIONS

- A. The Turf company shall be experienced in both the manufacturing and installation of the specified type of synthetic infilled turf system.
 - 1. Use of outside, independent contractors for the installation is to be reviewed by the Owner's Representative prior to the Bid of Contract.
 - 2. The Turf Company shall identify and provide the name of a single point of contact for their company for this project beginning with the bid process through construction administration and project close-out.
 - 3. The Turf Company shall coordinate all bid documents, submittals, shop drawings, schedules, warranty, and close-out efforts internally and shall not rely on Owner's Representative to coordinate with multiple parties. Failure to do so could result in a time and materials charge from the Owner or Owner's Representative for additional coordination.
 - 4. For the purpose of meeting these qualifications, the type of fiber and infill are not determining factors in meeting these installation qualifications.
- B. Installer:
 - 1. Capable of providing competent workers skilled in this specific type of in-filled synthetic grass installation.
 - 2. Designated supervisory personnel on the project shall be certified as competent in the installation of this material including sewing seams and proper installation of the infill mixture.
 - 3. Possess an active California D-12 Synthetic Products license in good standing and have never had a license revoked.
 - 4. Shall not have had a Surety or Bonding Company finish work on any contract within the last 5 years.
 - 5. Shall not have been disqualified or barred from performing work for any public owner or other contracting entity in the U.S.
 - 6. For the purpose of meeting these qualifications, the type of infill is not determining factors in meeting these installation qualifications.

1.9 FIELD CONDITIONS

- A. Contractor shall be responsible for reviewing the base and ensuring it conforms to the project requirements prior to placement of the synthetic turf.
- B. Playing field subgrade preparation shall be completed and accepted by the Owner Representative prior to commencement of Work under this Section.
- C. Ambient Conditions: Care should be taken during installation to account for rapid fluctuations in temperature to avoid expansion and contraction which can affect the final installation. Temperature extremes shall be carefully monitored. The carpet should never be rolled or unrolled when frozen, which can cause cracking and irreparable damage to the secondary backing.

1.10 WARRANTY

A. Manufacturer: Provide Owner with turf manufacturer's warranty which guarantees the usability and playability of the synthetic turf system for its intended uses for a minimum **8** year period. The warranty coverage shall not be prorated nor limited to the amount of the usage. The warranty submitted must have the following characteristics:

1. A non-prorated, non-cancellable up-front pre-paid, third-party insured warranty. Warranty shall be covered by a third party insurance policy, non-cancelable and pre- paid, and is in effect covering this installation, and underwritten by a Best "A" Rated (or better) Insurance Carrier listed in the A.M. Best Key Rating Guide.
2. Insurance carrier shall confirm that the policy is in force and premiums prepaid for entire warranty duration in full.
3. The policy shall include a minimum annual aggregate of \$5,000,000 per year and be based on claims arising from fields installed and completed only during the policy year.
4. The policy shall provide full coverage for a minimum of 8 years from the date of Notice of Completion.
5. The policy shall cover all costs associated with full field replacement with new equal or better turf material, including labor, materials, and any other costs to repair or replace the field.
6. Owner shall not be responsible for any deductible.
7. Warranty shall have no restrictions on amount of use provided type of use is in accordance with the approved warranty language.
8. Shall warrant materials and workmanship, and that the materials installed meet or exceed the product specifications, including general wear and damage caused from UV degradation.
9. Shall have a provision to either make a cash refund or repair or replace such portions of the installed materials that are no longer serviceable to maintain a serviceable and playable surface.
10. Shall be a warranty from a single source covering workmanship and all self- manufactured or procured materials.
11. Guarantee the availability of replacement material for the synthetic turf system installed for the full warranty period.
12. The name on the warranty shall be made out to Desert Community College District.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. General:

1. Synthetic turf construction and components shall be non-toxic and not cause commonly known allergic reactions. Each synthetic turf system should be constructed to provide dimensional stability and resist damage from wear and tear during athletic and recreational usage.

2. System shall be permeable by design with adequate perforations through all of the backing coatings.
3. The bonding or fastening of system material components shall provide a permanent, tight, secure, and hazard-free athletic playing surface.
4. Seams shall be sewn with high strength sewing thread. Gluing of rolls is permitted if warrantied by the turf company and shall be glued with the specified glue.

B. Product Specifications:

1. Polyethylene Slit Film and Nylon Root Zone: 10,000 denier and 750 denier per end for root zone, low friction, eight-strand slit film fiber, measuring not less than 0.75 inches high and not less than 115 microns in thickness.
 - a. The low friction fiber shall be custom blended polyethylene, treated with UV inhibitors.
 - b. Fibers shall have been extruded individually through a spinnerette, stretched and twisted.
 - c. Low friction fiber shall be specifically designed to virtually eliminate abrasion.
2. The tufted fiber weight shall not be less than 58 ounces per square yard. The low friction fiber shall be custom blended polyethylene, treated with UV inhibitors.
3. The maximum gauge of the tufted fiber rows shall be 3/16 inch.
4. The turf product shall have an infiltration rate not less than 30" per hour as tested by ASTM D1551.
5. Backing: Not less than 2 components consisting of a primary and secondary backing system of multilayer polypropylene/Polyester. Secondary backing consisting of polyurethane foam – 56 OZ per square yard and 5mm thick.
 - a. Backing system shall be treated with UV inhibitors.
 - b. The backing shall receive polyurethane and acrylic applications during the manufacturing process.
 - c. The backing weight of all backing material (primary and secondary) shall be a minimum of 62.5 ounces per square yard.
6. The minimum tuft binding tensile strength shall be 8 pounds without infill, as determined by ASTM D1335.

C. The synthetic turf shall be delivered in 15-foot wide rolls and of sufficient length to extend from sideline to sideline. Head seams, between the sidelines, will not be acceptable.

2.2 INFILL SYNTHETIC TURF

A. Manufacturer and System: Astroturf- PGPN 5 mm or approved equal.

2.3 MATERIALS

A. Synthetic Turf Infill system shall consist of one primary Infill:

1. Primary Infill: Sand shall be rounded silica sand and dust free. Coarse jagged sand will not be accepted. Sand shall consist of 50-60 percent of the total infill material as defined by weight. The sand shall have the following gradation:

Sieves (US Mesh Size)	% Retained
16	0
25	10-30
30	30-50
35	15-35
40	5-15
50	<5
70	<1

2. At the end of installation, and prior to acceptance, the top of the infill shall be not less than a uniform 1/2 inch depth below the top of fibers. If additional infill is required to meet with requirement, it shall be furnished and installed by the Turf Company at no additional charge.

B. Thread for sewing seams of turf shall be as recommended by the synthetic turf manufacturer.

C. Synthetic Turf Glue

1. Any adhesive products required for the installation of the proposed turf system shall be purpose-suited to the system. The material and application methods shall be as recommended by the adhesive manufacturer.
2. Disposal of adhesive containers and unused adhesives as well as any fees resulting from such disposal shall be the responsibility of the Contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify the base, as specified in Section 32 18 14 - Synthetic Turf Base, has been installed and approved by Owner's Representative and turf manufacturer.
- B. Use a 2-5-ton static roller or other acceptable compactor to repair and properly compact any disturbed areas of the prepared base.
- C. Do not proceed with installation of turf until unacceptable base conditions have been corrected.

3.2 INSTALLING THE SYNTHETIC TURF

- A. The installation shall be performed in full compliance with the reviewed and accepted product submittal.

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- B. Only trained technicians, skilled in the installation of athletic caliber synthetic turf systems working under the direct supervision of the approved installer's supervisor, shall undertake cutting, sewing, gluing, shearing, topdressing or brushing operations.
- C. Strictly adhere to the installation procedures specified. Variance from these requirements shall be submitted to and accepted in writing, by the manufacturer's onsite representative, and submitted to the Owner, verifying that the changes do not, in any way, affect the warranty.
- D. The turf manufacturer and installation subcontractor shall inspect and accept the field base, and provide documentation to that effect, prior to the installation of the synthetic grass system. The surface must be perfectly clean as installation commences and shall be maintained in that condition throughout the process.
- E. Cutouts in the synthetic turf shall be in accordance with the Drawings and approved submittals. Coordinate cutouts in turf with Owner's Representative before cutting turf for utility boxes and other structures.
- F. The turf rolls shall be installed directly over the properly prepared base. Extreme care shall be taken to avoid disturbing the base, both in regard to compaction and planarity.
- G. The full width rolls shall be laid out across the width of the field.
- H. Utilizing standard state of the art sewing procedures each roll shall be attached to the next. After all of the rolls of the playing surface have been installed, the sideline areas shall be installed at right angles to the playing field turf.
- I. The synthetic turf field shall utilize sewn seams. 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.
 - 1. Seams between turf panels shall be sewn. Seams shall be sewn using double bagger stitches and polyester thread. Seams shall be flat, tight, and permanent with no separation or fraying.
 - 2. Inlaid markings that cannot be tufted into the fabric shall be installed by means of shearing out the existing green fiber and laying in a new piece of colored fabric into a bed of suitable "hot melt" adhesive placed directly on the original turf backing material.
 - a. Inlaid markings shall not be installed by means of cutting through the fabric and adhering the colored turf to a separate reinforcing tape or cloth.
- J. Connections of the perimeter synthetic turf edges shall be completed as shown on the Drawings:
 - 1. Connection to the recycled plastic header boards shall be done with industrial staples. Minimum embedment depth of fasteners shall be 1 inch with spacing a maximum 2 inches on center.
- K. The infill materials shall be installed to fill the voids between the fibers and allow the fibers to remain vertical and non-directional.
 - 1. Apply in thin lifts to depth specified. The turf shall be brushed as the mixture is applied.

2. The mix shall be uniform and even in thickness to assure proper playing characteristics.
3. The infill shall be placed with a void of 1/2 inch to the top of the fibers.

3.3 FIELD QUALITY CONTROL

- A. The Contractor shall provide the following prior to Final Acceptance and the Owner filing the Project Notice of Completion:
 1. Written warranty as specified with forms completed in Owner's name and registered with manufacturer and insurance carrier.
 2. Information confirming that the third-party insurance policy, non-cancelable and pre-paid, is in effect covering this installation, and underwritten by a Best "A" Rated Insurance Carrier. Insurance carrier shall confirm that the policy is in force and premiums paid.
 3. Three copies of Maintenance Manuals, which will include all necessary instructions for the proper care and preventive maintenance of the turf system.
 4. Project Record Documents, in accordance with Section 01 78 39 with plans showing actual locations of seams and other pertinent information.

3.4 DEMONSTRATION AND TRAINING:

- A. Upon completion of the field installation, Contractor shall have a supervisory person provide a field training demonstration with the Owner's personnel on how to care for the turf.
- B. At a minimum, the demonstration shall include a review of the provided maintenance manual including the proper procedure for removal of gum and other debris, and answer any questions.

3.5 MAINTENANCE CONTRACT

- A. If the proposed regular maintenance contract cost for the duration of the warranty is selected by the District, the Turf contractor shall provide one maintenance service visit per year for the first three years of the 8 year warranty, then semi-annual visits (i.e. twice a year) for the remaining five years of the warranty period. Each maintenance service visit shall include the following:
 1. One (1) Turf Contractor/Maintenance Contractor grooming session including:
 - a. A general sweeping to remove foreign objects such as dirt, leaves, bird droppings, chewing gum and other debris that may collect on the turf surface.
 - b. A deep groom sweep and rejuvenation to de-compact infill and in an effort to maintain appropriate G-Max levels, as well as clean the infill from deleterious matter contaminating the infill material.
 - c. All accumulated debris and contaminating material shall be off-hauled and disposed of in a legal manner by the Turf Company.
 2. Overall analysis and inspection of the field and its applicable systems, including fiber wear analysis, ultraviolet degradation, infill depth and consistency, infill migration, area edging attachments, sewn and glued seams.

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3. Minor repairs (sewing/adhesive failures, inlay separation, and general workmanship) as needed, of items found relating to the synthetic surface.

END OF SECTION

SECTION 32 18 13
SYNTHETIC GRASS SURFACING

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SECTION 32 18 14 - SYNTHETIC TURF BASE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Base for the synthetic turf consisting of, but is not necessarily limited to, the following:
 - 1. Vertical draining, porous stone aggregate base consisting of a uniform single stone base.
 - 2. Stone aggregate base for stability and leveling purposes, and substrate for porous drainage composite.
 - 3. Manufactured porous drainage composite.
- B. Related Requirements:
 - 1. Section 01 78 29 – Conformance Survey
 - 2. Section 31 23 16 – Excavation
 - 3. Section 31 23 23 - Fill
 - 4. Section 32 18 13 – Synthetic Grass Surfacing

1.2 REFERENCES

- A. California Building Code (CBC):
 - 1. Chapter 33 – Site Work, Demolition, and Construction.
- B. American Society for Testing and Materials (ASTM):
 - 1. D 1557: "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort." ASTM F2898-11: "Standard Test Method for Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non-confined Area Flood Test Method"
 - 2. ASTM D2434: "Standard Test Method for Permeability of Granular Soils (Constant Head)."
 - 3. ASTM C88: "Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate."
- C. California Occupational Safety and Health Standards (OSHA):
 - 1. Article 6 - Excavations and Shoring.
- D. State of California, Business and Transportation Agency, Department of Transportation (Caltrans) "Standard Specifications."

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 33 00 - Submittal Procedures.

2. Closeout Submittals shall be submitted in accordance with Section 01 78 39 - Project Record Documents.

1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's descriptive literature for pipe accessories, filter fabric, and porous drainage composite as applicable.
- B. Samples: Two 1-quart samples of each rock material and additional samples of each rock material to the Owner's testing agent as specified under Article "Material Testing," and Two 1-quart samples of Subdrain Trench Leveling Rock, as required.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's installation instructions.
- B. Certification: Certification signed by Contractor and drainage system Installer that installed materials conform to specified requirements and system was successfully checked and tested prior to covering with engineered permeable rock base, trench drain rock, and/or subdrain trench leveling rock.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Drawings.

1.7 QUALITY ASSURANCE

- A. Control of Work: Conform to Section 5 of the Standard Specifications.
- B. Control of Materials: Conform to Section 6 of the Standard Specifications.
- C. Single-Source Responsibility: Crushed stone shall come from only one supplier.
- D. Material delivered to the site not meeting the Specifications will be rejected by the Owner. Material rejected by the Owner shall be removed from the site at the Contractor's expense.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Prior to trucking of material to project sites, crushed rock shall be washed so it is clean of impurities and fines created during rock crushing operations.
- B. Store products to be installed as part of the field base neatly and orderly, stacked and blocked to prevent damage and contamination.

1.9 FIELD CONDITIONS

- A. Protection of Project Site: Make provisions, and take the necessary precautions, for protect existing and completed work from damage during turf installation.
- B. Contractor shall be responsible for stabilizing top of subgrade elevations for the synthetic turf areas prior to receiving the stone aggregate base and for executing fine grading as may be necessary or incidental to placement of the synthetic turf.
- C. Contractor shall prevent surface water and subsurface or groundwater from flowing into excavations and flooding area to receive turf base. Contractor shall not allow water to accumulate in excavations. Contractor shall remove water to prevent softening of sub grades.

1.10 MATERIAL TESTING

A. General:

1. The Owner will employ and pay for the services of an Independent Testing Agency as specified in Section 01 40 00 - Quality Requirements.
2. Payment for initial material testing is the responsibility of the Owner.
3. Employment by the Owner of the Testing Agency shall in no way relieve Contractor's obligations to perform the Work of the Contract.
4. The Owner reserves the right to change its testing laboratory if the need arises.
5. Cost of testing which are repeated on materials that have failed to meet specifications or are as a result of shortages shall be borne by the Contractor.
6. The Contractor shall include the following with its sample submittals:
 - a. Identification of proposed source and supplier.
 - b. Current lab mechanical analysis of the proposed stone using ASTM standards for sieve analysis.
 - c. Sample sizes as specified.
 - d. Certification that the supplier can deliver the total quantity of material needed to complete the project in a timely manner.

B. Pre-Construction Testing Procedures: The following tests will be performed by the Owner's Testing Agent prior to acceptance of rock provided under this Section. Testing of proposed Engineered Permeable Base Rock and Subgrade Trench Drain Rock will be performed in the following steps:

1. Engineered Permeable Base Rock and Subgrade Trench Drain Rock:
 - a. Contractor shall submit a 5-gallon separate composite to the Owner's Testing Agency, unless the Owner's Testing Agent elects to pull the sample directly at the quarry and/or requests test samples of varying quantities based on the testing labs' needs, for each porous base rock material. The Owner's testing agent will evaluate these materials as specified using ASTM C136 and ASTM D75 testing protocol as a guideline.
 - b. The submitted samples will be used for comparison with all subsequent samples submitted for acceptance during construction.
 - c. Material shall not be delivered to the project site until tests show it complies with the accepted material.
 - d. All rock to be provided for an Engineered Permeable Rock Base is required to pass the following qualifications:

Restrictions:

To ensure structural stability: $D_{60}/D_{10} > 5$ and $1 < \frac{D^2}{30} < 3$

$D_{10} * D_{60}$

Fragmentation shall be 100%.

$D''x$ " is the size of the sieve (in millimeters) that lets pass "x" percent of the stone. For example, D60 is the size of the sieve that lets 60 percent of the stone pass.

For calculation purposes, these sizes may be obtained by interpolation on a semi-log graph of the sieve analysis.

To ensure proper drainage: Porosity of Engineered Permeable Rock Base >

25% (when stone is saturated and compacted to 92% Modified Proctor)

Permeability of stone base > 30 in/hr (Tested thru ASTM D2434 with rock saturated and compacted to 92% Modified Proctor)

Depending on the type of rock present in the crushed stone mix, other mechanical characteristics might be necessary for approval.

e. Engineered Permeable Rock Base and Subdrain Trench Drain Rock shall be tested to show that both materials meet the following stability requirements:

Test Method	Criteria
LA Abrasion (California Test 211)	Not to exceed 35
Durability Index (California Test 229)	Not less than 40
Sulfate Soundness (ASTM C-88)	Not to exceed 12% loss for coarse aggregate, 10% for fine aggregate (based on a sulfate solution)

C. Testing During Construction:

1. During construction, samples will be taken and analyzed periodically by the Owner's representative/Testing Agent to assure strict compliance with the Specifications. The Owner may sample and test the rock material either at the source or at the project site upon delivery from incoming transfer trucks. Frequency of sampling for gradation testing would be to sample every 500 tons of Engineered Permeable Base Rock delivered to the site. Rock not meeting Specifications will be rejected by the Owner's representative. Materials rejected by the Owner's representative shall be removed from the site at the Contractor's expense. It is the Contractor's responsibility to ensure that all permeable stone for the synthetic turf base meet the above requirements throughout the installation process, including transfer and delivery to the site, placement, spreading, compaction, and installation of synthetic turf material. Proper investigation into rock sources may be required by the Contractor to ensure that the rock that was bid will meet the project specifications.
2. Subdrain Trench Leveling Rock: The leveling rock shall comply with section 2.04 A and be submitted to the Owner's Testing Agent for gradation testing. No additional tests are required for the leveling stone.

D. Permeability of placed engineered permeable rock base shall not be less than 10 in/hr. (Tested per ASTM F2898-11)

E. If rock stability to water and vehicles is in question, the Owner has the option to perform additional testing to ensure material shall adhere to requirements of Caltrans Section 68.

1.11 PROJECT RECORD DOCUMENTS

A. Accurately record location of pipe runs, connections, cleanouts, and invert elevations. Include locations of utilities remaining, re-routed utilities, new utilities, and newly discovered utilities as applicable by horizontal dimensions, elevations, inverts, and slope gradients.

1.12 POROUS CLOSED-CELL COMPOSITE GUARANTY

A. The manufacturer of the porous closed cell composite base shall provide a guaranty, in writing, that for a period of twenty five (25) years, the porous closed cell composite base shall be a part of a turf system that will not exceed a field average G-max of 120 g's as tested according to the ASTM 1936 Standard Specification.

PART 2 - MATERIALS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. The finished crushed stone or aggregate base supplied shall be stable, unyielding, and permeable.

2.2 ENGINEERED PERMEABLE ROCK BASE

A. Engineered Permeable Rock Base: Virgin, un-recycled, crushed stone meeting the gradation criteria for the California Department of Transportation 3/4-inch Permeable Class II (Section 68) and the following gradation.

Mesh size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
#4	25-40
#8	18-33
#30	5-15
Mesh size	Percent Passing
#50	0-7
#200	0-3

B. The above rock gradation range is a general recipe for the Contractor to use in order to meet the product performance requirements of the built stone base. The Contractor is responsible for ensuring that the type of rock and blend they submit, and install will meet all the specified requirements, including those outlined in item 1.10 of this specification section.

C. Soft rock materials, including sandstone, limestone, and shale, are not suitable. Rock supplier shall certify that all supplied rock will be void of this type of rock.

2.3 SUBDRAIN TRENCH DRAIN ROCK

A. Shall be 3/4-inch x 1/2-inch crushed virgin, un-recycled, washed rock, meeting the following general gradation requirements:

Sieve Size	Percent Passing
1"	100
3/4"	90-100
1/2"	10-40
3/8"	0-15
#4	0-5

B. The rock profile will extend from the bottom of the trench to the top of both sides of the subdrain trench, and to the top of rock elevation. The Engineered Permeable Base Rock shall not be installed over the subdrain trench drain rock.

C. The Contractor is responsible for ensuring the type of rock and blend they submit, and install will meet all the specified requirements, including those outlined in item 1.10 of this specification section.

D. Soft rock materials, including sandstone, limestone, and shale, are not suitable. Rock supplier shall certify that all supplied rock will be void of this type of rock.

2.4 SUBDRAIN TRENCH LEVELING ROCK

A. For planarity purposes, a clean uniform 3/8-inch crushed stone material, of the same source as the subdrain trench drain rock or Engineered Permeable Rock Base may be installed over the subdrain trench profile upon approval of Owner's representative. Maximum thickness for this stone layer is 1 inch.

2.5 MANUFACTURED BASE MATERIAL

A. Manufactured Porous Closed Cell Composite Base: Resilient, interlocking, polypropylene panels specifically engineered for sports fields; "PowerBase YSR" by Brock International, 303- 544-5800, or equal.

1. Panel Size: Approximately 73.5 x 49.0 inches.
2. Thickness: 1.0 inches, (25 mm).
3. Weight: 5.56 lbs per panel

2.6 GEOTEXTILE FILTER FABRIC

A. Geotextile Filter Fabric: Mirafi 140 N, or accepted equal, conforming to the following minimum specifications, unless otherwise recommended by the Geotechnical Engineer:

Property	Test Method	Typical Values
Grab Strength	ASTM D 4632	80 lb.
Puncture Strength	ASTM D 4833	25 lb.
Burst Strength	ASTM D 3786	130 lb.
Trapezoid Tear	ASTM D 4533	25 lb.
Permeability	ASTM D 4491	0.1 cm/sec
Apparent Opening Size	ASTM D 4751	#50 Sieve size
Permittivity	ASTM D 4491	

2.7 DRAINAGE ELEMENTS

A. Refer to Storm Drainage Specification Section for in-field drainage elements.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. Contractor shall verify that subgrade has been prepared according to specification sections 31 22 00 – Grading, 31 23 16 – Excavation, 31 23 16.13 – Trenching, and 31 23 23 Fill with regard to compaction, grade tolerances in accordance with section 01 70 00 – Execution Requirements- Field Engineering, and is free of debris, non-compactable material, topsoil, or organics prior to beginning work.
- B. Top of subgrade elevations shall be verified using laser-operation survey instruments. Refer to Conformance Surveying specifications for requirements.
- C. Once the subgrade conformance has been accepted and compaction has been properly achieved, the geotextile filter fabric shall be installed over the compacted and prepared subgrade, as shown on the plans, without disturbing grades.
- D. Geotextile fabric shall be installed with 6" overlap and stapled 6' on-center along seams. Staples to be 6" staples.

3.2 INSTALLATION OF THE SUBDRAIN TRENCH

- A. Contractor to install drain rock and piping in strict compliance with the manufacturer's written instructions and as indicated in the Drawings. Contractor to exercise caution and the appropriate sequencing of work, so as not to damage any drainage piping during the base rock installation.
- B. Contractor to protect drain trenches to ensure that pipe is not damaged in any way by construction operations and that the rock is not contaminated with native soils, unintended construction material, or deleterious materials during subsequent construction operations.

3.3 PLACING THE ENGINEERED PERMEABLE ROCK BASE

- A. The stone shall be laid without damaging the soil subgrade **and drainage trenches** Do not create depressions in subgrade with heavy equipment. If damage to subgrade occurs, correct as specified for subgrade preparation.

- B. The crushed stone shall be carefully and evenly spread over the subgrade and up both sides of the subdrain trenches to the depth shown on the Drawings.
- C. Excess water shall not be applied during installation of rock base and rough grading due to the potential of softening the subgrade and altering the grading.
- D. Crushed stone shall be smoothed and compacted uniformly to design grades by alternating raking, water settling, and rolling operations. Minimal rolling is advisable to achieve design grades and compaction. Only static rolling is allowed, and max 3-5-ton rollers should be used on the permeable stone base. Vibratory rolling of the permeable stone is not permitted.
- E. If the required compacted depth of the base course exceeds 6 inches, the base stone course shall be constructed in 2 or more layers or lifts of approximate equal thickness. Each layer shall achieve a uniform 90 percent relative compaction.
- F. Top of porous rock elevations shall be verified using laser-operation survey instruments. Refer to Conformance Surveying specifications for requirements.
- G. The final grade shall be ideally compacted to a uniform 90 – 92 percent relative compaction.
- H. Contractor shall not overwork the stone material and consequently modify its gradation characteristics. Minimal moving of the stone upon placement of the material on the subgrade and rolling is advisable to achieve design grades and compaction. Do not compact greater than 93 percent relative compaction.
- I. Contractor shall manually screed the top stone surface to ensure tolerances are met.
- J. Top of rock elevations shall be verified using laser-operation survey instruments. Refer to Conformance Surveying specifications for requirements.
- K. Finish surface planarity shall be verified, and if necessary adjusted, by the Contractor using string line method.
 - 1. Entire finished surface shall be “walked” with mason’s line in increments of approximately 3 feet.
 - 2. A mason’s line shall be held taught between two workers separated by a distance of approximately 40 feet then placed directly on the finished surface parallel to the direction of greatest slope.
 - 3. A third worker shall check for separations between the mason’s line and the finished surface that are equal to or greater than the specified tolerances.
 - 4. Areas of separation shall be outlined with marking paint and the depth of separation indicated.
 - 5. Areas outlined with marking paint shall be filled with top rock to the depth indicated and raked by hand. Filled areas shall be compacted to provide a non-yielding, smooth, flat surface.
 - 6. Final finished surface planarity shall be approved by the Owner and the synthetic turf installer.
- L. Once the top of the Engineered Permeable Rock Base is installed and compacted, the Contractor shall notify the Owner Testing Agent that it is ready for the field permeability test.

1. The Agent shall be given 2 working days' notice and have 2 days to complete the in-field test which will consist of a minimum of 4 controlled field permeability tests per synthetic turf field.
2. Tests shall be by the following test method: ASTM F2898-11: "Standard Test Method for Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non- confined Area Flood Test Method"
3. Permeability of placed Engineered Permeable Rock Base shall comply with specified requirements.
4. If the test does not comply with section 1.10, the Contractor shall provide within 48 hours a written repair procedure to correct the permeability deficiency.
5. Repair work, including associated delays, shall be the Contractor's sole responsibility. Fine tuning of the field base due to the testing operations is the responsibility of the Contractor.

3.4 INSTALLATION OF MANUFACTURED DRAINAGE MATERIAL

- A. Upon successful completion of installing the base, the porous drainage composite shall be installed in accordance with the Drawings and in strict compliance with the manufacturer installation instructions. Contractor to exercise extreme care in order to avoid disturbing the crushed stone base.
- B. Contractor to take measures to ensure that the product is not exposed to the outdoor elements longer than the manufacturer's recommendations. Product that exceeds this exposure time duration shall be removed from the project site immediately and not used on the project.
- C. Sections of the material shall be interlocked and/or connected to adjacent pieces of the drainage material in strict conformance with the manufacturer's written installation instructions.
- D. Provide geotextile filter fabric in the areas designated on the Drawings. Fabric shall be laid in shingle fashion overlapping 12 inches minimum following direction of slope with upslope fabric laying atop the down slope fabric.

END OF SECTION

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SECTION 32 18 15 - SYNTHETIC TURF SURFACING FOR RECREATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Synthetic turf surfacing, including artificial turf, [subbase preparation and placement of aggregate base course,] and turf infill.

1.2 REFERENCES

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ASTM D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings.
- C. ASTM D1577 - Standard Test Methods for Linear Density of Textile Fibers.
- D. ASTM D2256/D2256M - Standard Test Method for Tensile Properties of Yarns by the Single- Strand Method.
- E. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.
- F. ASTM D5034 - Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test).
- G. ASTM D5793 - Standard Test Method for Binding Sites per Unit Length or Width of Pile Yarn Floor Coverings.
- H. ASTM D5823 - Standard Test Method for Tuft Height of Pile Floor Coverings.
- I. ASTM D5848 - Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings.
- J. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- K. ASTM F1292 - Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment.
- L. ASTM F1551 - Standard Test Methods for Comprehensive Characterization of Synthetic Turf Playing Surfaces and Materials.
- M. ASTM F1951 - Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.
- N. CBC Ch. 11B - California Building Code-Chapter 11B.
- O. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings.
- P. International Play Equipment Manufacturers Association (IPEMA): www.ipema.org:

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Conference: Conduct conference at Project site following award of contract. Review methods and procedures related to synthetic turf surfacing installation including, but not limited to, the following:
 1. Review survey of subbase conditions.

2. Review delivery, storage, and handling procedures.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Shop Drawings: Provide installation details including roll and seaming layout, methods of attachment and details at penetrations and terminations
 - 1. Show layout of marking plan if any, indicating details for specified activity areas.
- C. Samples: For each type of synthetic turf surfacing indicated.
 - 1. Minimum 12-by-12-inch- square sample of synthetic turf surface with tufted perimeter line and carpet seam.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Installation Schedule: Showing planned commencement and completion dates for each portion of the Work; include critical dates indicated on Owner's project schedule.
- C. Warranty: Sample warranty specified in this Section.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Seaming Materials: Sufficient quantity for 100 sq. ft.
 - 2. Synthetic Turf Fiber: Sufficient quantity for 100 sq. ft.
 - 3. Infill Material: Sufficient quantity for 100 sq. ft., in weatherproof bags.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing synthetic turf surfacing materials similar to those specified for this project, with a record of successful service for a minimum of 5 years.
- B. Installer Qualifications: An experienced Installer certified by the manufacturer, employing workers trained and approved by manufacturer, who has successfully installed work similar in design and extent to that required for the project, in not less than 5 projects of similar scope.
- C. Source Limitations: Obtain synthetic turf surfacing materials through one source from a single manufacturer.
 - 1. Provide secondary materials including adhesives, paint, thread, and repair materials of type and from source recommended by manufacturer of synthetic turf surfacing materials.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit synthetic turf surfacing installation to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate installation of synthetic turf surfacing with installation of site paving, playground equipment, adjacent lawns, landscaping materials, site lighting, and related work.

1.10 WARRANTY

A. Manufacturer's Warranty: Submit manufacturer's standard published limited warranty form in which manufacturer agrees to repair or replace components of synthetic turf surfacing installation installed by manufacturer-certified Installer that fail in materials under normal use and maintenance, or provide other relief, within specified warranty period.

1. Failures include ultraviolet degradation, backing integrity, more than 50 percent loss of face fiber, and loss of tuft bind strength.
2. Warranty Period: Life of product.

B. Installer Project Warranty: Submit synthetic turf surfacing Installer's warranty, signed by Installer, covering the Work of this Section, including installation of all components of synthetic turf surfacing system, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Subject to requirements of this Section, provide listed products of SYNLawn, Dalton GA 30721; (866) 796-5296; info@synlawn.com; www.synlawn.com.

1. Distributed by:

SYNLawn San Diego
7060 Miramar Road, Suite 105
877-303-8873
2. Submit requests for substitution in accordance with Instructions to Bidders and Division 01 General Requirements.

B. Source Limitations: Obtain synthetic turf surfacing materials through one source from a single manufacturer.

1. Provide secondary materials including adhesives, paint, thread, and repair materials of type and from source recommended by manufacturer of synthetic turf surfacing materials.

2.2 PERFORMANCE REQUIREMENTS

A. Certification: Provide synthetic turf surfacing system with safety performance testing certified by IPEMA.

- B. Shock Attenuation Value: Provide synthetic turf system with G-max value not exceeding 200 and Head Injury Criteria (HIC) not exceeding 1,000 in accordance with ASTM F1292, based upon application and fall height indicated on Drawings.
- C. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Exterior Fire-Test Exposure: Provide synthetic turf surfacing materials identical to those of assemblies tested for Class A fire resistance according to ASTM E108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Accessibility Requirements: Comply with applicable provisions in ADA Standards and CBC Ch. 11B for recreation surfaces.
 - 1. Provide synthetic turf system meeting requirements of ASTM F1951.

2.3 SYNTHETIC TURF SURFACING

- A. Synthetic Turf Surfacing: Complete surfacing system, consisting of delustered UV-stabilized synthetic yarns bound to water-permeable primary and bio-based secondary coating.
 - 1. Basis of Design Product: SYNLawn SYNSport.
 - 2. Artificial Turf Fiber and Construction Characteristics:
 - a. Yarn, Turf Zone: Polyethylene; mono shape.
 - 1) Color: Field green.
 - 2) Denier, ASTM D1577: 10,800/6.
 - b. Yarn, Thatch Zone: Polyethylene.
 - 1) Color: Field green + beige.
 - 2) Denier: 5,000/8.
 - c. Finished Pile Height, ASTM D5823: 1 inch.
 - d. Face Weight, ASTM D5848: 58 oz./sq. yd.
 - e. Tuft Machine Gauge: 3/8 inch.
 - 3. SYNLawn's EnviroLoc Plus Backing System replaces a large portion of petroleum-based polymers with biobased polymers created from soybean plants (a renewable resource)
 - a. Backing, Primary: 6 oz./sq. yd. 15/18 polypropylene, 2 layers with fiber-reinforcing core.
 - b. Backing, Secondary: 22 oz. /sq. yd. bio-based urethane.
 - 1) Enviroloc+™
 - (a) Anti Fungi and Anti Algae blended into secondary backing.
 - c. Total Weight: 86 oz./sq. yd.
 - 4. Specifier: Select standard or temperature-reducing SYNLawn TCool infill material based upon Project requirements.
 - a. Infill: Silica sand ballast.
 - b. Temperature-Reducing Infill: Silica sand and moisture-retaining coated sand ballast.

5. Performance Characteristics:
 - a. Tuft Bind, ASTM D1335: Not less than 8 lb.
 - b. Grab tear strength, ASTM D5034: Not less than 200 lbf.
 - c. Elongation to break, ASTM D2256/D2256M: Not less than 30 percent.
 - d. Yarn breaking strength, ASTM D5793: Not less than 20 lb.
 - e. Foot Traffic Rating: 5.
 - f. Softness Rating: 4.
 - g. Flammability, ASTM D2859: Pass.
6. SYNLawn SYNTipede 243: Ideal for high foot traffic for most demanding applications including children's playgrounds. This product features low profile pile height and heavy duty grass blades; it is especially durable and cost effective. Product features SYNLawn's Super Yarn™ Sanitized® antimicrobial, EnviroLoc™ bio-based backing, StatBlock™ Anti- Static, DualChill™ IR Reflective, Deluster, and UV Stabilizer technologies.

2.4 SUPPLEMENTARY TURF SURFACING MATERIALS

- A. High Use Area Package: High density, crush-resistant component, configured for easy replacement without disturbing surrounding turf surfacing.
 1. Product: SYNLawn, TrampleZone.
 2. Specifier: SynLawn approved underlays are reviewed annually for safety, performance and ease of installation. Retain product(s) required to meet Shock Attenuation Value performance requirements for Project.
- B. Fall Pad: Rubber, lead, and heavy metal-free non-degradeable porous elastic pad, with permeability of not less than that of specified artificial turf surfacing, composed of 100 percent recycled non-contaminated post-industrial closed cell polyethylene foam, geotextile weed barrier faced on one side.
 1. Product: SYNLawn, Fall Pad.
 2. Pad Thickness: 2-1/8 inch.
 3. IPEMA Fall Height, ASTM F1292: 10.0 feet.
 4. Accessibility, ASTM F1951: Passes.
 5. Rainfall Capacity, ASTM F1551: Not less than 30 inches per hour.
- C. Turf Spikes: Manufacturer's approved fasteners.
- D. Nailer Board: Manufacturer's approved nailer/edger board.
- E. Curbing: Profile and extent as indicated on Drawings. Refer to Section 32 13 13 - Concrete Paving.

2.5 MATERIALS

- A. Infill Material: Silica sand in manufacturer's recommended formula for application to synthetic turf surfacing.
 1. Product: SYNLawn, Envirofill.
 - a. Color: Green or Brown, as selected by Architect.

2. Product: SYNLawn, T-Cool.
- B. Game Lines and Markings: Provide game lines and markers in widths and colors according to requirements indicated on Drawings.
 1. Application Method: Tufted in, to the maximum extent practicable, with remaining lines inlaid.
- C. Paint: For non-tufted lines and markings: Manufacturer's recommended paint for use on synthetic turf surfacing.
- D. Glue, Seaming Fabric, and Thread: As recommended by manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine synthetic turf surfacing base and perimeter conditions, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
 1. Verify substrate meets profile required.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SYNTHETIC TURF INSTALLATION

- A. General: Comply with synthetic turf surfacing manufacturer's written installation instructions. Install synthetic turf surfacing over area and in thickness indicated.
- B. Fall Pad: Place fall pads tightly abutted over area to receive synthetic turf surfacing. Tape seams with pad seam tape to secure pads in position prior to installing synthetic turf.
- C. Artificial Turf: Loose-lay artificial turf and allow fabric to relax for period recommended by manufacturer. Stretch carpet and attach at perimeter in accordance with approved submittals.
- D. Seaming: Form seams flat and snug, with no gaps or fraying. Remove yarns that are trapped within seams. Form seams as recommended in synthetic turf manufacturer's written instructions using manufacturer's provided or recommended materials.
- E. Attachment: Attach turf fabric to perimeter restraint system as recommended by the manufacturer.

3.3 ACTIVITY LINES AND MARKERS

- A. Install lines in accordance with approved submittals.

3.4 INSTALLATION, INFILL

- A. Mix and install infill material components in accordance with manufacturer's requirements for approved system. Groom material and leave surface ready for use.

3.5 PROTECTION

- A. Protect completed installation from damage. Prevent traffic over system prior to acceptance by Owner.

3.6 DEMONSTRATION

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SYNTHETIC TURF SURFACING FOR RECREATION

- A. Instruct Owner's personnel in proper inspection and maintenance of synthetic turf surfacing. Review manufacturer's recommended maintenance procedures and warranty terms and conditions.

END OF SECTION

SECTION 32 18 15
SYNTHETIC TURF SURFACING FOR RECREATION

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SECTION 32 18 16.13 - RUBBERIZED SURFACING FOR PLAYGROUNDS

PART 1 - GENERAL

1.1 RUBBER PLAYGROUND SURFACING

- A. Section includes: Resilient playground surfacing poured-in-place system.
- B. Related work: Playground equipment and resilient playground surfacing sub-base.
- C. Description: Provide all necessary materials, labor, tools and equipment to perform the work included in the section for the installation of the poured-in-place resilient playground surfacing.
- D. Quality Assurance: Crew chiefs shall show evidence of installing installed playground poured-in-place surfacing systems for a minimum of 5 years, and be subject to annual IPEMA project safety audit. Manufacturer shall meet current ASTM F-1292 Test Criteria and Consumer Product Safety Commission (CPSC) Publication 325.
- E. The installation of the poured-in-place product shall be completed by Manufacturer Certified Contractors or by direct employees of the Manufacturer's Installation Division. Manufacturer's detailed installation procedures shall be submitted to the Architect and made a part of the Bid Specifications.

PART 2 - SUBMITTALS

- 2.1 Manufacturer's Product Literature and Specification Data.
- 2.2 ASTM F1292 Impact Attenuation Test Certification for the poured-in-place system to be installed in compliance with the Critical Fall Height as determined by the Playground Equipment to be installed in conjunction with the poured-in-place surfacing system.
 - A. ASTM C1549 Solar Reflectance Index near Ambient Temperatures
 - B. ASTM E303 Skid resistance
 - C. ASTM E1980 Solar Reflective Index / Low Slope opaque
 - D. ASTM F1551 Water Permeability
 - E. ASTM F1951 Wheelchair Accessibility
 - F. IPEMA Certification
- 2.3 Statement of Warranty for a with detailed Warranty Claim requirements of the owner and specific procedures to be followed by the manufacturer in terms of response and repair of warranty claims.

PART 3 - PRODUCTS

3.1 PRODUCT(S):

A. MaxPour® Safety Surfacing or approved equal. Equals shall be submitted for review no less than 10 days before bid. No exceptions to this 10-day prior approval requirement are allowed.

Contact: Chris Wolf at PlayMax Surfacing, Inc., ("PlayMax") phone (951) 250-6039 or fax (951) 356-6550 cwolf@playmaxsurfacing.com , or visit PlayMax on the web at www.playmaxsurfacing.com .

3.2 DESCRIPTION:

A. A dual-durometer poured-in-place system with an upper wearing layer and an underlying impact attenuation cushion layer. The finished surface shall be porous and capable of being installed at varying thickness to comply with Critical Fall Height requirements of playground equipment installed in conjunction with the surface.

3.3 MATERIALS:

A. The MaxPour® play surface shall be manufactured from a precise blend of color MaxPour® TPV rubber granules by Rosehill, mixed with MaxPour® AROMATIC polyurethane binder. Polyurethane binder containing any TDI shall not be allowed due to environmental regulations. For hot, humid climates which may accelerate the cure of polyurethanes, PlayMax may substitute a slower-curing version of this binder. Systems requiring color mixes containing black shall use black EPDM granules for this purpose.

B. Top layers shall in all circumstances be MINIMUM $\frac{1}{2}$ " THICK. Systems advertising "nominal $\frac{1}{2}$ " thick", or "3/8" – $\frac{1}{2}$ thick" shall be grounds for rejection. Systems advertising "minimum weight / s.f. top layers" shall be grounds for rejection. In all cases, top layer thickness shall be a MINIMUM $\frac{1}{2}$ " THICK, irrespective of advertised system "weight".

Fall Height	48"
Playground Surface Thickness	.5"
Cushion Thickness	1.5"
Overall Thickness	2" Total

Fall Height	96"
Playground Surface Thickness	.5"
Cushion Thickness	2.5"
Overall Thickness	3" Total

C. MaxPour® wearing surface (top layer) shall be a mixture of MaxPour® TPV 1-4 mm rubber granules by Rosehill, or black EPDM rubber 1-3.5 mm granules bonded by MaxPour® polyurethane binder applied to 100% of the granules and applied to a minimum thickness of 1/2" over the cushion layer.

D. MaxPour® cushion course (bottom layer) shall be a precise blend of MaxPour® SBR rubber particles of heterogeneous distribution bonded by MaxPour® aromatic polyurethane binder applied to 100% of the rubber and installed to a designated thickness as required by the Consumer Product Safety Commissions Guidelines and ASTM F1292 Test Criteria.

E. Finish Texture: Pebble grain.

- F. Color choice and/or blend ratios of color shall be selected by the owner or architect.
- G. Color: As indicated on drawings.

SUB-BASE REQUIREMENTS

PART 1 - GENERAL

1.1 PREPARATION:

- A. The sub-base of the entire area to be surfaced shall be cleared of any foreign materials and treated to eliminate growth of grass, weeds, shrubbery, trees, etc.
- B. The native sub-base shall be graded to allow for proper water drainage that will prevent sub-base erosion.
- C. The native sub-base shall be compacted to a 90% rating.
- D. Curbing shall be installed at the perimeter of the area to be installed and may be concrete or other acceptable system that will not deteriorate over the anticipated life of the system. Curbing shall be set at an acceptable grade level to permit proper drainage and contain the area.

PART 2 - SUB-BASE SURFACE OPTIONS

2.1 ASPHALT/CONCRETE:

- A. A minimum three (3) inch layer may be applied over the sub-base materials to a finished tolerance of (+/-) 1/8" when measured with a ten foot straight edge. The concrete surface shall cure a minimum of twenty eight (28) days. Asphalt cure shall be a minimum of six (6) weeks prior to application of surfacing.

2.2 AGGREGATE SUB-BASE:

Installation of a minimum four (4) inch layer of Type 2 road base shall be completed and compacted to a 90% rating and a (+/-) 1/4" tolerance when measured with a ten foot straight edge in any direction. The compaction shall be completed in two-inch lifts after the area has been water sprayed.

Type 2 road base used as playground surfacing sub-base shall be graded flat, true and level. This is to prevent excessive rubber thickness at sloping areas and drains. In the event of heavy clay or non-draining native soils, the earth below the Type 2 sub-base may be graded 1.5 - 2% for slope to drainage system (drainage pipe, conventional drains French drains, etc.) Type 2 Sub-base shall be installed over and above the sloped native earth. Type 2 Sub-base shall be graded flat, true and level in preparation for the playground surfacing application. This manufacturer requirement supersedes any and all other specifications regarding sub base requirements or slope.

Aggregate base other than Type 2 road base must be submitted to PlayMax for approval.

PART 3 - CORRECTIONS

- 3.1 Any portion of the above stated work shall be inspected by PlayMax prior to application of the safety surfacing materials.
- 3.2 Any corrections deemed necessary by PlayMax or the Architect shall be completed by the parties responsible for the appropriate portion of the work prior to the installation of the Safety Surfacing system.
- 3.3 Under no circumstances shall PlayMax assume responsibility nor warranty cost for any failure of work completed by others (see Statement of Warranty.)

END OF SECTION

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Posts, rails, and frames.
- B. Wire fabric.
- C. Concrete.
- D. Manual gates with related hardware.
- E. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete anchorage for posts.

1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- D. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a (Reapproved 2017).
- E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
- G. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2018.
- H. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2014a.
- I. ASTM F626 - Standard Test Method for High Speed Puncture Properties of Plastics Using Load and Displacement Sensors; 2015.
- J. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2017a.
- K. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2016.
- L. CLFMI CLF 2445 - Product Manual - Drawings; 2012.
- M. ASTM F900 - Title 19 California Code of Regulations, Subchapter 1, Article 3.08 Decorative Materials; current edition.
- N. CLFMI CLF-FIG0111 - Field Inspection Guide; 2014.

- O. CLFMI CLF-PM0610 - Product Manual; 2017.
- P. CLFMI CLF-SFR0111 - Security Fencing Recommendations; 2014.
- Q. CLFMI WLG 2445 - Standard Practice for Preparation of Low-Carbon Steel for Electroplating; 1979 (Reapproved 2014).

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. See CLFMI CLF-SFR0111 for planning and design recommendations.
- D. Samples: Submit two samples of fence fabric, 12 inch by 12 inch in size illustrating construction and colored finish.
- E. Manufacturer's Installation Instructions: Indicate installation requirements and accessories.
- F. Manufacturer's Qualification Statement.
- G. Fence Installer Qualification Statement.
- H. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines.
- I. Field Inspection Records: Provide installation inspection records that include post settings, framework, fabric, barbed wire, fittings and accessories, gates, and workmanship.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Fence Installer: Company with demonstrated successful experience installing similar projects and products, with not less than five years of documented experience.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty for gate hardware.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Chain Link Fences and Gates, or equal:
 - 1. Allied Tube and Conduit Corp.: www.atcfence.com
 - 2. Anchor Fence, Inc.: www.anchorfenceinc.com.
 - 3. Master-Halco, Inc: www.masterhalco.com/#sle.

4. Merchants Metals: www.merchantsmetals.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 REGULATORY REQUIREMENTS

- A. Provide fences and gates meeting life safety and accessibility requirements of California Building Code (CBC) Title 24, Part 2, Chapters 10 and 11B; and ADA Standards, per latest amendments.
 1. Gates that are part of the accessible route shall meet all the requirements of an accessible door in compliance with CBC Section 11B-404 and 11B-206.5.
 2. Gate Hardware: Meet the requirements of CBC 11B-206.5 and 11B-404.2.9.
 - a. Latch: Latch, including padlock eye as integral part of latch, mounted 40 inches above finish grade. Comply with California Fire Code.
 - b. Hardware shall comply with local Fire Authority, California Building Code (CBC) Title 24, Section 1010.2, and California Fire Code (CFC) Section 503.5.2.
 - c. The lever of lever actuated latches or locks for an accessible gate shall be curved with a return to within 1/2 inch of the (face of) gate to prevent catching on the clothing or persons. California Referenced Standards Code T-24 Part 12, Section 12-10-202, Item (F).
 - d. Hand activated opening hardware, handles, pulls, latches, locks, and other operating devices for an accessible gate shall have a shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist to operate. CBC Section 11B-404.2.7 and 11B-309.4.
 3. Swing doors and gate surfaces within 10 inches of the finish floor or ground shall have a smooth surface on the push side extending the full width of the door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within 1/16 inch of the same plane as the other and be free of sharp or abrasive edges. Cavities created by added kick plates shall be capped. CBC Section 11B-404.2.10
 4. The bottom of the gate shall be within 3 inches of the finish surface of the path of travel. The maximum effort to operate a gate shall not exceed 5 lbf. CBC Section 11B-404.2.9.

2.3 MATERIALS

- A. Posts, Rails, and Frames:
 1. ASTM A1011/A1011M, Designation SS; hot-rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum yield strength of 50 ksi; zinc coating complying with ASTM F1043 and ASTM F1083.
 - a. Alternate minimum yield strengths based on application and load calculations:
 - 1) Intermediate grade: 50,000 psi (344 MPa).
 - 2) High Strength 83000 Grade: 83,000 psi (572 MPa).
 2. Line Posts: Type I round.
 3. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round.
 4. Comply with CLFMI CLF-PM0610.
- B. Wire Fabric:

1. ASTM A392 zinc coated steel chain link fabric.
2. Comply with CLFMI CLF-PM0610.

C. Concrete:

1. Ready-mixed, complying with ASTM C94/C94M; normal Portland cement; 2,500 psi strength at 28 days, 3 inch slump; 3/4 inch nominal size aggregate.

2.4 COMPONENTS

- A. Line Posts: 1.900" O.D diameter / .120" thick minimum @ 8'-0" o.c. maximum. Unless indicated larger on Drawings.
- B. Corner and Terminal Posts: 2.375" O.D. diameter / .130" thick minimum. Unless indicated larger on Drawings.
- C. Gate Posts: 4.00" O.D. diameter / .160" thick minimum (4.00" x 4.00" x 11 ga. (.120") minimum - refer to drawings). Unless otherwise indicated larger on Drawings.
 1. Provide posts for supporting single gate leaf, or one leaf of a double gate installation, for nominal gate widths.
 - a. Comply with CLFMI CLF 2445 published standards.
- D. Top Rail and Brace Rail: 1.660" diameter / .111" thick minimum, plain end, sleeve coupled. Unless indicated larger on Drawings.
- E. Bottom Rail: 1.660" diameter / .111" thick minimum, plain end, sleeve coupled. Unless indicated larger on Drawings.
- F. Pedestrian Gate Frame: 2.00" diameter / .160" thick minimum for welded fabrication.
 1. Fabricate perimeter frames of gates from metal and finish to match fence framework. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories with additional horizontal and vertical members to insure proper gate operation.
 2. Use same fabric as for fence, installed with stretcher bars and bands at vertical edges and at top and bottom edges.
 3. Install diagonal cross bracing consisting of 5/16 inch diameter truss rods with drop forged steel turnbuckles, per ASTM F626, where necessary to insure frame rigidity without sag or twist.
 4. Meet the requirements of ASTM F900. Maximum gate leaf width 4'-0" and minimum gate width of 36 inches along path of travel and means of egress.
 - a. Gate frame to be of welded construction.
 - 1) Weld areas to be protected with zinc-rich paint per ASTM A780/A780M.
 - b. The gate frame members are to be spaced no greater than 8'-0" (2.44 m) apart horizontally or vertically.
 5. Vehicle Rolling/Sliding Gates: Meet the requirements of ASTM F900.
 - a. Gates over 6 feet high, fabricate from Type I or Type II materials.

- G. Fabric: 1-inch or 2-inch diamond mesh interwoven wire, 9 gage, 0.1483 inch thick, top selvage knuckle end closed, bottom selvage knuckle end closed. Refer to drawings for designation of fence fabric requirements.
- H. Tension Wire: 6 gage, 0.1920 inch thick steel, single strand.
- I. Tension Band: 3/4 by 3/16 inch thick steel.
- J. Tension Strap: 3/4 by 3/16 inch thick steel.
- K. Tie Wire: Aluminum alloy steel wire.

2.5 MANUAL GATES AND RELATED HARDWARE

- A. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; fork latch with gravity drop and padlock hasp.
- B. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.
 - 1. Drop bolt is not to be provided or installed on exit gates.
 - 2. Provide galvanized pressed steel locking latch, requiring one padlock for locking both gate leaves, accessible from either side.
- C. Hinges: Finished to match fence components.
 - 1. Hinges: Hot dip galvanized pressed steel or malleable iron, structurally capable of supporting gate leaf and allow opening and closing without binding.
 - 2. Non-lift-off type hinge design to permit gate to swing 180 degrees.
 - 3. Closing: Manual.
- D. Latches: Finished to match fence components.
 - 1. Galvanized forked type with welded U-bracket on both sides. Capable of retaining gate in closed position and have provision for padlock.
 - a. Latch shall permit operation from either side of gate.
- E. Gate Holdback: Provide galvanized gate hold back keeper for each gate leaf over 5 feet (1524 mm) wide.
 - 1. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.

2.6 LIGHT-DUTY ARCHITECTURAL HARDWARE

- A. Roller Assembly: Steel chassis assembly with permanently lubricated and sealed roller bearings.
 - 1. Weight Rating: 1,000 pound (454 kg).
 - 2. Shaft: 1 inch diameter hardened steel shaft.
 - 3. Roller: Polymer casting, secured to shaft with nylon locknut.

4. Mounting to Round Fence Post: U-bolts.
5. Finish: Galvanized.

2.7 ACCESSORIES

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.
- C. Privacy slats: vertical orientation, 2" less than fence height. 2" or 2 1/4" width, High Density Polyethylene (HPDE) color pigmented with ultraviolet (UV) inhibitors. 25 year limited warranty, min. Color selection by Architect/Owner
- D. Other Fencing Accessories: Provide other pressed steel or cast iron accessories and fencing items necessary for a complete installation as required by Project conditions and as recommended by fencing manufacturer.

2.8 FINISHES

- A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot.
- B. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.
- C. Accessories: Same finish as framing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that areas are clear of obstructions or debris.

3.2 PREPARATION

- A. Removal: Obstructions or debris.
- B. Fence Layout: Lay out fencing in advance of installation, noting locations for posts, gates, operators and accessories applicable to the installation.
 1. Space line posts maximum 10 feet o.c, unless otherwise indicated.
 2. Straight runs between braced posts shall not exceed 500 feet.
- C. Excavation: Excavate line post holes as indicated on Drawings, minimum 10 inch diameter and to a depth of not less than 30 inches for post plus 3 inches below bottom of post.
 1. Excavate corner end, pull and gate posts minimum 12 inch diameter and to a depth of not less than 36 inches for post plus 3 inches below bottom of post.
 2. Provide footing depths conforming to CLFMI published standards, based on fabric height, wind pressure and soil types.

3.3 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567.
- B. Place fabric on outside of posts and rails.

- C. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- D. Line Post Footing Depth Below Finish Grade: ASTM F567.
- E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.
- F. Gates: Install gates plumb, level and secure. Install as recommended by fence manufacturer. Adjust hardware for smooth operation and lubricate as required.
- G. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.
- H. Provide top rail through line post tops and splice with 6-inch-long rail sleeves.
 - 1. Connect ends with sleeves forming a rigid connection, allow for expansion and contraction.
- I. Install center brace rail on corner gate leaves.
 - 1. Center Rails: Install mid rails between line posts and attach to post using rail end or line rail clamps.
- J. Bottom Rails: Install bottom rails between posts and attach to post using rail end or line rail clamps
- K. Do not stretch fabric until concrete foundation has cured 28 days.
- L. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
 - 1. Adjust fabric for rigid installation.
 - 2. Tighten hardware, fasteners, and accessories.
 - 3. Bend ends of tie wires to preclude snagging.
- M. Position bottom of fabric 2 inches above finished grade.
- N. Fastening: Fasten all fence and gate hardware secured in place by peening or welding to allow proper operation of components, but to prevent disassembly of fencing or removal of gates.
 - 1. Fastenings, hardware, and all other connections, which have been peened or welded, shall be covered with a heated re-galvanizing alloy.
- O. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.
- P. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- Q. Do not attach the hinged side of gate to building wall; provide gate posts.
- R. Peen all bolts upon installation.
 - 1. Fasten all fence and gate hardware secured in place by peening or welding to allow proper operation of components, but to prevent disassembly of fencing or removal of gates.
 - 2. Cover fastenings, hardware, and all other connections, which have been peened or welded, with a heated re-galvanizing alloy.
- T. Perform three random field inspections confirming proper installation.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From True Position: 1 inch.
- C. Do not infringe on adjacent property lines.

3.5 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.
- C. Post Settings: Randomly inspect three locations against design for:
 - 1. Hole diameter.
 - 2. Hole depth.
 - 3. Hole spacing.
- D. Fence Height: Randomly measure fence height at three locations or at areas that appear out of compliance with design.
- E. Gates: Inspect for level, plumb, and alignment.
- F. Workmanship: Verify neat installation free of defects. See CLFMI CLF-FIG0111 for field inspection guidance.

3.6 CLEANING

- A. Leave immediate work area neat at end of each workday.
- B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- C. Clean fence with mild household detergent and clean water rinse well.
- D. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.
- E. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.
- F. See Section 01 74 00 – Cleaning and Waste Management.

3.7 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

END OF SECTION

SECTION 32 31 19 – DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The contractor shall provide all labor, materials and appurtenances necessary for installation of the welded ornamental steel fence system defined herein at New Modular Classrooms & Sitework – Grand Terrace Elementary School, Colton Unified School District

1.2 RELATED WORK

- A. Section 31 10 00 – Site Clearing
- B. Section 32 13 13 - Concrete

1.3 SYSTEM DESCRIPTION

- A. The manufacturer shall supply a total fence system of Ameristar Montage II® (3) rail panel, Majestic style, Ornamental Steel. The system shall include all components (i.e., panels, posts, gates and hardware) required.
- B. Changes at elevation, terrain: The manufacturer shall supply a ® *Welded and Rackable* (ATF – All Terrain Flexibility) Ornamental Steel. The system shall include all components (i.e., panels, posts, gates and hardware) required. Match fence design stated in item 1.3 / A.

1.4 QUALITY ASSURANCE

- A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.5 REFERENCES

1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
3. ASTM D523 - Test Method for Specular Gloss.
4. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
5. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
6. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
7. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

8. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
9. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
10. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.6 SUBMITTAL

- A. The manufacturer's literature shall be submitted prior to installation.

1.7 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.8 PRODUCT WARRANTY

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufacturer's warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 - MATERIALS

2.1 MANUFACTURER

- A. The fence system shall conform to Montage II® Majestic style, Ornamental Steel with extended pickets bottom rail treatment, 3-Rail style manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma.

2.2 MATERIAL

- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft² (276 g/m²), Coating Designation G-90.
- B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75" x 1.75" x .105". Picket holes in the rail shall be spaced 4.715" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.3 FABRICATION

- A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at

each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).

- C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).
- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.
- E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 12ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'.
- F. Pedestrian swing gates shall be self-closing, having a gate leaf no larger than 48" width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5" x 6" footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5" - 1.375") and vertical (0 - .5"). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.

PART 3 - EXECUTION

3.1 PREPARATION

- A. All new fence installation shall be laid out by the contractor in accordance with the construction plans.

3.2 FENCE INSTALLATION

- A. Fence post shall be spaced according to Table 3, plus or minus $\frac{1}{2}$ ". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.3 FENCE INSTALLATION MAINTENANCE

A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufacturers' warranty.

3.4 GATE INSTALLATION

A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

B. Perforated Metal: McNicholds Quality Round Perforated, 18 Gage Galvanized, 3/16" Round on 1/4" Staggered. 48.0000" x 120.0000". Weld 18 Gage U-Edging at all perforated metal edges. Weld perforated metal to gate and fencing where shown on plans. De-burr smooth with no sharp edges. Prime and paint to match gates and fencing.

3.5 CLEANING

A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

Table 1 – Minimum Sizes for Montage II Posts

Fence Posts	Panel Height		
2 1/2" x 12 Ga.	Up to and Including 6' Height		
3" x 12 Ga.	Over 6' and Including 8' Height		
Gate Leaf	Gate Height		
	Up to & Including 4'	Over 4' Up to & Including 6'	Over 6' Up to & Including 8'
Up to 4'	2 1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'-1" to 6'	3" x 12 Ga.	4" x 11 Ga.	4" x 11 Ga.
6'-1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16" Wall
8'-1" to 10'	4" x 11 Ga.	6" x 3/16" Wall	6" x 3/16" Wall
10'-1" to 12'	4" x 11 Ga.	6" x 3/16" Wall	6" x 3/16" Wall
12'-1" to 14'	4" x 11 Ga.	6" x 3/16" Wall	6" x 3/16" Wall
14'-1" to 16'	6" x 3/16" Wall	6" x 3/16" Wall	6" x 3/16" Wall

Table 2 – Coating Performance Requirements

Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

Table 3 – Montage II – Post Spacing By Bracket Type

Span	For INVINCIBLE® 8' Nominal (91-1/2" Rail)				MAJESTIC 8' Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount (BB301)*		Industrial Line 2-1/2" (BB319) 3" (BB320)		Industrial Universal 2.5" (BB302) 3" (BB303)		Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings ± 1/2" O.C.	94-1/2"	95"	94-1/2"	95"	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"

*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.

3.6 FENCES, GATES, AND HARDWARE:

1. Gates that are part of the accessible route shall meet all the requirements of an accessible door in compliance with CBC Section 11B-404.
2. The levers of lever actuated latches or locks for accessible gates shall be curved with a return to within 1/2" of the gate surfaces to prevent catching on the clothing or persons. California Reference Standards Code T-24 Part 12, Section 12-10-202, item (F).
3. Swing doors and gate surfaces within 10" of the finish floor or ground shall have smooth surface on the push side extending the full width of the door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within 1/16" of the same plane as the other and be free of sharp or abrasive edges. Cavities created by added kick plates shall be capped. CBC Section 11B-404.2.10.

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DECORATIVE METAL FENCES AND GATES

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SECTION 32 84 00 – IRRIGATION SYSTEM

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. Install a modified irrigation system including materials, equipment and procedures required for the Work.

1.2 SYSTEM DESCRIPTION

- A. Regulatory Requirements:
 - 1. Comply with local, municipal and state laws, rules and regulations governing the work.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 00; Submittals.
 - 1. Materials List: Include manufacturer's name and description of items to be furnished.
- B. Closeout Submittals:
 - 1. Submit a complete list of materials including manufacturer's name and product installation literatures.
 - 2. Record drawings: Submit dimensioned plan drawings and details, prior to completion.
- C. AS-BUILTS
 - 1. As-Builts: Four (4) copies shall be submitted, completed, and approved prior to the final inspection.
 - 2. The As-Builts shall be computer generated (Auto Cad 14 or latest version or any compatible C.A.D. program).
 - a. Prints shall show the locations of the marked remote control valves, flow sensors, master valves, manual control valves, locations and size of all supply and lateral lines, sleeves, location and type of all sprinkler heads, quick coupling valves, isolation valves, backflow devices, point of connections, controllers and all other related equipment.

- b. Dimensions shall be legible from two permanent points of reference such as buildings and sidewalks.
- c. Drawings shall be a full size 24" x 36" minimum.

1.4 SUBSTITUTIONS

- A. If the irrigation contractor wishes to substitute any equipment or materials as an "or equal" for those equipment or materials listed on the irrigation specifications or job scope, the contractor may do so by providing the following information to the District for approval:
 - 1. The Contractor shall provide a statement indicating the reason for making a substitution, using a separate sheet of paper for each item to be substituted.
 - 2. The contractor shall provide descriptive catalog literature, performance charts, and flow charts for each item to be substituted illustrating that the alternate item meets or exceeds the specifications of the original item.
 - 3. The contractor shall provide the amount of cost saving if the substituted item is approved.
- B. The contractor shall be responsible for the total performance of such substitution to equal or surpass the original in every respect.
- C. If the substitution proves to be unsatisfactory in the opinion of the landscape architect, the contractor shall remove such work and replace it with the originally specified item (including installation) at no cost to the District.
- D. The District shall have the sole responsibility for accepting or rejecting any substituted item as an approved equal to equipment and material listed on the irrigation specifications and scope of work.

1.5 QUALITY ASSURANCE

- A. Qualifications: Work shall be performed by skilled workers and by an installer licensed to perform irrigation sprinkler installation.
- B. Regulating Requirements: All local, municipal and state laws, rules, and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications, and their provision shall be carried out by the contractor. Nothing contained in these specifications, however, shall be construed to conflict with any of the above rules and requirements of the same. When these specifications and drawings call for or describe materials, work, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of these Specifications and drawings shall take precedence.

1.6 WARRANTY

- A. Provide a one-year warranty, for labor and materials necessary to maintain sprinkler

irrigation system in full operating condition.

1.7 MAINTENANCE

- A. Maintenance Manuals:
 - 1. Provide complete operating and maintenance instruction manuals for new equipment.
- C. Extra Materials:
 - 1. Four (4) sprinklers of and with each specified nozzle.

1.8 PRODUCT HANDLING

- A. Exercise care in handling, loading, unloading and storing pipe and fittings. Store materials under cover. Transport in a manner to prevent undue stresses on piping and other materials.

1.9 IRRIGATION LEAD MAN

- A. An irrigation lead man satisfactory to the District shall be present on the site at all times during the progress of work.
 - a. The lead man must be able to speak English and communicate with the District, District Inspector, and school site staff.
 - b. The lead man must be knowledgeable of the specifications and Scope of Work and have access to these documents on the project site.
 - c. The lead man shall be authorized to represent the contractor.

1.10 PROJECT CONDITIONS

- A. The contractor shall be acquainted with all site conditions and exercise extreme care in excavating and working near existing utilities. The contractor shall call Dig Alert, if necessary, two (2) days prior to any excavation (1-800-227-2600) and shall provide the verification number from Dig-Alert at the job start meeting. The contractor shall become familiar with all on-site underground utilities prior to any trenching.
- B. Should the contractor damage any utilities or piping during excavation or at any time on the school site, the contractor shall promptly notify the District for instruction as to further action. Failure to do so shall make the contractor liable for any damage thereto arising from his operations subsequent to discovery of such utilities not shown on plans.

1.11 INSPECTIONS: SPECIFICATIONS & SAFETY

- A. Daily inspections shall be performed without prior notice and the inspector will call upon the irrigation lead man to assist in verifying that installation meets the specifications.

Daily safety inspections will be performed without prior notice by the inspector, District, or school site staff. The contractor shall adhere to all safety recommendations made at the job walk or respond to any safety-related issues concerning this project. At any time the contractor receives either a verbal or written request to rectify a safety concern, s/he shall

**SECTION 32 84 00
IRRIGATION SYSTEM**

stop work and immediately correct the safety issue. Any time a contractor receives a written notice for a safety violation, s/he shall consider this a legal step to remove the contractor from this project.

- B. The contractor shall notify the inspector 24 hours in advance for the pressure side piping inspection.
- C. The contractor shall submit a request for a final inspection 48 hours in advance. When the sprinkler system has been completed, the contractor, in the presence of the District Inspector and the District, shall perform a coverage test to determine if the coverage of water to turf and planting areas is complete and adequate.
- D. The following items shall be considered part of the final inspection:
 - 1. All items and materials covered in the specifications.
 - 2. Guarantee form and product warranty information.
 - 3. Soil compacted in trenches and around sprinkler heads, level with existing elevations. No settlement.
 - 4. Sprinkler control valves and boxes.
 - 5. Final site review and acceptance:
 - a. The contractor shall operate each system in its entirety for the District Inspector. Any system deemed not acceptable by the District Inspector, or not in compliance with these specifications and scope of work, shall be reworked to complete satisfaction of the District Inspector.

1.12 GUARANTEE

- 1. The guarantee for the irrigation system shall be made in accordance with the following form. The general conditions and supplementary conditions of these specifications shall be filed with the District upon completion of the project. The standard one (1) year guarantee shall include:
 - a. Filling and repairing depressions due to settlement of irrigation trenches for one (1) year following acceptance of project.
 - b. All items stated within the plans, specifications, construction notes, etc. specific to this project.
- 2. A copy of the signed guarantee form shall be present at the final inspection.

The guarantee form shall be on the contractor's letterhead and contain the following information:

(See next page)

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IRRIGATION SYSTEM

GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

We hereby guarantee for one year from the date of acceptance by that the sprinkler irrigation system we have furnished and installed is free from defects in material and work, and the work has been completed in accordance with the specifications and the scope of work.

In the event that work performed by the contractor is faulty or defective materials are provided and/or erected/applied by him/her, the District will notify the contractor to that effect in writing. In such notice the District will order the contractor to remove (at his/her own expense) the faulty work and/or defective materials and to replace it with work and/or material that conforms to the requirements of the Contract. The District will also state in the said notice the time within which the contractor must begin the said removal and replacement and must complete the same. Upon receipt of this notice, the contractor must proceed forthwith to remove said faulty work and/or defective material from the site. The contractor shall then replace the same with new work and/or material that will conform to the provisions of the contract, using methods and materials approved by the District. The contractor shall also repair and/or replace (at his/her own expense) all work and/or material that is damaged, injured, or destroyed by the removal of said faulty work and/or defective material or by replacement of same with acceptable work and material as directed by the District Representative. If the contractor does not fix the problem within the time frame stated in the written notice, will proceed in having the repairs made and the contractor shall be responsible for all charges incurred.

Signature of Responsible Party

PROJECT: _____
(School or site)

CONTRACTOR: _____ LIC. NO.: _____

ADDRESS: _____

PHONE: _____ FAX: _____

DATE OF ACCEPTENCE: _____

BY:(Signature of District) _____

Typed or printed name of District _____

NAME OF DEPARTMENT DISTRICT REPRESENTS: _____

BRANCH OR COMPANY NAME: _____

PART 2 – PRODUCTS

2.1 MATERIALS

- A. GENERAL: Use only new materials, of brands and types noted on drawings, specified herein, or approved equals.
- B. The contractor is to review all materials with supplier and allow sufficient time to order any product requiring lead-time.
- C. Pipe and Fittings:
 1. Plastic Pipe shall be Schedule 40 and Class 200: Extruded from 100 percent Virgin Polyvinyl Chloride (PVC) Compound, meeting requirements of Class 12454-B of "Standard Specifications for Rigid Polyvinyl Chloride Compounds and Chlorinated Polyvinyl Chloride Compounds" ASTM D 1784.
 - a. Plastic fittings shall be Schedule 40 molded from PVC Type I Compound, conforming to the requirements of Class 12454-B of ASTM D 1784.
 - b. Nipples: Schedule 80.
 - c. Plastic pipe shall be continuously and permanently marked with the following information: Manufacturer's name, nominal pipe size, Schedule or Class, SDR (Standard Dimension Ratio, or pressure rating in PSI) National Sanitation Foundation (NSF).
 - d. PVC primer and solvent for chemical weld of pipe and fittings shall be as recommended by pipe manufacturer (IPS Weld-On P-70, IPS Weld-On 2711 [gray] cement; Spears Blue 75 [SB75]). Containers for solvent and primer shall be clearly marked with manufacturer's data. Solvent and primer shall not be more than one year old. Blue or red-hot glue shall not be used on the project.
 2. Connection between steel pipe and copper pipe or tube shall use a brass nipple.
 3. Connection between any female threaded fitting and plastic pipe shall be made with a Schedule 80 nipple.
 4. Steel pipe or fittings shall not be used underground.
 5. Brass Pipe: Seamless, 85 percent red brass, iron pipe sized, threaded.
 6. Brass Fittings: Bronze and brass 250 PSI, screwed, A.S.A. B16.17 and FSWW-P-460.
- D. Shut-off Valves:
 1. Gate valves on pipe 3-inch and larger shall be A.W.W.A. Specification, Class "D" dimensions caulk bells, or standard flanged, or a combination of outlets as required, iron body, brass trimmed, non-rising stem with operating nut. Gate valves 2-inch or smaller shall be bronze, non-rising stem, screwed.

2. Quick coupler valves shall be all brass, per plan.
3. Couplers shall be same manufacturer as quick coupler valve.
4. Electric remote control valves shall be 24-volts capable of operating on #14 gauge UF wire; either bronze or brass, globe or angle pattern, and diaphragm actuated.

E. Yard Boxes and Remote Control Boxes

1. Yard boxes installed in pavement shall be Brooks 4-TT 10-1/4" traffic box with cast iron traffic cover marked "Irrigation", or larger, as may be required to obtain specified clearance.
2. Pull boxes to be Brooks 3-1/2 (T) PB 10" x 17" pull box w/full bolt-down traffic cover marked "Irrigation".
3. Remote control valve boxes for turf areas or shrub areas shall be Carson, or approved equal, large rectangular. Use Cover with Captive Pentahead "L" Bolt.

F. Controller

1. Existing. Verify available stations with District prior to connections.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Piping and devices shall be supported to maintain uniform alignment and prevent sagging by installing hangers and anchors of sufficient strength to support the weight of the pipe and its contents.
- B. Isolate piping from incompatible materials.

3.2 LAYING PIPE

- A. Trenches shall be deep enough to provide earth coverage of 12-inch for non-pressure lines and 24-inch for pressure lines, from finished grades to top of pipe. The bottom of trenches shall be free of rocks, clods, and other sharp-edged objects. Piping in ground shall be laid on a firm bed for its entire length.
- B. Plastic pipe and fittings 2" and below shall be Schedule 40 PVC solvent welded, using solvents and methods recommended by the pipe manufacturer. Plastic pipe 3" and larger shall be gasket Class 200 PVC. Remove all dust, dirt and moisture from pipes and fittings before applying primer and solvent; wipe excess solvent from joints with a clean rag. Primer shall be used on all PVC glued joints, pressure and non-pressure piping.
- C. Welded joints shall cure at least 15 minutes before moving or handling and at least 24 hours before water will be permitted in pipe, or as recommended by manufacturer.

- D. Pressure piping installed under a driveway or sidewalk shall be sleeved; sleeves shall be two pipe sizes larger.
- E. Piping through concrete and asphalt pavement shall be L type copper with $\frac{1}{4}$ -inch of foam wrap around the pipe to allow for expansion.
- F. Holes cored through walls shall be two pipe sizes larger to allow for foam wrap around pipe.
- G. PVC pipes shall not be installed above ground unless approved by the District Inspector.
- H. Lettering shall be facing up on all under ground PVC piping.

3.3 IRRIGATION HEAD INSTALLATION

- A. After installation, examine system operation for complete coverage. Make adjustments, as may be required to provide complete coverage.
- B. Branch lines, swing joints or sprinkler risers shall not be sized smaller than the sprinkler heads they serve.

3.4 YARD BOX INSTALLATION

- A. Enclose underground gate valves in yard boxes of sufficient size to provide no less than 1 1/2-inch of clearance on all sides of equipment installed therein.
- B. Sides and ends of yard boxes shall be extended down to the centerline of the main line when the main is more than $\frac{1}{4}$ -inch below the bottom of the box. The box shall enclose all shut-off valves below ground.
- C. Yard boxes in paved areas shall be set in a concrete bed 4-inches thick with a clearance of at least 1-inch below pipe or below the walls of the box.
- D. Yard and remote boxes shall be installed level to grade.

3.5 REMOTE CONTROL VALVE BOX INSTALLATION

- A. The remote control value box shall extend to the body of the valve, and box tops shall be 2-inches above finished grade in ground-cover areas. In turf areas, the top of the box shall be flush with finished turf grade. In paved areas, box tops shall be flush with finished grade. Plastic yard box covers shall be bolted down.
- B. Pea gravel shall be filled up to the bottom of the manual and remote valve and there shall be at least 4-inches of gravel inside of the valve box.
- C. Emboss or "Brand" remote box lids with 3-inch size numbers, showing number that corresponds with controller station and a 3-inch size letter to show which controller it serves. There shall be one remote valve for each remote box.

3.6 QUICK COUPLER VALVES AND ASSEMBLIES

A. Install quick couplers 1-inch above finished grade.

3.7 VALVES

A. Pressure piping system shall be supplied with valves at all points where required.

B. Valves shall be installed with the best of workmanship, neat appearance and groupings; so all parts are easily accessible. Valves near walk curbs and appurtenances shall be set back 12-inches.

C. Valves shall be full size of line in which they are installed unless otherwise indicated.

E. Remote Control Valves & Manual Sprinkler Valves:

1. Remote control valves shall be low wattage (24-volts) and shall be capable of operating properly on no larger than #14 gauge UF wire.
2. Remote control valves shall be adjustable to control flow of water through valve adjustments and shall be accessible through valve boxes installed above each valve.
3. Remote control valves shall be installed and adjusted so that sprinkler heads operate at pressure recommended by head manufacturer. Remote control valves shall be adjusted so that a uniform distribution of water is applied by sprinkler heads to planting areas from each individual valve system.
4. Remote control valves on any line shall be installed 3-inches minimum and 8-inches maximum below finish grade to top of flow control stem.
5. Remote control valves shall be installed with schedule 80 nipples on the inlet and outlet side of valve.
6. Manual and remote control valves for lawn and shrub areas shall be installed within the perimeter of the area it serves.
7. Manual and remote control valves for all athletic fields shall be installed in the following specified location:
 - a. Control valves shall be grouped together, installed on the perimeter of the athletic field and installed in yard boxes.
 - b. Provide Manual operating key to District.

3.9 CONTROL WIRE

A. Snake control wires into mainline trench and maintain a minimum of 18-inches cover to finish grade.

B. Under paving, control wires shall be encased in Schedule 40 PVC pipe and shall extend a minimum of 12-inches beyond pavement.

- C. Bundle and tie control wires at 10-foot intervals.
- D. Color code 2-Wire control wires: White for common ground wire, red or black for valve control wire.
- E. Wire splicing shall be done only in controller cabinet and at remote control valve boxes.
- F. Stubbed out control wires shall terminate in bolted yard boxes.
- G. Control wires coming out of the ground shall be in approved U.L. electrical conduit, and all changes in directions shall be installed with approved sweeps. Exposed electrical conduit shall be rigid galvanized pipe.

3.10 VERIFICATION AND TESTING

- A. The contractor shall notify District Inspector 24 hours in advance for the pressure side piping inspection.
 - 1. Pressure Side Piping: After all pressure-side equipment has been installed (gate valves, remote control valves, quick-couplers, etc), welded joints have cured for at least 24 hours, lines are flushed, and outlets are capped, the system shall be tested under local water pressure plus 20% for a minimum of 4 hours. Joints shall remain exposed for inspection during the pressure test. The contractor may center load pipe with back fill to prevent arching or slipping under pressure.
 - 2. Repair leaks and repeat pressure test, until the entire system is watertight.
- B. Perform a coverage test to determine if the coverage of water to turf and planting areas is complete and adequate.
 - 1. Final site review and acceptance:
 - a. The contractor shall operate each system in its entirety. Features of system deemed unacceptable shall be reworked, and the coverage test repeated.

3.11 CLEAN-UP

- A. Clean up shall be performed as each portion of work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be broomed and washed down, and any damage sustained to the work of others shall be repaired and work returned to its original condition at no cost to the District.

END OF SECTION

PLANTING OPERATIONS

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. Labor, materials and equipment required to complete landscape planting, as indicated.
- C. Related Sections:
 - 1. Section 32 84 00: Irrigation System.

1.2 SUBMITTALS

- A. Material Samples:
 - 1. Fertilization: Contractor shall furnish the Project Manager with delivery receipts for soil amendment materials to substantiate applications.
 - 2. Pesticides: Submit manufacturer's literature and application methods for each pesticide proposed for use.
- B. Certificates:
 - 1. Submit a certificate with each delivery of bulk material, including import soil, stating source, quantity, and type of material, and that material conforms to Specification requirements.

1.3 QUALITY ASSURANCE

- A. Plant Materials:
 - 1. Plant materials shall be furnished in the quantities or spacing as shown or noted for each location, and shall be of the species, kinds, sizes and types, per symbol or as described on the Drawings.
 - 2. All plant material will be inspected at the project site and inspected for conformance to these specifications.
- B. Verification of Dimensions and Quantities: Before proceeding with work, Contractor shall carefully check and verify dimensions and quantities and shall immediately inform the District and the Project Manager of any discrepancies between Drawings and Specification and actual conditions.
- C. Protection: Carefully and continuously protect areas included in work, such as lawns, plant materials, fences and supports, until final acceptance of the work by the District Inspector.
- D. Pest Management Method and Products:
 - 1. Only pest management methods and products demonstrated to be safest and lowest risk to children will be used, those products that will not cause or those that will have the least

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PLANTING OPERATIONS**

health effects as cancer, neurological disruption, birth defects, genetic alteration, reproductive harm, immune system dysfunction, endocrine disruption and acute poisoning.

Pest management methods and products used in the execution of this contract shall be in strict conformance with the District.

2. Only pest management products that can be applied in a manner and at a time where no person can inhale or come into direct contact with them, or be exposed to volatile agents shall be used.

E. Quality Assurance

1. Installer's Personnel Certifications: Certified Landscape Technician, CLT-Exterior.
2. Soil analysis of each un-amended soil type.

F. Maintenance Service

1. Trees and Shrubs: 12 months.
2. Ground Cover, grass, and Other Plants: three months

1.4 DELIVERY, STORAGE AND HANDLING

- A. Plants shall be protected in transit and after delivery to project site. Plants in broken containers will not be accepted and plants with broken branches or injured trunks will be rejected.
- B. Plant materials damaged in planting operations shall be replaced.

1.5 WARRANTY

- A. Shrubs and groundcover, including grass, shall be guaranteed for growth and health for a period of 90-days after completion of maintenance period. Sparse grass areas needing replacement include any seeded area with 50% or less coverage within a 4 sq. ft area. Trees shall be guaranteed by Contractor to live and grow in upright position for a period of one year after completion of the maintenance period. Any tree requiring replacement shall exhibit 25% unhealthy canopy, such as dead leaves, broken branches, and/or evidence of disease/insect infestation, among other ailments.
- B. Within 15 days after notification by the District Inspector, remove and replace plant materials that fail. Replacement materials shall be guaranteed as specified for original plant materials.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Soil Conditioners – for bid purposes:

1. Gro-Power Plus (bacteria included) with 1.25 percent soil penetrant and consisting of the following percents by weight: 5-nitrogen, 3-phosphoric acid, 1-potash, 50-humus, 15-humic acid.
2. Nitrolized Redwood Sawdust: Containing minimum 0.5 percent nitrogen based on dry weight.
3. Shavings shall be mill-run shavings, not sawdust, nitrolized with a minimum of 1/2 percent nitrogen.

B. Pest Management Methods and Products

1. Pesticides (insecticides, herbicides, fungicides, rodenticides, avicides and growth regulators) shall not contain any ingredients (both active and inert) that are:
 - a. Banned, suspended, cancelled, discontinued or withdrawn by United States Environmental Protection Agency or Department of Pesticide Regulation of California Environmental Protection Agency.
 - b. Not registered for the intended use with above agencies.
 - c. Known or suspected to be a carcinogen according to International Agency for Research on Cancer (IARC), United States Department of Health and Human Services - National Toxicology Program (USDHHD-NTP), United States Department of Labor-Occupational Health and Safety Administration (USDOL-OSHA), California Safe Drinking Water and Toxic Enforcement Act of 1986 (Prop 65).
 - d. Known to be mutagenic, teratogenic, oncogenic, neurotoxic, or cause reproductive hazards in humans.
 - e. Listed as Class I Pesticides (extremely toxic) or labeled as "Danger".
 - f. Classified as Highly Toxic by USDOL-OSHA if mode of application is spraying or broadcast-spreading.

C. Plant Materials: Plant materials indicated on Drawings and specified shall conform to the following:

1. Nomenclature: Plant names on Drawings conform to "Standard Plant Names" established by the American Joint Committee on Horticultural Nomenclature; names not covered therein follow established nursery lexicon.
2. Condition: Plants shall be symmetrical, typical for variety and species, sound, healthy, vigorous, free from plant disease, insect pests or their eggs. Plants shall have healthy, normal root systems, well filling their containers, but not root bound. Plants shall not be pruned prior to delivery except as authorized by the District.
3. Dimensions: Height and spread of all plant material shall be as indicated and shall be measured with branches in their normal position. Caliper of trees shall be measured 4-feet above surface of ground. Where caliper or other dimensions of any plant materials are omitted, it shall be understood that these plant materials shall be normal stock for type listed.
4. Groundcover plants shall be well rooted in flats or containers.
5. Plants, General: Nursery-grown and complying with ANSI Z60.1.

PART 3 - EXECUTION

3.0 Planting required 90-days, minimum, prior to occupancy.

3.1 **EXAMINATIONS**

- A. Contractor shall schedule following inspections. Notify the District Inspector:
 1. When planting, and other indicated.
 2. At the completion of the maintenance period at final inspection.

- B. Plant materials shall be subject to examination and approval of the District before planting.
- C. Contractor shall make a request to the Project Manager for a check inspection allowing 2 calendar days notice from completion of construction and planting operations. This examination with approval of the District, will establish start of Maintenance Period.

3.2 GRADING AND SOIL PREPARATION

Final Soil preparations shall be per the Soils Report and Recommendations.

- A. Preliminary Grading:
 - 1. Preliminary grading shall be done in such a manner as to anticipate finish grading. Import soil where used, shall be dug into top 2-inches of the existing soil. Excess soil shall be removed or redistributed before application of soil amendments. Allowance shall be made so that when finish grading has begun there shall be no deficiency in specified depth of mulched planting beds.
 - 2. Moisture Content: Soil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in air or that clods will not break readily. Water shall be applied, if necessary, to provide ideal moisture content for tilling and for planting.
 - 3. Weeding: After soil preparation and establishment of final grades prior to any planting, Contractor shall irrigate thoroughly for 2 to 3 weeks or until weed seeds and/or grass have germinated. When there is sufficient weed seed and/or grass germination, Contractor shall apply a post-emergent weed killer. Contractor shall then wait an additional one week to allow weed killer to dissipate, then plant as indicated on Drawings and Specifications.
- B. Finish Grading:
 - 1. When preliminary grading, including weeding, has been completed and soil has dried sufficiently to be readily worked, planting areas shall be graded to elevations indicated on Drawings. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given. Minor adjustments of finish grades, if required, shall be made at the direction of the District. Finish grades shall be smooth, even, and at uniform planes with no abrupt change of surface. Soil areas adjacent to buildings shall slope away from buildings to allow a natural runoff of water, and surface drainage shall be as indicated on Drawings. Low spots and pockets shall be graded to drain properly. Finish grade of planting areas shall be 1 1/2-inches below grade adjacent to pavement.
 - 2. Trenches: If sprinkler system is installed after grading is completed, upper portion of backfill shall be re-tilled and amended to required depth for particular area specified.
- C. Prepared Soil: For bid purposes, soil backfill in pits for trees, shrubs, vines, and for planter boxes shall be a prepared soil consisting of 3-parts nitrolized sawdust and 7-parts native on-site soil, measured by volume, to which shall be added 1-pound of Gro-Power Plus per cubic yard of mix. Prepared soil shall be mixed in areas adjacent to planting work, and shall be accurately proportioned, using a suitable measuring container. Final Prepared Soil shall be per the soils report and recommendation.

3.3 METHOD OF PLANTING

- A. No planting shall be done until operations in conjunction with installation of sprinkler system have

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been completed, final grades have been approved, concrete and headers have been installed, planting areas have been prepared as specified, and work tested and approved.

- B. Relative position of trees and plants is subject to approval of the District, and they shall, if necessary, be repositioned as directed at no additional cost to the District.
- C. Plants shall be set so that, when settled, they bear same relation to the required grade as they bore to natural grade before being transplanted plus 4" for trees (base of trunk to natural grade) and 2" for shrubs. Each plant shall be planted in center of pit and backfilled with prepared soil. No soil in muddy condition shall be used for backfilling. No filling will be permitted around trunks or stems. Broken or frayed roots shall be properly cut off and allowed to heal per California Arborists Association standards until planting.
- D. Shrubs, unless otherwise indicated, shall be placed a minimum of 30-inches from buildings, walls, and fences.
- E. Planting of Trees: Pits for trees shall be dug square with bottom level, length of sides equal to 2 times diameter of ball of tree and bottoms 4-inches below ball, except in paved areas, minimum length of sides shall be 4-feet. Compacted soil at sides and bottoms shall be loosened by scarifying or other approved method. Pits shall be back-filled with compacted, prepared soil to bottom of the tree ball, tree set to required grade, balance of pit filled with prepared soil, and thoroughly settled by tamping and watering. Top of rootball shall be 2" above adjacent grade. Slope backfill towards edge of planting pit, away from trunk. No water basin required for trees planted in gravel or on a slope.
- F. Planting of Shrubs and Vines: Shrubs and vines shall be planted in pits at least 12-inches greater in diameter than ball of earth and at least 2-inches below bottom of ball. Compacted soil at bottom of pit shall be loosened and pit filled with prepared soil to bottom of ball. When plant has been properly set, pit shall be filled to the required grade with prepared soil, thoroughly settled by tamping and watering.
- G. Planting of Groundcover: Ground cover plants shall be evenly spaced to produce uniform coverage, and staggered in rows at intervals indicated on Drawings. Plants shall be mulched as specified and watered after planting operations are completed. Soil shall be kept continually moist by watering as often as required. Mulching and first watering shall be done in conjunction with planting, but not later than same day the plants are planted. Backfill of prepared soil is not required.
- H. Mulching: Per Plans.
- I. Watering Basins: Not required in gravel mulched areas.

3.4 TREE SUPPORTS

- A. Use 3 stakes in paved areas and 2 stakes in planting areas. Stakes shall be at least 10-feet long, placed and driven as indicated on drawings. Fasten stakes together and to trees per details.
- B. Placement: Stakes shall be located to prevent interference with operation of sprinkler system. If necessary, stakes shall be relocated as required or directed.

3.5 PESTICIDE APPLICATION

- A. Application rates and methods shall conform to written recommendations of manufacturer and shall comply with regulations of San Bernardino County Agricultural Commissioner and the Department of Agriculture, State of California.
- B. Only well trained, competent operators shall be allowed to apply pesticides.
- C. Certificated applicators shall be used wherever required by regulations of the County of San Bernardino, or the State of California or as determined by the District IPM Coordinator.
- D. Pesticide application shall be performed in accordance with pertinent State and Federal laws and regulations. In addition, application shall be performed under following conditions, but not limited to:
 - a. Posting warning sign according to District policy, verify.
 - b. Using low pressure spraying when permitted.
 - c. Strict adherence to manufacturer's recommended re-entry period after application.
 - d. Pesticides shall be used in strict conformance to manufacturer's instructions on product labeling.
 - e. Applicators shall use appropriate personal protective equipment recommended in accordance with product labeling. They include body coveralls, respirators, splash goggles and rubber gloves.

3.6 FINAL INSPECTION

- A. Schedule the following inspections and notify the District Inspector:
 - 1. When planting, sowing and other indicated or specified work, except maintenance work, has been completed.
 - 2. Final inspection at the completion of the maintenance period.
- B. Plant materials shall be subject to inspection and approval of the District before planting.
- C. After completion of construction and planting operations, request for a check inspection. Allow at least 2 days notice prior to inspection. This inspection, with the approval of the District, will establish the start of the landscape maintenance period.
- D. Upon completion of the landscape maintenance period, request for a final inspection. Allow at least 2 days notice prior to inspection.

3.8 MAINTENANCE

- A. Contractor shall continuously maintain areas included in Contract during progress of work, maintenance period, and until final acceptance of work.
- B. Maintenance period shall be for a minimum of 90-days.
- C. Maintenance shall be continued by Contractor if plant materials are not acceptable at end of Contract, or until acceptance by the District.

SECTION 32 93 00
PLANTING OPERATIONS

- D. Maintenance shall include continuous operations of watering, weeding, trimming, edging, cultivating, fertilizing, spraying, insect and pest control, replacement or any other operations necessary to ensure good normal growth.
- E. During installation period and during maintenance period, Contractor shall be responsible for maintaining adequate protection for planted areas.
- F. At completion of maintenance period plant materials shall be alive, healthy, undamaged and free of infestations.
- G. Replacements: Contractor shall replace plant materials that is dead or damaged. Replacements shall meet requirements for original plantings. All plants that exhibit less than a 80% healthy, living canopy shall be replaced.
- H. Planted areas shall be kept free of debris, and shall be cultivated and weeded at not more than 10-day intervals.
- I. Water plantings adequately to ensure continued growth of plants.
- J. In areas that do not have sprinkler coverage or which may require supplemental deep watering. Hose watering shall accomplish this.
- K. Chemical herbicides may be used to control weeds when approved by the District IPM Coordinator.
- L. Weed Control on Groundcover and Shrub Beds: Apply pre-emergent herbicide after planting. Herbicide shall be approved for use by the State and County and shall have minimal detrimental effect on groundcover plants. Rate and method of application shall conform to the written recommendations of manufacturer.
- M. New Trees: Broadcast commercial fertilizer over entire watering basin at rate of $\frac{1}{4}$ -pound for every inch of trunk caliper and water immediately. Repeat approximately 30 to 45 days after start of maintenance or after tree has produced definite signs of establishing itself after transplant and is producing new growth, whichever is first.
- N. Shrub Areas: Fertilization: Shrub areas shall receive an application of commercial fertilizer at rate of 1-pound per 1,000 square feet 30-days after start of maintenance. Irrigate after application.
- O. Insect and Fungus Control: Contractor shall be alert for signs of insect presence or presence of damage from plant fungi. Upon locating such evidence, Contractor shall report matter to the District Pest Control Specialist and take remedial action as directed by the District IPM Coordinator.

SECTION 32 93 00
PLANTING OPERATIONS

3.9 CLEAN UP

A. Upon completion of planting operations and maintenance period, remove equipment and clean site of debris and superfluous materials. Discard debris and superfluous materials in a legal manner.

END OF SECTION

SECTION 33 05 13 - MANHOLES AND STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Monolithic concrete manholes with transition to lid frame, covers, anchorage, and accessories.
- B. Modular precast concrete manhole sections with tongue-and-groove joints covers, anchorage, and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.

1.3 REFERENCE STANDARDS

- A. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2012).
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.
- C. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections; 2013.
- D. ASTM C478M - Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric]; 2014.
- E. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2008 (Reapproved 2013).
- F. ASTM C923M - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals [Metric]; 2008b (Reapproved 2013).
- G. Greenbook: Standard Specifications for Public Works Construction; Latest edition as adopted by local jurisdiction.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate manhole locations, elevations, piping sizes and elevations of penetrations.
- C. Product Data: Provide manhole covers, component construction, ladders, features, configuration, and dimensions.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Manhole Sections: Reinforced precast concrete in accordance with ASTM C478 (ASTM C478M), with resilient connectors complying with ASTM C923 (ASTM C923M).
- B. Concrete: As specified in Section 03 30 00.
- C. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.
- D. Concrete Reinforcement: As specified in Section 03 30 00.

2.2 COMPONENTS

- A. Lid and Frame: ASTM A 48/A 48M, Class 30B Cast iron construction, machined flat bearing surface, removable lockable lid, closed lid design; live load rating of 2000 psf (9.576 kPa); sealing gasket; lid molded with identifying name.
- B. Manhole Steps: Formed galvanized steel rungs; 3/4 inch (19 mm) diameter. Formed integral with manhole sections.
- C. Strap Anchors: Bent steel shape, 3 x 24 inch (150 x 610 mm) size x 1/4 inch (6 mm) thick, galvanized to ASTM A 123/A 123M, Grade specified for applicable material category.

2.3 CONFIGURATION

- A. Shaft Construction: Concentric with concentric cone top section; lipped male/female dry joints; sleeved to receive pipe sections.
- B. Shape: Cylindrical.
- C. Clear Inside Dimensions: As indicated.
- D. Design Depth: As indicated.
- E. Clear Lid Opening: As indicated.
- F. Pipe Entry: Provide openings as indicated.
- G. Steps: As indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify items provided by other sections of work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes is correct.

3.2 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

3.3 MANHOLES

- A. Place concrete base pad, trowel top surface level.
- B. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.
- C. Form and place manhole cylinder plumb and level, to correct dimensions and elevations. As work progresses, build in fabricated metal items.
- D. Cut and fit for pipe.
- E. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.
- F. Set cover frames and covers level without tipping, to correct elevations.
- G. Coordinate with other sections of work to provide correct size, shape, and location.

3.4 SCHEDULES

- A. Storm Sewer Manholes: Precast concrete sections, galvanized steel steps, 48 inch (1200 mm) inside dimension, to depth indicated, with bolted lid.
- B. Electric Service Manholes: Prefabricated FRP sections, integral molded steps, 60 inch (1500 mm) inside dimension, to depth indicated.

END OF SECTION

SECTION 33 05 13
MANHOLES AND STRUCTURES

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SECTION 33 11 16
SITE WATER DISTRIBUTION PIPING

SECTION 33 11 16 – SITE WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and fittings for site water lines including domestic water lines and fire water lines.
- 1. Site water lines up to approximately 5 feet from the building perimeter. See individual building systems for continuation.
- B. Valves.

1.2 RELATED REQUIREMENTS

- A. Division 22 - Plumbing: Underground water line extension into the building.
- B. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- C. Section 31 23 23 - Fill: Bedding and backfilling.
- D. Section 33 13 00 - Disinfecting of Water Utility Distribution: Disinfection of site service utility water piping.

1.3 REFERENCES

- A. ASTM D1785 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2012.
- B. ASTM D2241 - Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series); 2009.
- C. ASTM D2466 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40; 2013.
- D. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings; 1996 (Reapproved 2010).
- E. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 1998 (Reapproved 2011).
- F. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association; 2010 (ANSI/AWWA C105/A21.5).
- G. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association; 2012 (ANSI/AWWA C111/A21.11).
- H. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; American Water Works Association; 2009 (ANSI/AWWA C151/A21.51).
- I. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service; American Water Works Association; 2009.
- J. AWWA C504 - Rubber Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm); American Water Works Association; 2010.

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- K. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS; American Water Works Association; 2011 (ANSI/AWWA C508).
- L. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances; American Water Works Association; 2010 (ANSI/AWWA C600).
- M. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution; American Water Works Association; 2007 (ANSI/AWWA C900/C900a).
- N. Greenbook: Standard Specifications for Public Works Construction; Latest edition as adopted by local jurisdiction.
- O. NFPA - National Fire Protection Association.
- P. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2022, as amended in 2022 CBC Referenced Standards.
- Q. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances; 2019; 2019, as amended in 2022 CBC Referenced Standards.
- R. UL 246 - Hydrants for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, joints, couplings, valves and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 1. Submit a certificate stating that the meters have been tested and that the accuracy and capacity meet the requirements of AWWA C700 when tested in accordance with AWWA C705.
- D. Certificates: Provide a NFPA Certificate of installation with copies for Owner, Architect, local fire officials, and DSA.
- E. Project Record Documents:
 - 1. Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

SECTION 33 11 16
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3. On a set of Contractor Drawings, kept at the site during construction, mark construction that is installed differently from that indicated.
 - a. Locate materials installed underground by dimensions from fixed identifiable points whether installed as indicated or not.

F. Maintenance Data:

1. Submit maintenance data and parts list for potable water system materials and products.
2. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Section 01 78 00 - Closeout Submittals.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with utility company requirements.
- B. Manufacturer's Qualification: Firms regularly engaged in the manufacture of potable water system materials and products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- C. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with potable water piping work similar to that required for project.

1.7 REGULATORY REQUIREMENTS

- A. Materials and installation shall be in accordance with the following documents hereinafter referred to as the "Standard Specifications".
 1. Standard Specification for Public Works Construction, Latest Adopted Edition including Regional and local amendments.
- B. Comply with NFPA 24 as adopted by authority having jurisdiction.
- C. Comply with CFC Chapter 33 – Fire Safety During Construction and Demolition

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.
- B. Do not store materials directly on the ground. Support the pipe uniformly during shipping and storage.
 1. Do not stack higher than 4 feet nor stack with weight on bells.
 2. Cover plastic pipe to protect it from sunlight.
 3. Keep inside of pipe and fittings free of dirt and debris.
 4. Avoid scratching the pipe surface.
- C. Do not install pipe that is cracked, broken, gouged, scratched or forming a clear depression. Remove damaged pipe from the site.

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SITE WATER DISTRIBUTION PIPING

- D. Do not install pipe contaminated with a petroleum product or any other toxic material whether inside or outside of pipe.
- E. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged.
 - 1. Hoist pipe with mechanical equipment using a cloth belt sling or a continuous fiber rope which avoids scratching the pipe.
 - 2. Pipes may be lowered by rolling on two ropes controlled by snubbing.

PART 2 - PRODUCTS

2.1 SITE FIRE LINE SYSTEM DESCRIPTION

- A. CFC 508 and 901 with NFPA Compliance: Install fire water systems in accordance with NFPA 24 "Standard for Installation of Private Fire Service Mains and Their Appurtenances".
 - 1. Coordinate installation with sprinkler risers at building to match requirements with NFPA 13.
- B. Local Fire Department/Fire Marshal Regulations: Comply with governing regulations pertaining to hydrants, including hose unit threading and similar matching of connections.
- C. UL Compliance: Provide fire hydrants that comply with UL 246 "Hydrants for Fire-Protection Service", and are listed by UL, and approved by the authorities having jurisdiction.

2.2 WATER PIPE

- A. General:
 - 1. Provide piping materials and factory-fabricated piping products of size, type, pressure ratings, and capacities as indicated.
 - 2. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements.
 - 3. Provide size and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in potable water systems.
 - 4. Where more than one type of materials or products are indicated, selection is Installer's option.
- B. Piping:
 - 1. Provide pipes of one of the following materials, of weight/class indicated.
 - 2. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.
- C. Ductile Iron Pipe: AWWA C151:
 - 1. Fittings: Ductile iron, standard thickness.
 - a. Ductile-iron, AWWA C110; asbestos-cement couplings.

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SITE WATER DISTRIBUTION PIPING

2. Joints: AWWA C111, rubber gasket with rods, conforming to ASTM D 1869.
3. Jackets: AWWA C105/A21.5 polyethylene jacket.

D. PVC Pipe: ASTM D 1785, Schedule 80 for sizes 1/2 inch through 3 inches.

1. Fittings: ASTM D 2466, PVC, socket type, solvent cement joints; or elastomeric gaskets joints.
2. Joints: ASTM D2855, solvent weld.

E. PVC Pipe: AWWA C900 Class 150 for sizes 4 inches through 12 inches:

1. Fittings: AWWA C111, ductile-iron, cement lined, with rubber gaskets.
2. Joints: Bell and spigot, ASTM D 3139 compression gasket ring.

F. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with " Water Service " in large letters.

2.3 VALVES

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Gate Valves Up To 3 Inches (75 mm):

1. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, compression ends, with control rod, post indicator, valve key, and extension box.

C. Gate Valves 3 Inches (75 mm) and Over:

1. AWWA C500, Class 150, iron body, bronze trim, non-rising stem with square nut, single wedge, flanged ends, control rod, post indicator, valve key, and extension box.

D. Ball Valves Up To 2 Inches (50 mm):

1. Brass body, teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, AWWA inlet end, compression outlet with electrical ground connector, with control rod, valve key, and extension box.

E. Swing Check Valves From 2 Inches to 24 Inches (50 mm to 600 mm):

1. AWWA C508, 150 psi working pressure, iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged ends.

F. Butterfly Valves From 2 Inches to 24 Inches (50 mm to 600 mm):

1. AWWA C504, iron body, bronze disc, resilient replaceable seat, water or lug ends, ten position lever handle.

G. Valve Ends: Provide flanged, threaded, hub or sleeve type mechanical joint ends designed to suit pipe or tapping sleeves connections.

H. Valve boxes for water service valves, Brooks Concrete Works Model #1-RT or #3-RT with the word "WATER" cast in top of cover, or comparable box by Fraser Cement Products Company.

SECTION 33 11 16
SITE WATER DISTRIBUTION PIPING

2.4 HYDRANTS

- A. Hydrants: Type as required by local Fire Department or utility company.
 - 1. Provide non-freeze yard hydrants, 3/4 inch (19 mm) inlet, 3/4 inch (19 mm) hose outlets, bronze casing, cast-iron or cast-aluminum casing guard, key operated, and tapped drain port in valve housing.
 - 2. Fire Service Hydrant: James Jones Model No. J-4060-DR.
 - a. Outlets:
 - 1) 4 inch diameter: One.
 - 2) 2-1/2 inch diameter: Two.
- B. Hydrant Extensions: Fabricate in multiples of 6 inches (150 mm) with rod and coupling to increase barrel length.
- C. Hose and Streamer Connection: Match sizes with utility company, two hose nozzles, one pumper nozzle.
- D. Fire Department Connections: As required by Fire Department having jurisdiction and responsibility for serving site.
- E. Finish: Primer and two coats of enamel in color required by local Fire Department or utility company.

2.5 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 31 23 16.13.
- B. Cover: As specified in Section 31 23 16.13.

2.6 ACCESSORIES

- A. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.
 - 1. Clamps, Straps, and Washers: Steel, ASTM A506.
 - 2. Rods: Steel, ASTM A 575.
 - 3. Rod Couplings: Malleable-iron, ASTM A 197.
 - 4. Bolts: Steel, ASTM A 307.
 - 5. Cast-Iron Washers: Gray-iron, ASTM A 126.
- B. Concrete for Thrust Restraints: Concrete type specified in Section 03 30 00.
- C. Backflow Preventer: Detector check assembly
 - 1. Reduced-pressure-principle assembly consisting of shutoff valves on inlet and outlet and strainer on inlet. Assemblies shall include test cocks and pressure-differential relief valve located between 2 positive seating check valves and comply

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with requirements of ASSE Standard 1013. Assemblies shall have approval of Health Department having jurisdiction.

2. Manufacturer: Subject to compliance with requirements, provide identification markers of one of the following (pending approval of local water authority having jurisdiction):
 - a. Cla-Val Co.
 - b. Febco
 - c. Hersey Products, Inc.
 - d. Watts Regulator Co.
 - e. Basis of Design: Zurn Industries Inc. Wilkins Regulators Div.: Wilkins Model 375ADA Reduced Pressure Detector Assembly: www.zurn.com.

3. Substitutions: See Section 01 60 00 - Product Requirements.

D. Meter:

1. Comply with AWWA C700. Acceptable manufacturers, or equal.
2. Acceptable manufacturers:
 - a. Western Water Meter Inc.
 - b. Rockwell International Corp.
 - c. Hersey Products Inc.
3. Water meter shall be:
 - a. Flanged multi-jet turbine type.
 - b. Meet the requirements of local water department.
4. The meter housing shall be bronze with brass case and lid.
5. Meter chamber shall be molded and corrosion resistant and shall have a sapphire rotor bearing. The meter register shall be vacuum sealed in copper housing with magnetic coupling. It shall have a leak indicator and heat tempered glass.
6. Concrete Meter Box: Meter boxes shall be Brooks Concrete Works Series 3 through 37 meter box, standard meter vault or 300 Series meter vault, or equal, as required by local water department.

E. Identification

1. Underground-Type Plastic Line Marker: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide blue tape with black printing reading "CAUTION WATER LINE BURIED BELOW".

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SITE WATER DISTRIBUTION PIPING

- a. Manufacturer: Subject to compliance with requirements, provide identification markers of one of the following:
 - 1) Allen Systems Inc.
 - 2) Seton Name Plate Corp.
 - 3) Northtown Co.
- b. Substitutions: See Section 01 60 00 - Product Requirements.
- 2. Nonmetallic Piping Label: If nonmetallic piping is used for water service, provide engraved plastic laminate, label permanently affixed to main electrical meter panel stating "THIS STRUCTURE HAS A NONMETALLIC WATER SERVICE".
- F. Corrosivity Protection: All underground metallic pipe and fittings shall be protected against corrosive soil by wrapping with 8 mil minimum polyethylene sheet.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.
- B. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.3 TRENCHING

- A. See the sections on excavation and fill for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide 4 sq ft (1.5 sq m) thrust restraint bearing on subsoil.
- D. Do not backfill until installation has been approved and as-built drawings are up to date. Promptly install all piping after excavation or cutting for same has been done, so as to keep the excavations open as short a time as possible.
- E. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.4 INSTALLATION - PIPE

SECTION 33 11 16
SITE WATER DISTRIBUTION PIPING

- A. General: During back-filling/top-soiling of underground potable water piping, install continuous underground-type plastic line markers located directly over buried lines at 6" to 8" below finished grade.
- B. Maintain separation of water main from sewer piping in accordance with plumbing code.
- C. Group piping with other site piping work whenever practical.
- D. Establish elevations of buried piping to ensure not less than 3 ft (0.9 m) of cover.
- E. Install pipe to indicated elevation to within tolerance of 5/8 inches (20 mm).
- F. Install ductile iron piping and fittings to AWWA C600.
- G. Polyvinyl Chloride Pipe: Install in accordance with manufacturer's installation instructions.
 - 1. Pressure water lines (4 inch (102 mm) and larger): Install in accordance with pipe manufacturers recommendations, or as shown in J-M Installation Guide "Ring-Tite PVC Pipe". Provide thrust blocks as required by "J-M Installation Guide".
- H. Route pipe in straight line.
- I. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- J. Install access fittings to permit disinfection of water system performed under Section 33 13 00.
- K. Slope water pipe and position drains at low points.
- L. Install trace wire 6 inches (150 mm) above top of pipe; coordinate with Section 31 23 16.13.
- M. Provide and install 14-gauge copper "Tracer" wire, continuous for entire length, for all underground non-metallic piping. Secure to piping at alternate joints, at each fitting and at each valve. Locate "Tracer" wire alongside pipe, but not under pipe.
- N. Installation of identification: During back-filling/top-soiling of underground water piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade.

3.5 INSTALLATION - VALVES AND HYDRANTS

- A. Check operation of all valves before installing. Install valves true to line and grade. Install valves in accordance with AWWA 600 and manufacturer's written instructions. Wrap all buried, ferrous metal valves with polyethylene film in conformance with Section 5-4 of AWWA C105.
- B. Set valves on solid bearing.
- C. Install valves as indicated with stems pointing up. Provide valve box over underground valves.
- D. Center and plumb valve box over valve. Set box cover flush with finished grade.

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- E. UL/FM-Type Fire Hydrants: Comply with NFPA 24. Install with gate valve and provision for drainage as indicated.
- F. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway.
- G. Set hydrants to grade, with nozzles at least 20 inches (500 mm) above ground.
- H. Locate control valve 4 inches (100 mm) away from hydrant.
- I. Provide a drainage pit 36 inches (900 mm) square by 24 inches (600 mm) deep filled with 2 inches (50 mm) washed gravel. Encase elbow of hydrant in gravel to 6 inches (150 mm) above drain opening. Do not connect drain opening to sewer.
- J. Paint hydrants in accordance with Section 09 90 00.
- K. Fire Department Connections: Install in accordance with AWWA 600-82 and manufacturers written instructions.

3.6 INSTALLATION OF WATER METERS

- A. Install water meter in accordance with AWWA 600-82 and/or utility company's installation instructions and requirements. Check operation of all meters before operation. Install meter boxes where indicated.
- B. Size meter and arrange piping and specialties to comply with utility company's requirements.
- C. Set meter on concrete pad as indicated. Refer to Division 3 for concrete, formwork, and reinforcing requirements.
- D. Mount meter on wall brackets as indicated.

3.7 ROUGH-IN FOR WATER METER

- A. Install rough-in piping and specialties for water meter installation in accordance with utility company's instructions and requirements.

3.8 ANCHORAGE INSTALLATION

- A. Provide anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches.

3.9 INSTALLATION OF BACKFLOW PREVENTER

- A. Install backflow preventers at each connection to mechanical equipment and systems and in compliance with the plumbing code and authority having jurisdiction. Install air cap fitting and pipe relief outlet drain without valves to nearest floor drain. Identify all piping downstream of backflow preventers as "industrial water".
- B. Install pressure-regulating valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gage on valve outlet.

3.10 CORROSION PROTECTIVE COATING APPLICATION

- A. Steel Pipe or Valve Assemblies:
 1. Implement all the following measures:

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- a. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.
- b. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:
 - 1) At each end of the pipeline.
 - 2) At each end of all casings.
 - 3) Other locations as necessary so the interval between test stations does not exceed 1,200 feet.
- c. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically isolate each buried steel pipeline per NACE Standard SP0286 from:
 - 1) Dissimilar metals.
 - 2) Dissimilarly coated piping (cement-mortar vs. dielectric).
 - 3) Above ground steel pipe.
 - 4) All existing piping.
- d. Choose one of the following corrosion control options:

OPTION 1

- 1) Apply a suitable dielectric coating intended for underground use such as:
 - (a) Polyurethane per AWWA C222; or
 - (b) Extruded polyethylene per AWWA C215; or
 - (c) A tape coating system per AWWA C214; or
 - (d) Hot applied coal tar enamel per AWWA C203; or
 - (e) Fusion bonded epoxy per AWWA C213.
- 2) Apply cathodic protection to steel piping as per NACE Standard SP0169.

OPTION 2

- 3) As an alternative to dielectric coating and cathodic protection, apply a $\frac{3}{4}$ -inch cement mortar coating per AWWA C205 or encase in concrete 3 inches thick, using any type of cement. Joint bonds, test stations, and insulated joints are still required for these alternatives.

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2. NOTE: Some steel piping systems, such as for oil, gas, and high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

B. Iron Pipe or Valve Assemblies:

1. Implement all the following measures:
 - a. Electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE Standard SP0286.
 - b. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.
 - c. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:
 - 1) At each end of the pipeline.
 - 2) At each end of any casings.
 - 3) Other locations as necessary so the interval between test stations does not exceed 1,200 feet.
 - d. Choose one of the following corrosion control options:

OPTION 1

 - 1) Apply a suitable coating intended for underground use such as:
 - (a) Polyethylene encasement per AWWA C105; or
 - (b) Epoxy coating; or
 - (c) Polyurethane; or
 - (d) Wax tape.
 - 2) NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.
 - 3) Apply cathodic protection to cast and ductile iron piping as per NACE Standard SP0169.

OPTION 2

 - 4) As an alternative to coating systems described in Option 1 and cathodic protection, concrete encase all buried portions of metallic piping so that there is a minimum of 3 inches of concrete cover provided over and around surfaces of pipe, fittings, and valves using any type of cement.

C. Plastic and Vitrified Clay Pipe

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1. No special precautions are required for plastic and vitrified clay piping placed underground from a corrosion viewpoint.
2. Protect all metallic fittings and valves with wax tape per AWWA C217 or epoxy.

D. All Pipe or Valve Assemblies:

1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.
2. Where metallic pipelines penetrate concrete structures, such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

E. Concrete

1. From a corrosion standpoint, any type of cement may be used for concrete structures and pipe because the sulfate concentration is negligible, 0 to 0.1 percent. (American Concrete Institute (ACI-318) Table 4.3.1)
2. Standard concrete cover over reinforcing steel may be used for concrete structures and pipe in contact with these soils due to the low chloride concentration found onsite. (Design Manual 303: Concrete Cylinder Pipe. Ameron p.65)

3.11 IDENTIFICATION INSTALLATION

- A. During backfilling/top-soiling of underground water piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6 to 9 inches below finished grade.
- B. Attach nonmetallic piping label permanently to main electrical meter panel.

3.12 SERVICE CONNECTIONS

- A. Provide water service to utility company requirements with reduced pressure backflow preventer and water meter with by-pass valves and sand strainer.
- B. Tap water main with size and in location as indicated, in accordance with requirements of water agency standards.
- C. Connections to Plumbing Systems: Make connections of service laterals to plumbing facilities at a location 5 feet outside the building line as indicated. Connections shall be made utilizing standard prefabricated adapters installed in accordance with the pipe manufacturer's recommendations.

3.13 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.
- B. Test valves for leakage and alignment prior to backfilling.
- C. Conduct piping tests before joints are covered, and after thrust blocks have sufficiently hardened. Fill pipeline 24-hrs. prior to testing and apply test pressure to stabilize system. Use only potable water.

SECTION 33 11 16
SITE WATER DISTRIBUTION PIPING

- D. Pressure test water piping to 200 psi (1380 kPa).
 - 1. PVC Water Pipelines: Test all water lines in accordance with manufacturers recommendations.
 - a. Test pipe in accordance with Division 22 - Plumbing.
 - 2. Increase pressure in 50 psi increments and inspect each joint between increments. Hold at test pressure for one hour, decrease to 0 psi. Slowly increase again to test pressure and hold for one more hour.
 - 3. Test fails if leakage exceeds 2-qts per hour per 100 gaskets or joints, irrespective of pipe diameter.
- E. Fire Department Connections: On-site fire department connections shall be tested by the Contractor as directed by the Fire Department having jurisdiction. Perform all tests in the presence of the assigned Inspector.
- F. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- G. Submit the completed and approved NFPA Certificate as indicated under Submittals in this section.

3.14 CLEANING

- A. Clean and disinfect water-distribution piping as indicated in Section 33 13 00 - Disinfection of Water Distribution Systems.

END OF SECTION

SECTION 33 13 00
DISINFECTING OF WATER UTILITY DISTRIBUTION

SECTION 33 13 00 – DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Disinfection of site domestic water lines and site fire water lines specified in Section 33 11 16.
- B. Disinfection of building domestic water piping specified in Division 22.
- C. Testing and reporting results.

1.2 RELATED REQUIREMENTS

- A. Division 22 - Plumbing; Plumbing Piping: Disinfection of building domestic water piping system.
- B. Section 33 11 16 - Site Water Distribution Piping.

1.3 REFERENCE STANDARDS

- A. AWWA B300 - Hypochlorites; American Water Works Association; 2011 (ANSI/AWWA B300).
- B. AWWA B301 - Liquid Chlorine; American Water Works Association; 2010 (ANSI/AWWA B301).
- C. AWWA B302 - Ammonium Sulfate; American Water Works Association; 2010 (ANSI/AWWA B302).
- D. AWWA B303 - Sodium Chlorite; American Water Works Association; 2010.
- E. AWWA C651 - Disinfecting Water Mains; American Water Works Association; 2005 (ANSI/AWWA C651).

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Test Reports: Indicate results comparative to specified requirements.
- C. Certificate: From authority having jurisdiction indicating approval of water system.
- D. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.
- E. Disinfection report:
 1. Type and form of disinfectant used.
 2. Date and time of disinfectant injection start and time of completion.
 3. Test locations.

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4. Initial and 24-hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
5. Date and time of flushing start and completion.
6. Disinfectant residual after flushing in ppm for each outlet tested.

F. Bacteriological report:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24-hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certification that water conforms, or fails to conform, to bacterial standards of the County in which the project lies.

1.5 QUALITY ASSURANCE

- A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum three years documented experience.
- B. Testing Firm: Company specializing in testing potable water systems, certified by governing authorities of California.
- C. Submit bacteriologist's signature and authority associated with testing.

PART 2 - PRODUCTS

2.1 DISINFECTION CHEMICALS

- A. Chemicals: AWWA B300, Hypochlorite, AWWA B301, Liquid Chlorine, AWWA B302, Ammonium Sulfate, and AWWA B303, Sodium Chlorite.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that piping system and water well has been cleaned, inspected, and pressure tested.
- B. Schedule disinfecting activity to coordinate with start-up, testing, adjusting and balancing, demonstration procedures, including related systems.

3.2 DISINFECTION

- A. Use method prescribed by the applicable state or local codes, or health authority or water purveyor having jurisdiction, or in the absence of any of these follow AWWA C651.

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DISINFECTION OF WATER UTILITY DISTRIBUTION

- B. Provide and attach equipment required to perform the work.
- C. Inject treatment disinfectant into piping system.
- D. Maintain disinfectant in system for 24 hours.
- E. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.
- F. Replace permanent system devices removed for disinfection.
- G. Pressure test system to 120 psi (827 kPa). Repair leaks and re-test.

3.3 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.
- B. Test samples in accordance with AWWA C651.

END OF SECTION

SECTION 33 13 00
DISINFECTING OF WATER UTILITY DISTRIBUTION

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SECTION 33 31 11 - SITE SANITARY SEWERAGE PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Sanitary sewerage system piping and appurtenances from a point 5 feet outside the building to the point of disposal.
- B. Sanitary sewerage drainage piping, fittings, and accessories.
- C. Connection of building sanitary drainage system to municipal sewers.
- D. Cleanout Access.

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Supply of connection devices to building piping for placement by this Section.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete for cleanout base pad construction.
- B. Section 31 23 16 - Excavation: Excavating of trenches.
- C. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- D. Section 31 23 23 - Fill: Bedding and backfilling.
- E. Section 33 05 13 - Manholes and Structures.

1.04 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.05 REFERENCE STANDARDS

- A. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2009).
- B. ASTM C425 - Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings; 2004 (Reapproved 2013).
- C. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2012.
- D. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections; 2012.
- E. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2014.
- F. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2008.

- G. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2011.
- H. ASTM D2564 - Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems; 2004 (Reapproved 2009).
- I. ASTM D3034 - Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings; 2014.
- J. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals; 2007 (Re-approved 2013)
- K. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2010.
- L. Standard Specifications for Public Works Construction (Greenbook).
- M. Agency requirements.

1.06 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of sewer line with size, location and installation of service utilities.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.07 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories.
- C. Shop Drawings:
 - 1. For pre-cast concrete sanitary manholes, including frames and covers.
- D. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Project Record Documents:
 - 1. Submit documents under provisions of Section 01 78 00 - Closeout Submittals.
 - 2. Record location of pipe runs, connections, catch basins, cleanouts, and invert elevations.
 - 3. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.08 REGULATORY REQUIREMENTS

- A. Conform to applicable code for materials and installation of the Work of this section.
- B. Comply with requirements of Uniform Plumbing Code, Health Department, and Authorities having jurisdiction.
- C. Utility Compliance: Comply with local utility regulations and standards pertaining to sanitary sewerage systems.
- D. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to sanitary sewerage systems.
- E. Permits: Obtain all required permits in name of Owner.

1.09 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that storm sewerage system piping may be installed in compliance with original design and referenced standards.
 - 1. Locate existing sanitary sewerage system piping and structures that are to be abandoned and closed.

1.10 SEQUENCING AND SCHEDULING

- A. Coordinate connection to public sewer with utility company.
- B. Coordinate with interior building sanitary drainage piping.
- C. Coordinate with other utility work.

PART 2 - PRODUCTS

2.01 SEWER PIPE MATERIALS

- A. Provide products that comply with applicable code(s).
- B. General: Provide pipe and pipe fitting materials compatible with each other. Where more than one type of materials or products is indicated, selection is Installer's option.
- C. Plastic Pipe: ASTM D3034, Type SDR35, Polyvinyl Chloride (PVC) material; inside nominal diameter of 4 to 8 inches (100 to 200 mm), bell and spigot style solvent sealed joint end.
 - 1. Solvent Cement: ASTM D2564
 - 2. Gaskets: ASTM F477, elastomeric seal.
 - 3. Pipe Joints: ASTM D3212
- D. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required wyes, bends, cleanouts, reducers, traps and other configurations required.

2.02 PIPE ACCESSORIES

- A. Cleanouts: Provide cast-iron ferrule and countersunk brass cleanout plug, with round cast-iron access frame and heavy-duty, secured, scoriated cast iron cover.
 - 1. Acceptable Manufacturers:

- a. Ancon, Inc.
- b. Josam Co.
- c. Smith (Jay R.) Mfg. Co.
- d. Wade Div.; Tyler Pipe.
- e. Zurn Industries, Inc.; Hydromechanics Div.
- B. Tracer Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Sewer Service" in large letters.
- C. Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid green in color with continuously printed caption in black letters "CAUTION - SEWER LINE BURIED BELOW."
 - 1. Allen Systems, Inc.; Reef Industries, Inc.
 - 2. Brady (W.H.) Co.; Signmark Div.
 - 3. Calpico, Inc.
 - 4. Carlton Industries, Inc.
 - 5. EMED Co., Inc.
 - 6. Seton Name Plate Co.
 - 7. Northtown Co.
- D. Couplings: Rubber or elastomeric compression gasket, made to match pipe inside diameter or hub, and adjoining pipe outside diameter.
 - 1. Gaskets: ASTM C425, rubber for vitrified clay pipe; ASTM C443, rubber for concrete pipe; ASTM C564, rubber for cast-iron soil pipe; and ASTM F477, elastomeric seal for plastic pipe. Gaskets for dissimilar or other pipe materials shall be compatible with pipe materials being jointed.
- E. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required wyes, bends, cleanouts, reducers, traps and other configurations required.
- F. Corrosivity Protection: All underground metallic pipe and fittings shall be protected from corrosive soils by 8 mil minimum polyethylene sheet.

2.03 MANHOLES

- A. Manholes shall conform to sewer agency Standard Drawings and the SPPWC.
- B. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, heavy-duty, ductile iron, 24-inch inside diameter by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter cover, indented top design, with lettering "SANITARY SEWER" cast into cover.
- C. Lid and Frame: Cast iron construction, hinged lid.
 - 1. Nominal Lid and Frame Size: 26 inches (660 mm).
- D. Pre-cast Concrete Manholes: ASTM C 478 pre-cast reinforced concrete, of depth indicated with provision for rubber gasket joints.
 - 1. Base Section: 12-inch minimum thickness for floor slab and 4.125-inch minimum thickness for walls and base riser section, and having a separate base slab or base section with integral floor.

2. Riser Sections: 4.125-inch minimum thickness; 48-inch diameter, and lengths to provide depth indicated.
3. Top Section: Eccentric cone type, unless concentric cone or flat-slab-top type is indicated. Top of cone to match grade rings.
4. Grade Rings: Provide 2 or 3 reinforced concrete rings, of 6 to 9 inches total thickness and match 24-inch diameter frame and cover.
5. Gaskets: ASTM C 443, rubber.
6. Steps: Cast into base, riser, and top sections sidewall at 12- to 16-inch intervals.
7. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
8. Channel and Bench: Concrete.

E. Base Pad: Cast-in-place concrete of type specified in Section 03 30 00, levelled top surface to receive concrete shaft sections, sleeved to receive sanitary sewer pipe sections.

2.04 BEDDING AND COVER MATERIALS

- A. Pipe Bedding Material: As specified in Division 31 - Earthwork and applicable Agency Standards.
- B. Pipe Cover Material: As specified in Division 31 - Earthwork and applicable Agency Standards.

PART 3 - EXECUTION

3.01 GENERAL

- A. Perform work in accordance with applicable code(s).

3.02 TRENCHING

- A. See Division 31 - Earthwork for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
 1. Correct over excavation in accordance with the Section in Division 31.
 2. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.
- C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.
- D. If during the installation of pipe, the trench material, backfill material is found to be unsuitable, as determined by the Engineer, it shall be removed and replaced by crushed rock as defined by SSPWC 200-2.2 or 200-2.3 except that minimum sand equivalent value shall be 30. Any excess material that is generated by this process shall be disposed of by the Contractor at no additional cost to the Owner.
- E. Bedding:

SECTION 33 31 11
SITE SANITARY SEWERAGE PIPING

1. Excavate pipe trench in accordance with the Section in Division 31 for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
2. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth, compact to 95 percent.
3. Maintain optimum moisture content of bedding material to attain required compaction density.

3.03 EXAMINATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.
- C. Unless specified otherwise, all buried piping shall have coverage of at least three feet between top of pipe and finished grade.

3.04 INSTALLATION, GENERAL

- A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of the underground sanitary sewerage system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical.
- B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements.
- C. Use fittings for branch connections, except where direct tap into existing sewer or manhole is indicated.
- D. Use proper size increasers and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- E. Install piping pitched down in direction of flow, at minimum slope of 2 percent, except where indicated otherwise.
 1. Place bell ends of piping facing upstream.
- F. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking, or a combination of both.
- G. No pipe shall be laid in water and all costs for drainage and/or dewatering trenches during construction shall be borne by the Contractor.

3.05 INSTALLATION - PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Pipe Applications for Underground Sanitary Sewers
 1. Pipe Sizes 15 inches and Smaller: PVC gasket joint sewer pipe and fittings.

2. Pipe Sizes 1-1/2 to 10 Inches: Hubless cast-iron soil pipe and fittings.
- C. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 1. Plastic Pipe: Also comply with ASTM D2321.
 2. Pipe shall be assembled by hand or by use of a bar and block or by lever puller. No swinging or stabbing shall be permitted. The "popping-on" of joints is expressly forbidden. All bell and spigot type connection shall be marked on the spigot end to indicate full insertion.
- D. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch (3 mm) in 10 feet (3 m).
- E. Connect to building sanitary sewer outlet and municipal sewer system, through installed sleeves.
- F. Install trace wire 6 inches (150 mm) above top of pipe; coordinate with the Section in Division 31- Earthwork.

3.06 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. Join and install hubless cast iron soil pipe and fittings, with "Best" or "MG" cast-iron couplings with neoprene gaskets. Stainless steel couplings not acceptable below grade.
- B. Join and install PVC pipe as follows:
 1. Pipe and gasketed fittings, joining with elastomeric seals in accordance with ASTM D3312.
 2. Installation in accordance with ASTM D2321.
- C. Join different types of pipe with standard manufactured couplings and fittings intended for that purpose.

3.07 INSTALLATION MANHOLES

- A. Install manholes complete with accessories as indicated. Form continuous concrete or split pipe section channels and benches between inlets and outlet. Set tops of frames and covers flush with finish surface where manholes occur in pavements. Elsewhere, set tops 3 inches above finish surface, unless otherwise indicated.
- B. Place pre-cast concrete manhole sections as indicated, and install in accordance with ASTM C 891.
- C. Provide rubber joint gasket complying with ASTM C 443 at joints of sections.
- D. Apply bituminous mastic coating at joints of sections.

3.08 INSTALLATION - CLEANOUTS

- A. Install cleanouts and extension from sewer pipe to cleanout at grade as indicated. Set cleanout frame and cover in concrete block 18 by 18 by 12 inches deep, except where location is in concrete paving. Set top of cleanout 1 inch above surrounding earth grade or flush with grade when installing in paving.
 1. Provide as shown on plans or as required by UPC.

- B. Form bottom of excavation clean and smooth to correct elevation.
- C. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.
- D. Establish elevations and pipe inverts for inlets and outlets as indicated.
- E. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.09 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work.
- B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of 3000 psi 28-day compressive-strength concrete.
- C. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

3.10 CLOSING ABANDONED SANITARY SEWERAGE SYSTEM

- A. Abandoned Piping: Close open ends of abandoned underground piping that is indicated to remain in place. Provide sufficiently strong closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.
 - 1. Close open ends of concrete or masonry utilities with not less than 8-inch-thick brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Wood plugs are not acceptable.
- B. Abandoned Structures: Remove structure and close open ends of the remaining piping, or remove top of structure down to not less than 3 feet below final grade; fill structure with stone, rubble, gravel, or compacted dirt, to within 1 foot of top of structure remaining and fill concrete.

3.11 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.
- B. Perform testing of completed piping in accordance with local authorities having jurisdiction.
- C. Request inspection prior to and immediately after placing bedding.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- E. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
 - 1. Make inspections after pipe between manholes and manhole locations has been installed and approximately 2 feet of backfill is in place, and again at completion of project.

2. All sewer mains constructed and to become part of the public sewer system shall be digitally recorded by the jurisdictional agency prior to acceptance of the sewer system for maintenance by the agency.
3. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects correct such defects, and reinspect.
4. If requested by local utility, provide video recording of visual interior inspection.
5. Reinspect after any corrections.

3.12 CLEANING

- A. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 1. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
 2. Flush piping between manholes, if required by local authority, to remove collected debris.

3.13 PROTECTION

- A. Protect finished installation under provisions of Section 01 50 00 - Temporary Facilities and Controls.
- B. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 31 11
SITE SANITARY SEWERAGE PIPING

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SECTION 33 41 11 - SITE STORM DRAINAGE SYSTEM

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Storm drainage piping, fittings, and accessories.
- B. Connection of drainage system to municipal sewers.
- C. Catch basins, Trench drains, Plant area drains, Paved area drainage, Site surface drainage, Detention tank, and Detention basin.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete for cleanout base pad construction.
- B. Section 31 22 00 - Grading.
- C. Section 31 23 16 - Excavation: Excavating of trenches.
- D. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- E. Section 31 23 23 - Fill: Bedding and backfilling.
- F. Section 33 05 13 - Manholes and Structures.

1.3 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.4 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
- D. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2014.
- E. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Metric]; 2014.
- F. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2012.
- G. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric); 2011.

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- H. ASTM D1784 - Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds; 2011.
- I. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2011.
- J. ASTM D2729 - Standard Specification for Polyvinyl Chloride (PVC) Sewer Pipe and Fittings; 2011.
- K. ASTM D3034 - Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings; 2014.
- L. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals; 2007 (Re-approved 2013).
- M. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014.
- N. ASTM F2648 – Standard Specification for High-Density Polyethylene (HDPE) for pipe and fittings.
- O. ASTM F2787 - Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers; 2013.
- P. ASTM F2922 - Standard Specification for Polyethylene (PE) Corrugated Wall Stormwater Collection Chambers; 2013e1.
- Q. DIN 19580 - Drainage Channels for Vehicular and Pedestrian Areas - Durability, Mass per Unit Area and Evaluation of Conformity; 2010.
- R. Greenbook: Standard Specifications for Public Works Construction; Latest edition as adopted by local jurisdiction.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of storm drainage with size, location, and installation of service utilities.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.6 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories.
- C. Shop Drawings:
 - 1. For pre-cast concrete manholes, including frames and covers.

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2. For cast-in-place concrete or field-erected masonry sanitary manholes, including frames and covers.
3. Coordination profile drawings showing drainage system piping in elevation. Draw profiles at a horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate pipe and underground structures. Show types, sizes, materials, and elevations of other utilities crossing drainage system piping.
4. Detention Tank:
 - a. Provide product data and shop drawings indicating the design capacity, layout, per the manufacturer's product design manual and ASTM F2787.
 - b. Indicate: Depth of perimeter stone above, below, and around chamber,
 - c. A structural evaluation by a registered structural engineer that demonstrates that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met.
 - 1) The 50-year creep modulus data specified in ASTM F2922 must be used as a part of the AASHTO structural evaluation to verify long-term performance.
 - d. All design specifications for chambers shall be in accordance with the manufacturer's latest design manual.
- D. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- E. Project Record Documents:
 1. Submit documents under provisions of Section 01 78 00 - Closeout Submittals.
 2. Record location of pipe runs, connections, catch basins, cleanouts, and invert elevations.
 3. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for materials and installation of the Work of this section.
- B. Comply with requirements of California Plumbing Code and Authorities Having Jurisdiction.
- C. Utility Compliance: Comply with local utility regulations and standards pertaining to storm drainage systems.
- D. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to storm drainage systems.

1.8 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that storm drainage system piping may be installed in compliance with original design and referenced standards.

1. Locate existing storm drainage system piping and structures that are to be abandoned and closed.

1.9 SEQUENCING AND SCHEDULING

- A. Coordinate connection to public storm sewer with utility company.
- B. Coordinate with interior building storm drainage piping.
- C. Coordinate with other utility work.

PART 2 – PRODUCTS

2.1 DRAINAGE PIPE MATERIALS

- A. Provide products that comply with applicable code(s).
- B. Concrete Pipe: Reinforced, ASTM C76 (ASTM C76M), Class IV with Wall type A; mesh reinforcement; inside nominal diameter of 18 to 24 inches (460 to 610 mm), bell and spigot end joints.
- C. Reinforced Concrete Pipe Joint Device: ASTM C443 (ASTM C443M) rubber compression gasket joint.
- D. Plastic Pipe: ASTM D3034, SDR 35, Type PSM, Polyvinyl Chloride (PVC) material; inside nominal diameter of 4-15 inches (100 to 380 mm), bell and spigot style solvent sealed joint end.
 1. Bell and spigot style, push on joints and molded rubber gaskets
 2. Maximum pipe length 20 feet.
- E. Plastic Pipe: ASTM D 3034, Type PSM, SDR 35 Polyvinyl Chloride (PVC) material; inside nominal diameter of 4 to 15 inches (100 to 380 mm).
 1. Bell and spigot style, push on joints and molded rubber gaskets
 2. Maximum pipe length 20'.
- F. Plastic Pipe: ASTM D 679, Polyvinyl Chloride (PVC) material; inside nominal diameter of 18 to 27 inches (457 to 686 mm).
 1. Bell and spigot style, push on joints and molded rubber gaskets
 2. Maximum pipe length 20 feet.
- G. Plastic Pipe: ASTM F2648, Watertight (WT), High-Density Polyethylene (HDPE) material: inside: nominal diameter of 4 to 60 inches.

Bell and spigot watertight gasketed joint per ASTM D3212
Fittings shall conform to ASTM F2306
Watertightness shall be in accordance with ASTM F2487
12 to 60 inch pipe shall have an exterior bell wrap installed by the manufacturer

H. Refer to Drawings for additional information

2.2 PIPE ACCESSORIES

- A. Pipe Joints: Mechanical clamp ring type, stainless steel expanding and contracting sleeve, neoprene ribbed gasket for positive seal.
- B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required wyes, bends, cleanouts, reducers, traps and other configurations required.
- C. Filter Fabric: Non-biodegradable, woven. Provide 315ST manufactured by Advanced Drainage Systems, Inc.: www.ads-pipe.com.
- D. Tracer Wire: UL Listed Single conductor, Type UF solid copper with polyvinyl (PVC) insulation.
- E. Magnetic Tape:

2.3 CATCH BASIN, TRENCH DRAIN, CLEANOUT, AND AREA DRAIN COMPONENTS

- A. Reinforced cast-in-place concrete, nominal shaft dimension as indicated on Drawings.
- B. Lids and Drain Covers: Cast iron, hinged to cast iron frame.
 - 1. Catch Basin:
 - a. Lid Design: Linear grill.
 - b. Nominal Lid and Frame Size: As indicated on Drawings.
 - 2. Cleanout:
 - a. Lid Design: Checkerboard grill.
 - b. Nominal Lid and Frame Size: As indicated on Drawings.
 - 3. Area Drain:
 - a. Lid Design: Linear grill.
 - b. Nominal Lid and Frame Size: As indicated on Drawings.
- C. Sediment Filter: Provide sediment filter compliant with BMP practice for NPDES II, as indicated on Drawings.
 - 1. Product: Storm Water Sediment Control Grate Insert manufactured by Transpo Industries, Inc.: www.transpo.com
- D. Drain Basin for Drainage Retention System:
 - 1. General
 - a. PVC surface drainage inlets shall include the drain basin type as indicated on the contract drawing and referenced within the contract specifications.
 - b. The ductile iron grates for each of these fittings are to be considered an integral part of the surface drainage inlet and shall be furnished by the same manufacturer.

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SITE STORM DRAINAGE SYSTEM**

c. The surface drainage inlets shall be as manufactured by Nyloplast a division of Advanced Drainage Systems, Inc., or prior approved equal.

2. Materials

a. Drain Basins: PVC pipe stock, utilizing a thermoforming process to reform the pipe stock to the specified configuration.

b. Drainage Pipe Connection Stubs: PVC pipe stock and formed to provide a watertight connection with the specified pipe system.

c. Joints: Conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals.

- 1) The flexible elastomeric seals shall conform to ASTM F477.
- 2) The pipe bell spigot shall be joined to the main body of the drain basin or catch basin.

d. Surface Drainage Inlets Main Body and Pipe Stubs: Conform to ASTM D1784 cell class 12454.

e. The grates and frames furnished for all surface drainage inlets shall be ductile iron.

- 1) Fabricate specifically for each basin so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet.
- 2) Grates for drain basins shall be capable of supporting various wheel or live loads as indicated by location.
 - (a) H-20.
- 3) 12 inch (300 mm) and 15 inch (380 mm) square grates will be hinged to the frame using pins.
- 4) Ductile iron used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05.
- 5) Grates and covers shall be provided painted black.

E. Trench Drain System: Trench drain system assembled from factory fabricated, polymer concrete castings in standard lengths and variable depths, with integral joint flanges and integral grating support rails; includes joint gaskets and grating.

1. Basis of Design: ACO Polymer Products, Inc., KlassikDrain; Model as indicated on Drawings: www.aco-online.com.
2. Load Class: DIN 19580, Class E.
3. Grating Material and Style: ADA Standards compliant ductile iron.
4. Basis of Design: ACO Polymer Products, Inc., SlabDrain; Model as indicated on Drawings: www.aco-online.com.
5. Load Class: DIN 19580, Class A.
6. Grating Material and Style: ADA Standards compliant ductile iron.
7. Basis of Design: ACO Polymer Products, Inc., FlowDrain; Model as indicated on Drawings: www.aco-online.com.
8. Load Class: DIN 19580, Class A.
9. ADA Standards compliant.
10. Grating Material and Style: ADA Standards compliant slotted ductile iron.

11. Basis of Design: ACO Polymer Products, Inc., PowerDrain; Model as indicated on Drawings: www.aco-online.com.
12. Load Class: DIN 19580, Class D.
13. Grating Material and Style: ADA Standards compliant slotted ductile iron.
14. Basis of Design: ACO Polymer Products, Inc., ACO Sport; Model System 3000 - Track Trench Drainage: www.aco-online.com.
15. Load Class: DIN 19580, Class A.
16. ADA Compliant.
17. Grating Material and Style: ADA compliant slotted ductile iron.
18. ADA Compliant.
20. Trench Width: As indicated on Drawings.
21. Trench Section Length: 39 inches (1 m), and 19-1/2 inches (500 mm).
22. Grating Support Rail: Stainless steel.
23. Accessories:
 - a. Oval to round pipe connection.
 - b. Vertical outlet strainer.

2.4 DETENTION TANK / RETENTION BASIN

- A. Storm water/drainage retention chambers are designed to control storm water runoff.
- B. As a subsurface retention system, storm water/drainage retention chambers retain and allow effective infiltration of water into the soil.
- C. As a subsurface detention system, storm water/drainage retention chambers hold and allow for the metered flow of water to an outfall.
- D. Arch shaped underground storm water storage chamber in a gravel pit:
 1. Manufacturer: Stormtech: www.stormtech.com
 - a. Model: SC-740.
 - b. Size (L x W x H): 85.4 x 51.0 x 30.0 inches (2170 x 1295 x 762 mm).
 - c. Chamber Storage / Maximum Installed Storage*: 45.9 / 74.9 cu.ft. (1.3 / 2.12 cu.m)
*Assumes 6-inch (150 mm) stone above, below and between chambers and 40% stone porosity. The nominal storage volume of all storm water/drainage retention chambers includes the volume of the clean, crushed, angular stone.
 - d. Provide matching end cap.

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2. Live Load Rating: AASHTO LRFD HS-20.
3. The structural design of the chambers, the structural backfill and the installation requirements shall ensure that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met for:
 - a. Long-Duration Dead Loads; and
 - b. Short-duration live loads, based on the AASHTO design truck with consideration for impact and multiple vehicle presence.
 - c. Design shall consider earth and live loads as appropriate for the minimum to maximum specified depth of fill.
4. Chamber Construction:
 - a. The chamber shall be injection molded of an impact modified polypropylene per ASTM F2418 or polyethylene copolymer per ASTM F2922 to maintain adequate stiffness through higher temperatures experienced during installation and service.
 - b. Chambers shall be designed in accordance with ASTM F2787.
 - c. Chambers shall be designed in accordance with ASTM F2418.
 - d. The chamber shall have a continuously curved section profile.
 - e. The chamber shall be open-bottomed.
 - f. The chamber shall incorporate an overlapping corrugation joint system to allow chamber rows of almost any length to be created.
 - 1) The overlapping corrugation joint system shall be effective while allowing a chamber to be trimmed to shorten its overall length.
 - g. Chamber rows shall provide continuous, unobstructed internal space with no internal support panels.
 - h. Chambers shall have forty-eight orifices penetrating the sidewalls to allow for lateral conveyance of water.
 - i. Chamber shall have two orifices near its top to allow for equalization of air pressure between its interior and exterior.
 - j. Chamber shall have both of its ends open to allow for unimpeded hydraulic flows and visual inspections down a row's entire length.
 - k. Chamber shall have 14 corrugations.
 - l. Provide on the top of the chamber a 4-inch (100 mm) diameter inspection port to grade.
 - 1) Product: Nyloplast 12 inch (300 mm) inline drain body with 12 inch (300 mm) solid hinged cover and frame, with concrete collar (4 inch (100 mm) 4 inch (100 mm) thick by minimum 36" cross dimension) with 4 inch (100 mm) schedule 40 screw-in cap. Provide 4 inch (100 mm) schedule 40 PVC pipe into chamber.
5. End Cap Construction
 - a. End cap to fit into any corrugation of a chamber, allowing capping of a chamber that has its length trimmed; segmenting rows into storage basins of various lengths.
 - b. Provide saw guides for cutting for various diameters of pipe used to inlet the system.
 - 1) End cap shall have structural capacity to allow cutting an orifice of any size at any invert elevation.

- c. Curve primary face of each end cap outward to resist horizontal loads generated near the edges of beds.
- E. Geotextile Filter Fabric: Non-biodegradable, non-woven, AASHTO M288 Class 2. Provide Geosynthetics 601T manufactured by ADS Advanced Drainage Systems, Inc.; www.ads-pipe.com.

2.5 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 31 23 16.13.
- B. Cover: As specified in Section 31 23 23.

PART 3 – EXECUTION

3.1 TRENCHING

- A. See Section 31 23 16.13 - Trenching for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
 - 1. Correct over excavation in accordance with Section 31 22 00 - Grading.
 - 2. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.
- C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.
- D. Bedding:
 - 1. Excavate pipe trench in accordance with Section 31 23 16.13 for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
 - 2. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6-inch (150 mm) compacted depth, compact to 90 percent.
 - 3. Maintain optimum moisture content of bedding material to attain required compaction density.

3.2 PREPARATION

- A. Prior to placement of geosynthetic fabric for drainage basin:
 - 1. Bottom of drainage tank basin shall be granular well-graded soil/aggregate mixtures, less than 35% fines, compacted in maximum 6-inch (150 mm) lifts to 95% Standard Proctor density. Fill material shall comply with manufacturer's design guidelines.

3.3 EXAMINATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

B. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.

3.4 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of the underground drainage system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical.

1. Install in accordance with Standard Specifications for Public Works Construction (Greenbook), local standards and soils report.
2. Install pipe, fittings, and accessories in accordance with ASTM D3034 and manufacturer's instructions. Seal joints watertight.

B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements.

C. Use fittings for branch connections, except where direct tap into existing sewer or manhole is indicated.

D. Use proper size increasers and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.

E. Install piping pitched down in direction of flow, at minimum slope of 2 percent, except where indicated otherwise.

1. Place bell ends of piping facing upstream.

F. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking, or a combination of both.

3.5 INSTALLATION – PIPE

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.

1. Plastic Pipe: Also comply with ASTM D2321.

C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch (3 mm) in 10 feet (3 m).

D. Connect to building storm drainage system, foundation drainage system, and utility/municipal sewer system.

E. Make connections through walls through sleeved openings, where provided.

F. Install continuous trace wire 6 inches (150 mm) above top of pipe; coordinate with Section 31 23 16.13.

3.6 INSTALLATION - CATCH BASINS, TRENCH DRAINS AND CLEANOUTS

- A. Install cleanouts and extension from storm sewer drain pipe to cleanout at grade as indicated. Set cleanout frame and cover in concrete block 18 by 18 by 12 inches deep, except where location is in concrete paving. Set top of cleanout 1 inch above surrounding earth grade or flush with grade when installing in paving.
 1. Provide as shown on plans or as required by UPC.
- B. Form bottom of excavation clean and smooth to correct elevation.
- C. Form and place cast-in-place concrete base pad, with provision for drainage pipe end sections.
- D. Level top surface of base pad; sleeve concrete shaft sections to receive drainage pipe sections.
- E. Establish elevations and pipe inverts for inlets and outlets as indicated.
- F. Mount lid and frame level in grout, secured to top cone section to elevation indicated.
- G. Drain Basin:
 1. Install per manufacturer's instructions and detail for H-20 traffic rating
 2. The specified PVC surface drainage inlet shall be installed using conventional flexible pipe backfill materials and procedures.
 3. The backfill material shall be crushed stone or other granular material meeting the requirements of Class 1 or Class 2 material as defined in ASTM D2321.
 4. Bedding and backfill for surface drainage inlets shall be well placed and compacted uniformly in accordance with ASTM D2321.
 5. The drain basin body will be cut at the time of the final grade.
 6. No brick, stone or concrete block will be required to set the grate to the final grade height.
 7. For load rated installations, a concrete slab shall be poured under and around the grate and frame.
 8. The concrete slab must be installed taking into consideration local soil conditions, traffic loading, and other applicable design factors.

3.7 INSTALLATION - DRAINAGE RETENTION TANK (CHAMBER)

- A. The installation of chambers shall be in accordance with the manufacturer's latest installation instructions.

3.8 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work.
- B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of 3000 psi 28-day compressive-strength concrete.
- C. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

3.9 CLOSING ABANDONED STORM DRAINAGE SYSTEM

- A. Abandoned Piping: Close open ends of abandoned underground piping that is indicated to remain in place. Provide sufficiently strong closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.
 1. Close open ends of concrete or masonry utilities with not less than 8-inch-thick brick masonry bulkheads.
 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Wood plugs are not acceptable.
- B. Abandoned Structures: Remove structure and close open ends of the remaining piping or remove top of structure down to not less than 3 feet below final grade; fill structure with stone, rubble, gravel, or compacted dirt, to within 1 foot of top of structure remaining and fill concrete.

3.10 CLEANING

- A. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 1. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
 2. Flush piping between manholes, if required by local authority, to remove collected debris.

3.11 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.
 1. Perform testing of completed site piping in accordance with the Uniform Plumbing Code using water or air pressure test.
- B. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.

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1. Make inspections after pipe between manholes and manhole locations has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
2. If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects correct such defects, and reinspect.
3. Perform video inspection of all piping prior to final acceptance of work.
 - a. All video operations shall be recorded digitally for playback if required.
 - b. All video inspections will include a detailed narrative identifying exact locations of the installed lines and limits of areas to be re-installed.
 - c. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest at no cost to Owner.

3.12 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

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SITE STORM DRAINAGE SYSTEM

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