

PROJECT MANUAL

**PROJECT/CONTRACT NUMBER:
26-045-001/CP3374**

DSA Appl. #: 01-118374

Bid Number: B-11-18-19

PH New Field Concession and Restroom Building

Piedmont Hills High School

EAST SIDE UNION HIGH SCHOOL DISTRICT

VOLUME [2 of 2]

May 30, 2019

SIGNATURE SHEET

FOR

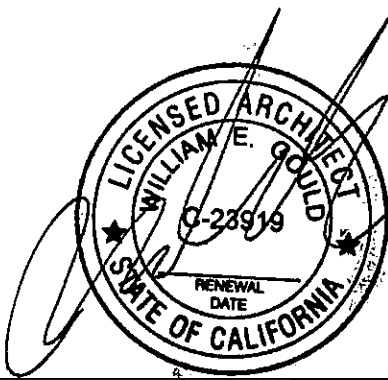
**PIEDMONT HILLS HIGH SCHOOL
CONCESSIONS BUILDING**

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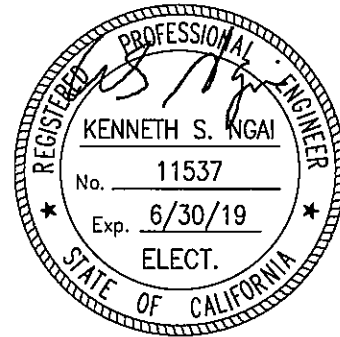
EAST SIDE UNION HIGH SCHOOL DISTRICT

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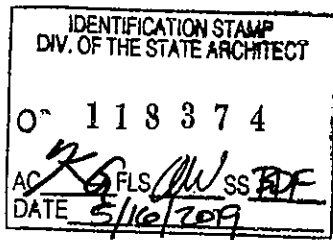
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SECTION 02 41 13 - SELECTIVE SITE DEMOLITION

1.00 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section requires the selective removal and subsequent off-site disposal of, but not limited to, the following:
 - 1. Portions of site improvements indicated on drawings and as required to accommodate new construction.
 - 2. Removal and protection of existing fixtures, materials, and equipment items indicated "salvage."

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Schedule indicating proposed sequence of operations for selective demolition work to Architect for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.
 - 1. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations, if any.
 - 2. Coordinate with Owner's continuing occupation, if any, of portions of existing building and with Owner's partial occupancy, if any, of completed new addition.
- C. Photographs of existing conditions of structure surfaces, equipment, and adjacent improvements that might be misconstrued as damage related to removal operations. File with Architect prior to start of work.

1.04 JOB CONDITIONS

- A. Occupancy: Owner will occupy portions of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in manner that will minimize

need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities that will affect Owner's normal operations.

- B. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.
1. Conditions existing at time of inspection for bidding purposes will be maintained by Owner insofar as practicable. However, minor variations within structure may occur by Owner's removal and salvage operations prior to start of selective demolition work.
- C. Partial Demolition and Removal: Items indicated to be removed but of salvageable value to Contractor may be removed from structure as work progresses. Transport salvaged items from site as they are removed.
1. Storage or sale of removed items on site will not be permitted.
- D. Environmental Controls: Comply with governing regulations pertaining to environmental protection.
1. Lead in Construction: All contractors shall comply with Title 8, California Code of Regulations (CCR), Section 1532.1, when abating lead relating to demolition of remodel activity in all public buildings. Workers must be trained by the Department of Health Services (DHS) accredited trainer provider and certified by DHS. Exposure assessment (air monitoring) must be performed in all workplaces where employees may be exposed to lead. Exposure assessment is an eight hour period when air monitoring takes place to determine permissible exposure limit for each activity taken.
- E. Protections: Provide temporary barricades and other forms of protection to protect Owner's personnel and general public from injury due to selective demolition work.
1. Provide protective measures as required to provide free and safe passage of Owner's personnel and general public to occupied portions of building.
 2. Erect temporary covered passageways as required by authorities having jurisdiction.
 3. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
 4. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
 5. Protect floors with suitable coverings when necessary.

6. Construct temporary insulated dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dust proof doors and security locks.
 7. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.
 8. Remove protections at completion of work.
- F. Damages: Promptly repair damages caused to adjacent facilities by demolition work.
- G. Traffic: Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
1. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- H. Flame Cutting: Do not use cutting torches for removal until work area is cleared of flammable materials. At concealed spaces, such as interior of ducts and pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations.
- I. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.
1. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by Owner/Occupant. Provide temporary services during interruptions of existing utilities, as acceptable to governing authorities.
 2. Maintain fire protection services during selective demolition operations.
- J. Dust Control: Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection.
1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

2.00 PRODUCTS (Not Applicable)

3.00 EXECUTION

3.01 PREPARATION

- A. General: Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of areas to be demolished and adjacent facilities to remain.
1. Cease operations and notify Architect immediately if safety of structures, or improvements to remain appears to be endangered. Take precautions to support structure until determination is made for continuing operations.
 2. Cover and protect furniture, equipment, and fixtures from soilage or damage when demolition work is performed in areas where such items have not been removed.
 3. Erect and maintain dust-proof partitions and closures as required to prevent spread of dust or fumes to occupied portions of the building.
 - a. Where selective demolition occurs immediately adjacent to occupied portions of the building, construct dust-proof partitions of minimum 4-inch studs, 5/8-inch drywall (jointstaped) on occupied side, 1/2-inch fire-retardant plywood, or equivalent, on demolition side and fill partition cavity with sound-deadening insulation, or as otherwise directed.
 - b. Provide weatherproof closures for exterior openings resulting from demolition work.
 4. Locate, identify, stub off, and disconnect utility services that are not indicated to remain.
 - a. Provide bypass connections as necessary to maintain continuity of service to occupied areas of building.

3.02 DEMOLITION

- A. General: Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.
1. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.
 2. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors, or framing.
 3. Provide services for effective air and water pollution controls as required by local authorities having jurisdiction.
 4. Demolish foundation walls to a depth of not less than 12 inches below lowest foundation level. Demolish and remove below-grade wood or metal construction. Break up below-grade concrete slabs.
 5. For interior slabs on grade, use removal methods that will not crack or structurally disturb adjacent slabs or partitions. Use power saw where possible.
- B. If unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the

conflict. Submit report to Architect in written, accurate detail. Pending receipt of directive from Architect, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

3.03 SALVAGED MATERIALS

- A. Salvaged Items: Where indicated on Drawings as "Salvage - Deliver to Owner," carefully remove indicated items, clean, store, and turn over to Owner and obtain receipt.
 - 1. Historic artifacts, including cornerstones and their contents, commemorative plaques and tablets, antiques, and other articles of historic significance, remain property of Owner. Notify Architect if such items are encountered and obtain acceptance regarding method of removal and salvage for Owner.
 - 2. Carefully remove, clean, and deliver to Owner the following items:
 - a. As indicated on the Construction Documents.

3.04 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove from building site debris, rubbish, and other materials resulting from demolition operations. Transport and legally dispose off site.
- B. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.
 - 1. Burning of removed materials is not permitted on project site.

3.05 CLEANUP AND REPAIR

- A. **General:** Upon completion of demolition work, remove tools, equipment, and demolished materials from site. Remove protections and leave interior areas broom clean.
- B. Repair demolition performed in excess of that required. Return elements of construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION 02 41 13

SECTION 10 14 23 - PANEL SIGNAGE**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. Room-identification signs.

1.3 DEFINITIONS

- A. Accessible: In accordance with the California Building Code, Chapter 11B.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For panel signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
- D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

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

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in CBC Chapter 11B for signs.

2.2 SIGNS

- A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: 0.25 inch.
 - b. Color(s): As selected by Architect from manufacturer's full range.
 - 2. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Square cut.
 - b. Corner Condition in Elevation: Square.
 - 3. Mounting: Surface mounted to wall with tamper resistant countersunk through fasteners and clear silicone adhesive.
 - 4. Text and Typeface: Accessible raised characters and California Contracted Grade 2 Braille conforming to all requirement of CBC Chapter 11B.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Exposed Metal-Fastener Components, General:

- a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use oval countersunk screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.
2. Sign Mounting Fasteners:
- a. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
- B. Adhesives: As recommended by sign manufacturer and that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 2.4 FABRICATION
- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
- 2.5 GENERAL FINISH REQUIREMENTS
- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated on Drawings.

C. Mounting Methods:

1. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.

- D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 14 23

SECTION 26 05 00**BASIC ELECTRICAL MATERIALS AND METHODS****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Electrical identification.
 - 2. Utility company electricity-metering components.
 - 3. Concrete equipment bases.
 - 4. Electrical demolition.
 - 5. Cutting and patching for electrical construction.
- B. Refer to drawings for applicable codes.
- C. Refer to Division 11 and Division 13 specifications for additional electrical work to be provided.
- D. Refer to TR, TL, AV and FS drawings for additional electrical work to be provided.

1.2 SUBMITTALS

- A. Product Data: For utility company electricity-metering components.
- B. Shop Drawings: Dimensioned plans and sections or elevation layouts and single-line diagram of electricity-metering component assemblies specific to this Project.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Devices for Utility Company Electricity Metering: Comply with utility company published standards.

- C. Comply with NFPA 70.

1.4 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings for electrical supports, raceways, and cable with general construction work.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment that requires positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for service entrances and electricity-metering components.
- D.
- E. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.
- F. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs. Strength rating to suit structural loading.
- D. Slotted Channel Fittings and Accessories: Recommended by the manufacturer for use with the type and size of channel with which used.
 - 1. Materials: Same as channels and angles, except metal items may be stainless steel.

- E. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- G. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- H. Expansion Anchors: Carbon-steel wedge or sleeve type.
- I. Toggle Bolts: All-steel springhead type.
- J. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 ELECTRICAL IDENTIFICATION

- A. Identification Device Colors: Use those prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick.
- C. Tape Markers for Conductors: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- D. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.
- E. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape compounded for permanent direct-burial service, and with the following features:
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Embedded continuous metallic strip or core.
 - 3. Printed legend that indicates type of underground line.
- F. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.

- G. Warning and Caution Signs: Preprinted; comply with 29 CFR 1910.145, Chapter XVII. Colors, legend, and size appropriate to each application.
 - 1. Interior Units: Aluminum, baked-enamel-finish, punched or drilled for mechanical fasteners.
 - 2. Exterior Units: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate with 0.0396-inch, galvanized-steel backing. 1/4-inch grommets in corners for mounting.
- H. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.3 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Comply with requirements of electrical power utility company for all new service entrance equipment, raceways and structures.

2.4 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Division 3 Section "Cast-in-Place Concrete."
- B. Concrete: 3000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, slotted channel system components.
- B. Dry Locations: Steel materials.
- C. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four with, 200-lb minimum design load for each support element.

3.3 SUPPORT INSTALLATION

- A. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- B. Size supports for multiple raceway or cable runs so capacity can be increased by a 25 percent minimum in the future.
- C. Support individual horizontal single raceways with separate, malleable-iron pipe hangers or clamps except use spring-steel fasteners for 1-1/2-inch and smaller single raceways above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- D. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- E. Secure electrical items and their supports to building structure, using the following methods unless other fastening methods are indicated:
 - 1. Wood: Wood screws or screw-type nails.
 - 2. Gypsum Board: Toggle bolts. Seal around sleeves with joint compound, both sides of wall.
 - 3. Masonry: Toggle bolts on hollow block and expansion bolts on solid block. Seal around sleeves with mortar, both sides of wall.
 - 4. New Concrete: Concrete inserts with machine screws and bolts.
 - 5. Existing Concrete: Expansion bolts.
 - 6. Structural Steel: Spring-tension clamps.
 - a. Comply with AWS D1.1 for field welding.
 - 7. Light Steel Framing: Sheet metal screws.
 - 8. Fasteners for Damp, Wet, or Weather-Exposed Locations: Stainless steel.
 - 9. Light Steel: Sheet-metal screws.
 - 10. Fasteners: Select so load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 IDENTIFICATION MATERIALS AND DEVICES

- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- C. Self-Adhesive Identification Products: Clean surfaces before applying.
- D. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
- E. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker.
- F. Install warning, caution, and instruction signs where required to comply with 29 CFR 1910.145, Chapter XVII, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Indoors install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
- G. Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

3.5 ELECTRICITY-METERING EQUIPMENT

- A. Install utility company metering equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.6 FIRESTOPPING

- A. Apply firestopping to cable and raceway sleeves and other penetrations of fire-rated floor and wall assemblies to restore original undisturbed fire-resistance ratings of assemblies.

Firestopping installation is specified in Division 7 Section "Through-Penetration Firestop Systems."

3.7 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated.

3.8 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- D. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.9 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair, refinish and touch up disturbed finish materials and other surfaces to match adjacent undisturbed surfaces.

END OF SECTION 260500

SECTION 26 05 13**CONDUCTORS AND CABLES**

PART 1 -

PART 2 - GENERAL

2.1 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

2.2 SUBMITTALS

- A. Field quality-control test reports.

2.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Comply with NFPA 70.

PART 3 - PRODUCTS

3.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

3.2 CONDUCTORS AND CABLES

- A. Manufacturers:
 - 1. American Insulated Wire Corp.; a Leviton Company.
 - 2. General Cable Corporation.
 - 3. Senator Wire & Cable Company.
 - 4. Southwire Company.
- B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
- C. Conductor Material: Copper complying with NEMA WC 5 or 7; solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.
- D. Conductor Insulation Types: Type THW, THHN-THWN or XHHW complying with NEMA WC 5 or 7

3.3 CONNECTORS AND SPLICES

- A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 4 - EXECUTION

4.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspace: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single conductors in raceway .
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.
- I. Fire Alarm Circuits: Type THHN-THWN, in raceway.
- J. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- K. Class 2 Control Circuits: Type THHN-THWN, in raceway.

4.2 INSTALLATION

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 16 Section "Basic Electrical Materials and Methods."
- F. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."

- G. Identify and color-code conductors and cables according to Division 16 Section "Basic Electrical Materials and Methods."
- H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

4.3 FIELD QUALITY CONTROL

- A. Testing: Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 05 26**GROUNDING AND BONDING****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes grounding of electrical systems and equipment. Requirements specified in this Section may be supplemented by requirements of other Sections.

1.2 SUBMITTALS

- A. Product Data: For ground rods.
B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled under UL 467 as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

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

1. Ground Rods:
 - a) Weaver
 - b) Thomas & Betts
 - c) Talley
2. Grounding Connectors:
 - a) Burndy Hyground Compression Systems
 - b) Erico/Cadweld
 - c) Amp Ampact Grounding System.
3. Pipe Grounding Clamps:
 - a) Burndy GAR Series
 - b) O-Z Gedney
 - c) Thomas & Betts
4. Telecommunication Grounding Bus Bar:
 - a) Chatsworth
 - b) Erico
 - c) Square D
 - d) Panduit

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."
B. Equipment Grounding Conductors: Insulated with green-colored insulation.

- C. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- F. Bare, Solid-Copper Conductors: ASTM B 3.
- G. Assembly of Bare, Stranded-Copper Conductors: ASTM B 8.
- H. Bare, Tinned-Copper Conductors: ASTM B 33.
- I. Copper Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
- J. Copper Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- K. Tinned-Copper Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- L. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulated spacer.
- M. Connectors: Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items. Exothermic-welded type, in kit form, selected per manufacturer's written instructions.
- N. Telecommunications Grounding System: Mount telecommunications main grounding busbar (TMGB) in each MDF. Install main telecommunications bonding backbone (TBB) conductor continuous from the MDF to every IDF. Bond the TMGB to the main building electrical grounding system and the nearest acceptable structural ground with a 3/0 AWG copper equipment grounding conductor.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel.
 - 1. Size: 3/4 inch in diameter by 120 inches in length.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.

2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the indicated height above the floor.
- E. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.
- F. Equipment Grounding Conductors: Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
1. Install insulated equipment grounding conductors in feeders.
 2. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
 3. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
 4. Air-Duct Equipment Circuits: Install an insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
 5. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install an insulated equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
 6. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - a. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 - b. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
 7. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing an insulated equipment grounding conductor with supply branch-circuit conductors.
- G. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- H. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- I. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers or supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

- J. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- K. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- L. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- M. Connections: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 6. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
 7. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
 8. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
 9. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
 10. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
 11. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.
- N. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-

sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

- O. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

3.2 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is indicated and at service disconnect enclosure grounding terminal. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
 - 3. Provide drawings locating each ground rod, ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results. Nominal maximum values are as follows:
 - a. Equipment Rated 500 kVA and Less: 10 ohms.
 - b. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - c. Equipment Rated More Than 1000 kVA: 3 ohms.
 - d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - e. Manhole Grounds: 10 ohms.

END OF SECTION

SECTION 26 05 33**RACEWAYS AND BOXES****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, underground pull boxes, hinged-cover enclosures, and cabinets indicated.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

- A. Manufacturers:
1. Allied Steel
 2. Certainteed
 3. Jones & Laughlin
 4. Carlon
 5. Kraloy
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. EMT and Fittings: ANSI C80.3.
1. Fittings: Set-screw or compression type.
- E. FMC: Aluminum.
- F. LFMC: Flexible steel conduit with PVC jacket.
- G. Fittings: NEMA FB 1; compatible with conduit and tubing materials.
- H. Underground Pull boxes:
1. Sizes: 17"(width) x 30" (length) x 24"(depth),(minimum dimensions, U.O.N)
 2. Pull boxes shall be precast concrete as indicated on plans.

- a) Traffic Box-High density reinforced concrete box with non-setting shoulders positioned to maintain grade and facilitate backfilling. Utility boxes shall be used where shown on the drawings. Use steel checker plate, H/20 loading, bolt down. Provide 12"extension pieces.
- b) Vandal Resistant Pull box insert-3/16 inch Hot dipped galvanized steel lid and lockbox. Varies according to style and size of pullbox. Mc Cain Inc. or approved equal.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers:

1. Allied Steel
2. Certainteed
3. Jones & Laughlin
4. Carlon
5. Kraloy

B. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

C. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:

1. Outlet Boxes:
 - a) Bowers
 - b) Hubbell
2. Weatherproof Outlet Boxes and Box Extension Adapters:
 - a) Bell
 - b) Red Dot
 - c) Carlon
3. Junction and Pull Boxes:
 - a) Circle AW
 - b) Hoffman
4. Conduit Fittings:
 - a) O-Z Gedney
 - b) Thomas & Betts, or approved equal.
5. Floor Boxes:
 - a) Wiremold/Walker
 - b) Hubbell
6. Underground PullBoxes:
 - a) Mc cain Inc. WWW.mccain-inc.com
 - b) Jensen Pre-cast
 - c) Christy Concrete Products
 - d) BES Concrete Products
 - e) Old Castle Precast Solution

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Floor Boxes: Cast metal, fully adjustable, rectangular.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

- H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- I. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.5 FACTORY FINISHES

- A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors:
 - 1. Exposed: Rigid steel or IMC.
 - 2. Concealed: Rigid steel or IMC.
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 6. Boxes and Enclosures: NEMA 250, Type 3R.
- B. Indoors:
 - 1. Exposed: EMT.
 - 2. Concealed: EMT.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
 - 4. Damp or Wet Locations: Rigid steel conduit.
 - 5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Conduits used for fiber optic cable installation shall be provided with inner duct.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

3.2 INSTALLATION

- A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

- B. Complete raceway installation before starting conductor installation.
- C. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."
- D. Install temporary closures to prevent foreign matter from entering raceways.
- E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above finished slab.
- F. Provide inner duct in conduit for all fiber optic cable installation.
- G. Provide flexible metal conduits for conduits installed inside cabinets.
- H. Make bends and offsets so ID is not reduced. Keep legs of bends in same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
 - 1. Install concealed raceways with a minimum of bends in shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- J. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 4. Change from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
- K. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
 - 1. Run parallel or banked raceways together on common supports.
 - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- L. Join raceways with fittings designed and approved for that purpose and make joints tight.
 - 1. Use insulating bushings to protect conductors on all raceways 2" and larger.
- M. Tighten set screws of threadless fittings with suitable tools.
- N. Terminations:
 - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
 - 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- P. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree

bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

- Q. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- R. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- S. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
- T. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
- U. Set floor boxes level and flush with finished floor surface.
- V. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- W. Install cable tray in accordance with NEMA VE 2 requirements.

3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

IDENTIFICATION FOR ELECTRICAL SYSTEMS

SECTION 26 05 33

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:

A. Identification of electrical equipment and devices for all renovation and new building projects.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for Identification of materials and method.
- C. Samples: One for each type of materials specified.

1.3 QUALITY ASSURANCE

- A. All identification material and methods, engraved labels, conductor numbers, branch circuit schedules, relay panel schedules, identification for circuit breakers and underground utility markers shall meet Code requirements and industry standards.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. For Engraved Labels: Lamicoid
- B. For Conductor Numbers: Brady
- C. For Underground Utilities Ribbon: Allen Systems, Inc.

2.2 IDENTIFICATION MATERIALS AND METHODS

- A. Coordinate names, abbreviations and other designations with equipment specified in this or other Divisions of the Specification or identified by the District.
- B. Conform to requirements of the CEC, latest adopted version with amendments by local AHJs including warning labeling and identification on existing equipment.
- C. Furnish products listed by UL or other testing firm acceptable to AHJ.

2.3 ENGRAVED LABELS

- A. Melamine plastic laminate, white with black core, 1/16-inch thick.

IDENTIFICATION FOR ELECTRICAL SYSTEMS

- B. Dymo tape labels are not acceptable.
- 2.4 CONDUCTOR NUMBERS
- A. Manufacturers standard vinyl-cloth self-adhesive cable and conductor markers of the wraparound type. Preprinted black numbers on yellow field.
- 2.5 BRANCH CIRCUIT SCHEDULES
- A. Provide branch circuit identification schedules, typewritten, clearly filled out, to identify load connected to each circuit and location of load. Numbers to correspond to numbers assigned to each circuit breaker pole position.
 - B. Provide two columns, odd numbers in left column, even numbers in right column, with 3-inch-wide line for typing connected load information.
- 2.6 RELAY PANEL SCHEDULES
- A. Provide typewritten schedule to identify the incoming circuit, the controlled load, and the controlling devices for each relay.
- 2.7 IDENTIFICATION FOR CIRCUIT NUMBERS:
- A. Provide permanent identification number in or on panelboard dead-front adjacent to each circuit breaker pole position. Square D adhesive is approved, other adhesives by specific prior approval only.
 - B. Horizontal centerline of engraved numbers to correspond with centerline of circuit breaker pole position.
 - C. Detectable plastic ribbon, 6-inch wide by 4 mil thick.
- 2.8 Underground utility markers:
- A. Color code as recommended by APWA. Safety Red for electric power distribution. Safety Alert Orange for telephone, signal, data and cable TV.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten labels to equipment in a secure and permanent manner.
- B. Mark underground utilities in conformance with APWA.
- C. Where signs are to be applied to surfaces which require finish, install identification after completion of painting.
- D. Engravers standard letter style, minimum 3/16-inch high capital letters.
- E. Drill or punch labels for mechanical fastening except where adhesive mounting is necessary because of substrate. Use self tapping stainless steel screws.

IDENTIFICATION FOR ELECTRICAL SYSTEMS

- F. Install an engraved label on each major unit of electrical equipment indicating both equipment name and circuit serving equipment (e.g. "EF-1, CKT. 2P1-1,3,5), including but not limited to the following items:
1. Disconnect switches, identify item of equipment controlled.
 2. Relays.
 3. Contactors.
 4. Time switches.
 5. Override switches.
 6. Service disconnect and distribution switches, identify connected load.
 7. Branch circuit panelboards.
 8. Central or master unit of each electrical system including communication/signal systems, unless the unit incorporates its own self-explanatory identification.
- G. Install engraved on the inside of flush panels, visible when door is opened. Install label on outside of surface panel.
- H. Apply markers on each conductor for power, control, signaling and communications circuits where wires of more than one circuit are present.
- I. Match conductor identification used in panelboards, shop drawings, contract documents and similar previously established identification for division 26 work.
- J. Provide branch circuit identification schedules, typewritten, clearly filled out, to identify load connected to each circuit and location of load. Numbers to correspond to numbers assigned to each circuit breaker pole position.
- K. Provide two columns, odd numbers in left column, even numbers in right column, with 3-inch-wide line for typing connected load information.
- L. Provide typewritten schedule to identify the incoming circuit, the controlled load, and the controlling devices for each relay.
1. Imprint over entire length of ribbon in permanent black letters, the system description, selected from manufacturer's standard legend which most accurately identifies the subgrade system.
 2. Install continuous tape, 6 to 8 inches below finish grade, for each exterior underground raceway.
 3. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16 inches, install a single marker. Over 16 inch width of lines, install multiple tapes not over 10 inches apart (edge to edge) over the entire group of lines.

END OF SECTION

SECTION 26 27 26**WIRING DEVICES****PART 1 - GENERAL****1.1 SUMMARY**

A. This Section includes the following:

1. Single and duplex receptacles, ground-fault circuit interrupters.
2. Single- and double-pole snap switches and dimmer switches.
3. Device wall plates.
4. Floor service outlets, poke-through assemblies and multioutlet assemblies.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Wiring Devices:
 - a. Bryant Electric, Inc./Hubbell Subsidiary.
 - b. Eagle Electric Manufacturing Co., Inc.
 - c. Hubbell Incorporated; Wiring Device-Kellems.
 - d. Leviton Mfg. Company Inc.
 - e. Pass & Seymour/Legrand; Wiring Devices Div.
 2. Multioutlet Assemblies:
 - a. Hubbell Incorporated; Wiring Device-Kellems.

- b. Wiremold Company (The).
3. Poke-Through, Floor Service Outlets and Telephone/Power Poles:
- a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Pass & Seymour/Legrand; Wiring Devices Div.
 - c. Square D/Groupe Schneider NA.
 - d. Thomas & Betts Corporation.
 - e. Wiremold Company (The).

2.2 RECEPTACLES

- A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.
- B. Straight-Blade and Locking Receptacles: Heavy-Duty grade.
- C. Straight-Blade Receptacles: Hospital grade.
- D. GFCI Receptacles: Straight blade, non-feed-through type, Hospital or Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.

2.3 SWITCHES

- A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.
- B. Snap Switches: Heavy-Duty grade, quiet type.
- C. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
 - 1. Switch: 20 A, 120/277-V ac.
 - 2. Receptacle: NEMA WD 6, Configuration 5-15R.
- D. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
 - 1. Control: Continuously adjustable slider; with single-pole or three-way switching to suit connections.
 - 2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable rotary knob, toggle switch, or slider; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; and 5-inch wire connecting leads.
 - 3. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.4 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces:
 - a. Steel with white baked enamel, suitable for field painting
 - b. 0.035-inch-thick, satin-finished stainless steel (above counters and in restrooms)
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Wet Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

2.5 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular, solid brass with satin finish.
- D. Power Receptacle: NEMA WD 6, Configuration 5-15R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: See telecommunication specifications for requirements.

2.6 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
 1. Service Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks.
 2. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
 3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 4. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
 5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors; and a minimum of four, 4-pair, Category 5 voice and data communication cables.

2.7 MULTIOUTLET ASSEMBLIES

- A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- B. Raceway Material: PVC.
- C. Wire: No. 12 AWG.

2.8 FINISHES

- A. Color:
 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies level, plumb, and square with building lines.
- B. Install wall dimmers to achieve indicated rating after derating for ganging.
- C. Install unshared neutral conductors on line and load side of dimmers.
- D. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.
- E. Remove wall plates and protect devices and assemblies during painting.
- F. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

- A. Comply with Division 16 Section "Basic Electrical Materials and Methods."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 CONNECTIONS

- A. Ground equipment according to Division 16 Section "Grounding and Bonding."
- B. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 - 1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
 - 2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION

SECTION 27 00 00**GENERAL TECHNOLOGY REQUIREMENTS****1. PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The provisions of the General Conditions, Supplementary Conditions, and the Sections included under Division 1 and 2, General Requirements, are included as a part of this section as though bound herein.

1. DRAWINGS:

- a. The Drawings prepared for this Project are an outline to show where apparatus must go in order to harmonize with the building and installations of the various trades. Work must be installed in accordance with the drawings insofar as possible. Drawings shall be carefully checked during the course of bidding and construction. If discrepancies, errors, or omissions are discovered prior to or during the construction phase, notify the Owner's Agent immediately for interpretation or correction. Take necessary measurements and be responsible for same, including clearances for equipment that is to be furnished. The Owner shall reserve the right to make minor location changes of equipment where such adjustments are deemed desirable from an appearance or operational standpoint. Such changes will be anticipated sufficiently in advance to avoid extra work or unduly delayed progress on the Project.

1.2 SUMMARY**A. RELATED SECTIONS**

1. The requirements of this Section supplement the General Conditions and shall apply to Work for Sections listed under Division 27 – TECHNOLOGY.

B. PERFORMANCE

1. Provide the labor, materials, equipment, appliances, services and transportation, and perform the operations in connection with the construction and installation of the Work. Work shall be as herein specified and as denoted on the accompanying Drawings.

1.3 REFERENCE STANDARDS

- A. NOTE: Educational facilities are unique facilities and do not specifically conform to the TIA/EIA standard, they are not commercial buildings that must flex with each new tenant. The Owner will deviate from the standard to enhance the instructional impact of the technology implementation. Deviations will be noted below:

1. Quantity of drops in a given space.
2. Quantity of drops within a single communications box.

3. Use of a collapsed backbone data system architecture.
 4. Deletion of wiring closets (IDF).
 5. Fiber cable direct to the classroom.
 6. No patch panels in classrooms containing hub units.
 7. When wiring closets (IDF) are used, room size requirements are not strictly adhered to.
- B. Where practices noted within this specification do not adhere strictly to the TIA/EIA standards, The Owner has done so for a specific purpose related to educational facilities. For those areas deviating from the standard, this contractor will not be liable for complying with the TIA/EIA standards.
- C. The standard references for the layout and construction of the system shall be the current version of:
1. GENERAL, (Includes Copper and Fiber):
 - a. TIA/EIA-568 - Commercial Building Standard for Telecommunications Wiring
 - b. TIA/EIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
 - c. TIA/EIA-606 - Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings.
 - d. TIA/EIA-607 - Commercial Building Grounding/Bonding Requirements.
 - e. BICSI-TDM Manuals-Building Industry Consulting Service International-Telecommunications Distribution Methods Manuals.
 - f. ANSI - American National Standards Institute
 - g. UL Listed - Underwriter's Laboratories Listed
 - h. UL Certified - Underwriter's Laboratories LAN Cable Certification Program.
 - i. NEMA - National Electrical Manufacture's Association.
 2. AUDIO:
 - a. Handbook for Sound Engineers
 - b. The New Audio Cyclopedia (Howard W. Sams, Indianapolis, Indiana 1987)
 - c. Davis Sound System Engineering Second Edition (Howard W. Sams, Indianapolis, Indiana 1987)
 3. VIDEO:
 - a. National Association of Broadcasters.
 - b. Engineers Handbook.

1.4 DEFINITIONS

A. PRECEDENCE:

1. Precedence of project documents shall be as follows:
 - a. In the event of a discrepancy between the specifications and drawings, whichever is more stringent or calls for the highest quantity or quality of materials has precedence.

B. OMISSIONS:

1. The omission of express reference to any parts necessary for, or reasonably incidental to, a complete installation shall not be construed as a release from providing such parts.

C. ANCILLARY AND ACCESSORY ITEMS:

1. No exclusion from, or limitations in, the language used in the drawings or specifications shall be interpreted as meaning that the accessories necessary to complete any required system or item of equipment are to be omitted.

D. DRAWINGS:

1. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed in accordance with the intent diagrammatically expressed on the drawings and described in these specifications. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.

E. ORDINANCES:

1. All work shall conform to all federal, state, and local ordinances and building official requirements.

F. BUILDING CODES:

1. All work shall conform to all state and local building codes and the following:
 - a. National Electrical Code (NEC)
 - b. National Fire Protection Association (NFPA)
 - c. EIA/TIA Standards and Recommendations.

G. UL LISTING

1. All material and equipment shall be listed, labeled, or certified by Underwriter's Laboratories, Inc., where such standards have been established.

H. FCC APPROVAL

1. The system shall be approved for direct interconnection to the utility services under Part 68 of FCC rules and regulations. Those systems that are not FCC approved or utilize an intermediary device for connection will not be considered. Provide FCC registration number of system being proposed with submittals.

I. SUBMITTALS

1. GENERAL:

- a. Provide complete shop drawings and submittals for all systems specified within 30 days of notice of award or actual award of contract which ever occurs first. The Architect/Consultant will review and return submittals and shop drawings within fourteen (14) days. Failure to obtain submittal approval within sixty (60) days of contract award, where the delay is due to the poor performance of the contractor, may be cause for cancellation of the contract without penalty of the Owner.
- b. Where applicable, the Contractor will submit the greatest quantity of submittal copies noted herein or in the General or Supplemental Conditions of the project documents. If not noted elsewhere within the project documents, the Contractor will submit a minimum of five (5) sets of submittals and shop drawings.
- c. The Contractor should not consider the Consultant or Owner's review of submittals to be exhaustive or complete in every detail. Approval of submittals, including substitutions, indicates only the acceptance of intent to comply with general design or method of construction and quality as specified. The functional requirements, operations, arrangements, and quantities must comply with the contract documents unless changes are specifically approved in writing. Submittal approval does not relieve the Contractor of responsibility for errors in dimensions, details, sizes, fir, etc.. or coordinating items with actual building conditions. Contractor's responsibility for error and omissions in submittals is note relieved by the Consultant or Owner review of submittals.
- d. Submittals and shop drawings will be provided in a single package, multiple partial submittals are not acceptable.
- e. Submittals which, in the Consultant's opinion, are incomplete deviate significantly from the requirements of the Project Specifications, or contain numerous errors will be returned without review for rework and are to be re-submitted.
- f. If submittals and/or drawings are rejected, or approved with noted changes and resubmittal required, the Contractor will correct the documents as required and resubmit within fourteen (14) days.
- g. The Contractor will not fabricate products, begin work, or submit invoices for the scope of work defined in the project documents until return of submittals and shop drawings with Consultant acceptance.

2. SCALED DRAWINGS (Shop Drawings):

- a. Each drawing shall have a descriptive title and all subparts of each drawing shall be completely described. All drawings shall have the name of the project, Owner's name and address, consultant, and electronics contractor in the title block.
- b. Backboards:
 - 1) Provide complete scaled elevation drawings of all backboards with equipment designations and locations. Provide dimensional relation of each piece of equipment to other pieces of equipment. If other Contrac-

tor(s) are providing equipment on the backboard, this Contractor will coordinate the layout of equipment on the backboard with the other Contractor(s).

c. Device Locations:

- 1) Provide complete scaled drawings detailing projected primary cable paths and locations of all equipment such as control panels, plug panels, video monitors, video projectors, equipment racks, speakers, etc... in quantities noted in the general requirements. These drawings will be utilized for "as-built" submittals with cable numbers noted at the end of the project.

d. Assembly, Supports, and Panel/Plate Layout:

- 1) Provide diagrammatic representation of all assemblies, i.e. monitor mount assembly, projector mount assembly, and connector panel and/or plate layout. Identify the components that make up the assembly or are used on the panel/plate. For connector panel or plate, indicate identification location and methodology.

e. One-Line System Diagram:

- 1) Provide one-wire drawings of all racks, consoles, control panels, and custom assemblies, etc., in quantities noted in the general requirements. Each drawing shall delineate circuit numbers for all cables and terminal connections. Provide typical wiring termination for all devices.

3. MANUFACTURERS PRODUCT DATA

a. Manufacturer Cut Sheets:

- 1) Provide complete sets of a project material list with manufacturer specification sheets for each manufactured device utilized within the system in quantities noted in the general requirements. The Owners Agent will use these sets in determining that all products listed are being supplied as required.

b. Samples:

- 1) Provide samples of the following:
 - a) Any plastic or custom metal panels.
 - b) All paint finishes of cabinets or custom assemblies. (These may be manufacturer cuts sheets indicating the various colors and finishes available).
 - c) Equipment identification tag material, labeling method, and numbering method.
 - d) Cable labeling material, labeling method, and numbering method.
 - e) Faceplate and modules of selected color for approval by Owner/architect.

- f) Faceplate labeling material, labeling method, and numbering method.

4. SCHEDULE:

- a. The Consultant has been retained by the Owner to provide inspection services throughout the duration of the project. Those services include:
 - 1) Inspection of technology rough-in methodologies (cable installation and support methods, component support methodologies.)
 - 2) Inspection of cable, face plate, and cabinet termination and labeling methodologies.
 - 3) Review of Verification Test Reports.
 - 4) Attend and Witness Final Acceptance Test (Proof of Performance Tests).
 - 5) Verify Contractor provision of training requirements.
- b. The Contractor is required to provide a projected schedule of activities for the Consultant to plan site visits. The Contractor is responsible to notify the Consultant of any changes in their activity schedule due to change in the overall construction schedule or Contractor schedule. Provide dates for the following:
 - 1) Date upon which 10% of the project cable is expected to be installed.
 - 2) Date upon which 10% of system supports are expected to be installed.
 - 3) Date upon which 10% of cable and plates are terminated and labeled.
 - 4) Date of Verification Test Report completion.
 - 5) Date of expected Final Acceptance Testing.
 - 6) Dates of expected Systems Training.

1.5 QUALITY ASSURANCE

A. GENERAL:

- 1. All equipment and materials required for installation under these specifications shall be new (less than 1 year from date of manufacture) and without blemish or defect.

B. SPECIFIC:

- 1. Each major component of equipment shall have the manufacturer's name, address, model number, and rating on a plate securely affixed in a conspicuous place. NEMA code ratings, UL label, or other data which is die-stamped into the surface of the equipment shall be stamped in a location easily visible.

1.6 ACCEPTABLE MANUFACTURERS

- A. These specifications are based on equipment manufactured by or for specific manufacturers. It is not the intent of these specifications to limit or restrict submission of proposals for products by other manufacturers but to set a baseline of operational functions, which all proposals must meet.

1.7 INSTALLING CONTRACTOR QUALIFICATIONS

- A. The Premises Wiring contractor performing work under this Section 27 00 00 shall be certified by the manufacturer of the equipment and components being furnished and be authorized by the manufacturer to install and convey the product warranty and performance guarantee to the Owner upon completion of contract. Installing contractor for all other sections must have a minimum of three years previous experience in audio/visual systems, and/or data communications, and/or telecommunication systems. All contractors and/or vendors supplying all or parts of the work described herein shall supply three project references, which substantiate the contractor/ vendors' previous experience as noted herein and in addition Division 27.

- B. Provide three project references for all subcontractors supplying all or parts of the work described herein which substantiate their previous experience as noted herein.

1.8 ENVIRONMENT

- A. The equipment specified herein is designed to operate in environments of normal humidity, dust, and temperature. Protect equipment and related wiring where extreme environmental conditions can occur.

2. PART 2 - PRODUCTS

2.1 DEVICE LOCATIONS

- A. Locate all apparatus requiring adjustments, cleaning, or similar attention so it will be accessible for such attention. Equipment racks are existing to remain.

2.2 PAINTING

- A. All supporting structures and enclosures supplied by the contractor not having a standard factory paint finish shall be painted in a manner approved by the Owner.

2.3 PAINT COLOR

- A. Provide, as may be required, custom color and/or finish for any equipment or materials supplied which are exposed to public view. Color and finish of all such equipment or materials shall be submitted to the Architect for approval. This does exclude equipment or materials where standard colors and finishes are specified herein, unless otherwise noted.

2.4 BLANK AND CUSTOM PANELS

- A. Finish of blank panels and/or custom assembly panels utilized for termination and/or inter-connection as part of this system shall be stainless steel.
- B. In addition, provide blank plastic panels finished in matte (or satin) black to close off all spaces around the source equipment in the distribution room racks. These panels shall have cutouts that provide access to the source machine and its controls. Match each panel to the device it is covering in the racks. Submit a sample of the plastic with finish to the Consultant for approval.

2.5 MARKINGS

- A. Switches, connectors, jacks, receptacles, outlets, cables and cable terminations shall be logically and permanently marked in a manner approved by the Owner. Custom panel nomenclature shall be engraved, etched, or screened. Marking for these items are purposely detailed in the drawings to ensure consistency and clarity. Verify any changes in working type size, and/or placement with the Owner prior to marking. Mount on the custom rack panels as described above a designation of each source machine, which correlates to the system architecture. Submit a sample layout for Consultant approval.

3. PART 3 - EXECUTION

3.1 INSTALLATION

A. GENERAL:

1. Perform this work in accordance with acknowledged industry and professional standards and practices, existing building conditions, and as specified herein. Provide and install all materials, devices, components, and equipment for complete, operational systems.
2. Maintain a competent supervisor and supporting technical personnel, acceptable to the Architect, during the entire installation. Change of the supervisor during the project shall not be acceptable without prior written approval from the Owner and the Owner's Agent.
3. Coordinate all efforts with those of related trades. In the event of any conflicts, delayed or improper preparatory work by others, notify the Owner's Agent. The Owner's Agent's decision will be binding. Verify all field conditions.

3.2 BOXES

A. MOUNTING:

1. With the exception of portable equipment, all boxes, conduits, cabinets, equipment and related wiring shall be held firmly in place and the mounting shall be plumb and square. All boxes shall be rigidly and securely mounted to building structure. All boxes shall be installed so that wiring contained in them is accessible. Install blanking devices or threaded plugs in all unused holes.

B. WIRING:

1. Wiring groups and circuits shall be isolated as indicated herein. Common pull or junction boxes shall be avoided. Where deemed necessary and approved, they shall be barrier.

C. CLEANING:

1. Clean all box interiors thoroughly before installing plates, panels, or covers.

3.3 WIRING METHODS & PRACTICES**A. SUPERVISION**

1. Installation of all audio, video and control cable to be provided under this scope of work is by this contractor. Supervision to include, but not be limited to ensuring proper:
 - a. Pulling Tensions.
 - b. Quantities.
 - c. Types.
 - d. Lengths.
 - e. Routing.
 - f. Wire Group Separation.
 - g. Identification.

B. IDENTIFICATION

1. All wires shall be permanently identified at each wire end utilizing a self-laminating wire or cable marker comprised of a white label with black lettering and clear over laminate area, in a manner approved by the Owner's Agent.
2. All faceplates will be permanently identified with engraved plastic laminate or metalized polyester identification labels.

C. TERMINAL BLOCKS:

1. All terminal block connections shall be readily accessible. Not more than one wire connected to one terminal. Spare terminal blocks, equivalent to 10% of those in actual use shall be provided.

D. SPLICING:

1. Splicing of cables is not permitted between terminations.

E. PULLING CABLE:

1. Do not pull wire or cable through any box fitting or enclosure where change of raceway alignment or direction occurs; do not bend conductors to less than recommend-

ed radius. Employ temporary guides, sheaves, rollers, and other necessary items to protect cables from excess tension, abrasion, or damaging bending during installation. Care shall be taken not to bend, crush or kink cables.

F. CABLE MANAGEMENT:

1. Building Locations:

- a. Comb straight and form in a neat and orderly manner all conductors in large junction boxes and cable support bridle rings or other types of open top support systems, providing circuit and conductor identification. Tie wraps are only to be used for cable management, not support. Arrange as required using tie wraps of appropriate size and type, (plenum rated as required). Limit spacing between ties to six inches and provide circuit and conductor identification at least once in each enclosure.

2. Equipment Cabinets or Racks:

- a. Comb straight and form in a neat and orderly manner all conductors located within equipment cabinets, located in the head end room or remote locations, and wiring harnesses in the head end room. Tie as required using Velcro cable ties of appropriate type and size.

G. SERVICE LOOPS:

1. Provide ample service loops at each termination and/or per drawings so that plates, panels, and equipment can be dismantled for service and inspection. Provide the following as a minimum:
 - a. Outlet box: Eighteen (18) inches from wall surface to jack.
 - b. Termination panel: Four (4) inches behind termination panel from last cable tie to jack.

H. NON-CABLE TRAY INSTALLATION :

1. All cable installations which are not supported by a cable tray or conduit system and where educational technology system cables are allowed to be placed loosely in the ceiling must follow the TIA/EIA standard methodology as noted in TIA/EIA 569 - Part 4.6 Ceiling Pathways. Specifically, sections 4.6.1 General, 4.6.2 Design Guidelines, and 4.6.5 Cable Support. Those sections are paraphrased herein (the contractor will be familiar with the specifics of these sections and install their cables in accordance with the standard or as noted herein).
2. The installation of all education technology cabling, regardless of type and separation requirements, from the head end room to various zones throughout the facility will use common pathway routes.
3. Inaccessible ceiling areas, such as lock-in ceiling tiles, drywall or plaster, will not be used as distribution pathways. Should the contractor find inaccessible ceiling areas as the only available pathway, the contractor will notify the Owner's Agent immediately for direction prior to proceeding with the cable installation.
4. Accessible ceiling areas must have adequate and suitable space available for the distribution layout (minimum of three inches clear vertical space between ceiling tiles and distribution wiring and pathway).

5. The design shall provide a suitable means and method for supporting cables and wires from the head end room (and/or telecommunications closet) to the area being served. The cable will not be laid directly on the ceiling tiles or rail. The Owner allows the use of "Caddy - Multifunction Clip" (as manufactured by ERICO or other equivalent manufacturer) installed on the ceiling support wire at a minimum height of eighteen inches above the tile and utilizing the appropriate D-ring or bridle ring for the installation of cable within a single zone.
6. Cable support will be provided through the use of open-top cable supports located on 48-60 inch centers. Where large quantities of cables (50-75) are bunched together in the ceiling at a congested area, the contractor will use multiple open-top cable supports or a special support designed to carry the additional weight.
7. A single classroom or suite of offices (with an area not exceeding 1200 square) feet will be considered a single telecommunication zone. Instructional spaces which exceed the 1200 square foot limit must be brought to the attention of the Owner's Agent for review and approval as a single zone. Loose cables from each zone to the telecommunications closet or headend room will be grouped and tied.

I. WIRING HARNESSSES:

1. All wires and cables used in assembling custom panels and equipment racks shall be formed into harnesses, tied with Velcro tie wraps and supported in accordance with accepted engineering practice.
2. Harnessed cables shall be combed straight. Each cable that breaks out from a harness for termination shall be provided with an ample service loop.
3. Harnessed cables shall be formed in either a vertical or horizontal relationship to equipment, controls, components, or terminations.

3.4 GROUNDING

A. GROUNDING PROCEDURE:

1. The system wiring will conform to the following procedures:

ITEM	PROCEDURE
Equipment AC Ground Pins:	Connect to AC ground.
Equipment Chassis:	Connect to AC ground and/or rack frames
Rack Frames:	Connect to AC ground. Use insulated bushings for all conduit connections
Shielded Cable Between AC powered equipment:	Connect to ground at one end only.
Unbalanced Equipment:	Float chassis from rack.
Conduit/Back Boxes:	Isolate system wiring, including AC power, from all conduits and permanent backboxes
AC Ground:	Green wire (grounding conductor) system shall be isolated from all other facility grounds. Connects at one point to earth.

B. METALLIC CONDUIT & ENCLOSURES

1. All metallic conduit, boxes, and enclosures shall be permanently and effectively grounded in accordance with the National Electrical Code. Metallic enclosures containing active equipment shall be grounded with due regard for minimization of electrical noise.

3.5 EQUIPMENT RACKS

1. The equipment racks are existing to remain

A. IDENTIFICATION:

1. All terminal blocks, rack mounted equipment, and active slots of card frame systems shall be clearly and logically labeled in a manner acceptable to the Owner as to their function, circuit, or system as appropriate. Labeling on manufactured equipment shall be engraved plastic laminate with white lettering on black background or dark background. Handwritten identification is not permitted. The contractor may substitute metallized polyester permanent identification labels with black printing on silver, white, or another light color background for the phenolic labels above.

3.6 CABLE TEST METHODOLOGY

A. TEST DOCUMENTATION:

1. Upon substantial completion of the data network and interfacing of the Owner supplied equipment, test every data port for the functional requirements as listed in previously. Document, on a contractor generated form, the compliance of every port and the testing individual will initialize the results of each location. Submit a written report detailing the results of initial adjustments and verification tests including all relevant drawings, charts, and photographs.

B. FIELD TEST REQUIREMENTS FOR A BALANCED TWISTED-PAIR CABLING SYSTEM

1. Every cabling link in the installation shall be tested in accordance with the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-B.2-1 (June 2002) Section 11.2: "100-Ohm twisted-pair transmission performance and field test requirements".
2. The installed twisted-pair horizontal links shall be tested from the IDF in the telecommunications room to the telecommunication wall outlet in the work area against the "Permanent Link" performance limits specification as defined in ANSI/TIA/EIA-568-B.2-1 (June 2002).
3. 100% of the installed cabling links must be tested and must pass the requirements of the standards mentioned in subsection 1 above and as further detailed in Section 27 15 00 - Horizontal Cabling. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation as described below.
4. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals).

5. The test equipment (tester) shall comply with or exceed the accuracy requirements for enhanced level II (Level II-E) field testers as defined in TIA-568-B; Annex I: Section I.4. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table I.4 of Annex I of TIA/EIA-568-B.2. (Table I.5 in this TIA document specifies the accuracy requirements for the Channel configuration.)
6. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
7. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction. The Fluke DSP-LIA101S permanent link adapter available for the DSP-4000 Series CableAnalyzer™ is an example of a tester interface that fully complies with this requirement.
8. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests (detailed in Section 27 15 00 - Horizontal Cabling). Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.
9. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks. (Reference TIA-568-B; Annex I: Section I.2.2)
10. A representative of the end-user shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase 5 business days before testing commences.
11. A representative of the end-user will select a random sample of 10% of the installed links. The representative (or his authorized delegate) shall test these randomly selected links and the results are to be stored in accordance with the prescriptions in Section 27 15 00 - Horizontal Cabling. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the end-user representative shall repeat 100% testing and the cost shall be borne by the installation contractor.

C. BALANCED TWISTED-PAIR CABLING SYSTEM PERFORMANCE TEST PARAMETERS

1. The test parameters for Cat 6 are defined in ANSI/TIA/EIA standard 568-B.2-1 "*Parameters to be reported*". The test of each Cat 6 link shall contain all of the following parameters as detailed below. In order to pass the link test all measurements (at each frequency in the range from 1MHz through 250MHz) must meet or exceed the limit value determined in the above-mentioned Cat 6 standard.

- a. **Wire Map** [as defined in TIA/EIA-568-B.2-1]: Wire Map shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.
- b. **Length** [as defined in TIA/EIA-568-B.2-1]: The field tester shall be capable of measuring length of all pairs of a permanent link or channel based on the propagation delay measurement and the average value for NVP. The physical length of the link shall be calculated using the pair with the shortest electrical delay. This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the permanent link configuration (90 meters – 295 ft) or the channel (100 meters – 328 ft) plus 10% to allow for the variation and uncertainty of NVP.
- c. **Insertion Loss (Attenuation)** [as defined in TIA/EIA-568-B.2-1]: Insertion Loss is a measure of signal loss in the permanent link or channel. The term 'Attenuation' has been used to designate "insertion loss". Insertion Loss shall be tested from 1 MHz through 250 MHz in maximum step size of 1 MHz. It is preferred to measure attenuation at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk Ratio (ACR) parameter. Minimum test results documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs, and the test limit value at this frequency.
- d. **NEXT Loss, pair-to-pair** [as defined in TIA/EIA-568-B.2-1]: Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1MHz through 250MHz. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the standards as shown in Table 1, column 2. A smaller step size more accurately identifies worst case margin conditions (see summary results, below).

Frequency Range (MHz)	Maximum Step size (MHz)	Fluke DSP-4000 Fluke DSP-4100
1 – 31.25	0.15	0.10
31.26 – 100	0.25	0.20

Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin (1) and the wire pair combination that exhibits the worst value of NEXT (worst case). NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

- e. **PSNEXT Loss** [as defined in TIA/EIA-568-B.2-1]: Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link-under-test (a total of 8 results). PSNEXT Loss captures the combined near-end crosstalk effect (sta-

tistical) on a wire pair when all other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1MHz through 250MHz and the step size may not exceed the maximum step size defined in the standards as shown in Table 1, column 2.

- f. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSNEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.
- g. ELFEXT Loss, pair-to-pair [as defined in TIA/EIA-568-B.2-1]: Pair-to-pair FEXT Loss shall be measured for each wire-pair combination from both ends of the link-under-test. FEXT Loss measures the unwanted signal coupling (crosstalk disturbance) on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ELFEXT Loss that must be evaluated and reported in the test results. ELFEXT measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire-pair combinations. ELFEXT is to be measured from 1MHz through 250MHz and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the standards as shown in Table 1, column 2. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case margin and the wire pair combination that exhibits the worst value for ELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.
- g. PSELFEXT Loss [as defined in TIA/EIA-568-B.2-1]: Power Sum ELFEXT is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields 8 wire-pair combinations. Each wire-pair is evaluated from 1MHz through 250MHz in frequency increments that do not exceed the maximum step size defined in the standards as shown in Table 1, column 2. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.
- h. Return Loss [as defined in TIA/EIA-568-B.2-1]: Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through 100 MHz in frequency increments that do not exceed the maximum step size defined in the standards as shown in Table 1, column 2. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.
- h. ACR (Attenuation to crosstalk ratio): ACR provides an indication of bandwidth for the two wire-pair network applications. ACR is a computed parameter that is analogous to ELFEXT and expresses the signal to noise ratio for a two wire-pair system. This calculation yields 12 combinations – six from each end of the link. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case margin and the wire pair combination that exhibits the worst value for ACR. These wire pair combinations must be identified for the tests

performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency:

- i. PSACR: The Power Sum version of ACR is based on PSNEXT and takes into account the combined NEXT disturbance of all adjacent wire pairs on each individual pair. This calculation yields 8 combinations – one for each wire pair from both ends of the link. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSACR. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.
- j. Propagation Delay [as defined in TIA/EIA-568-B.2-1: Propagation delay is the time required for the signal to travel from one of the link to the other. This measurement is to be performed for each of the four wire pairs. Minimum test results documentation (summary results): Identify the wire pair with the worst case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.
- j. Delay Skew [as defined in TIA/EIA-568-B.1; Section 11.2.4.11]. This parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero. Minimum test results documentation (summary results): Identify the wire pair with the worst case propagation delay (the longest propagation delay). The report shall include the delay skew value measured as well as the test limit value.

D. BALANCED TWISTED-PAIR CABLING SYSTEM TEST RESULT DOCUMENTATION

1. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test.
2. The test results records saved by the tester shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., "as saved in the tester" at the end of each test and that these results cannot be modified at a later time. Superior protection in this regard is offered by testers that transfer the numeric measurement data from the tester to the PC in a non-printable format such as the Fluke DSP-4000 Series CableAnalyzer™.
3. The database for the completed job shall be stored and delivered on CD-ROM including the software tools required to view, inspect, and print any selection of test reports.
4. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information.
 - a. The identification of the link in accordance with the naming convention defined in the overall system documentation:
 - b. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number.
 - c. The date and time the test results were saved in the memory of the tester.
5. General Information to be provided in the electronic data base with the test results information for each link:

- a. The identification of the customer site as specified by the end-user.
 - b. The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - c. The overall Pass/Fail evaluation of the link-under-test.
 - d. The name of the standard selected to execute the stored test results.
 - e. The cable type and the value of NVP used for length calculations.
 - f. The date and time the test results were saved in the memory of the tester.
 - g. The brand name, model and serial number of the tester.
 - h. The identification of the tester interface.
 - i. The revision of the tester software and the revision of the test standards database in the tester.
 - j. The test results information must contain information on each of the required test parameters that are listed in Section 27 15 00 - Horizontal Cabling and as further detailed below under paragraph 6.
6. The detailed test results data to be provided in the electronic database for each tested link must contain the following information:
- a. For each of the frequency-dependent test parameters, the minimum test results documentation shall be stored for each wire-pair or wire-pair combination as observed from each end of the link. The minimum test results documentation for each test parameter shall be in compliance with the information described herein.
 - 1) Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.5 m *[optional: foot]* and the test limit value
 - 2) Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value
 - 3) Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value
 - 4) Insertion Loss (Attenuation): Minimum test results documentation as explained in Section 27 15 00 - Horizontal Cabling for the wire pair with the worst insertion loss
 - 5) Return Loss: Minimum test results documentation as explained in Section 27 15 00 - Horizontal Cabling. Identify as detected from each end of the link, the wire pair that exhibits the worst case margin and the wire pair with the worst RL. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

- 6) NEXT, ELFEXT, ACR: Minimum test results documentation as explained in Section 27 15 00 - Horizontal Cabling. Identify as measured from each end of the link, the wire pair combination that exhibits the worst case margin and the wire pair combination that delivers the worst case value. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.
 - 7) PSNEXT, PSELFEXT, and PSACR: Minimum test results documentation as explained in Section 27 15 00 - Horizontal Cabling. Identify as detected from each end of the link, the wire pair that exhibits the worst case margin and the wire pair with the worst value. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.
 - 8) Link length, propagation delay, and delay skew shall be reported for each wire pair as well as the test limit for each of these parameters.
7. The test result information for each link shall be recorded in the memory of the field test equipment upon completion of the test.
 8. The test result records saved by the test equipment shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records.
 9. A guarantee must be made that these results are transferred to the PC unaltered, i.e., "as saved in the test equipment" at the end of each test.
 10. The popular 'csv' format (comma separated value format) does not provide adequate protection and shall not be acceptable.
 11. The database for the completed job – including twisted-pair copper cabling links if applicable – shall be stored and delivered on CD-ROM; this CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.
 12. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
 - j. The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - k. The overall Pass/Fail evaluation of the link-under-test including the Attenuation worst case margin (margin is defined as the difference between the measured value and the test limit value).
 - l. The date and time the test results were saved in the memory of the test equipment.
 13. General Information to be provided in the electronic data base containing the test result information for each link:
 - j. The identification of the customer site as specified by the end-user.
 - k. The overall Pass/Fail evaluation of the link-under-test. The name of the standard selected to execute the stored test results.

- l. The cable type and the value of the 'index of refraction' used for length calculations.
 - m. The date and time the test results were saved in the memory of the test equipment.
 - n. The brand name, model and serial number of the test equipment.
 - o. The revision of the test equipment software and the revision of the test standards database in the test equipment.
- 14. The detailed test results data to be provided in the electronic database for each tested optical fiber must contain the following information:
 - j. The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.
 - k. The attenuation measured at each wavelength, the test limit calculated for the corresponding wavelength and the margin (difference between the measured attenuation and the test limit value).
 - l. The link length shall be reported for each optical fiber for which the test limit was calculated based on the formulas previously shown.
 - m. All fiber optic cable shall be factory tested on a reel basis with performance data for each cable supplied to the contractor and to the Owner. Tests shall be conducted utilizing an OTDR (Optical Time Domain Reflectometer) at 850nm and 1300 nm with the attenuation in dB/km recorded for each fiber.

3.2 VERIFICATION TEST REPORT

- A. Submit a written report detailing the results of initial adjustments and verification tests including all relevant drawings, charts, and photographs. This report will be completed and submitted for review at least five (5) days prior to acceptance testing.

3.3 ACCEPTANCE TESTING

- A. The Acceptance Testing and provision of testing equipment will be the responsibility of and performed by the Contractor in the presence of the Owner, Architect, or the Owner's representative. Coordinate this period so that free access, work lighting, electrical is available on the site.
- B. Should the contractor schedule an Acceptance Test and the system or components are not ready for or fail Acceptance Testing, the contractor will pay for all subsequent trips and man-hours required for the consultant to properly document specification conformance by the contractor. The Owner will have the right to reduce pay requests or final application of payment to the contractor in an amount equal to the travel costs and man-hours expended by the Consultant and charged to the contractor. The Owner would then pay the Consultant from the funds withheld from the contractor.
- C. Upon witness of the Acceptance Testing and the determination, in the Consultant's opinion, that the Contractor has falsified the Verification Test Reports, the Owner has the right to hire an Independent Testing Agency to provide outside verification of the results. Falsifica-

tion of the test results is defined as cables shown as testing correctly in the Verification Report fail during the Acceptance Testing. (The Contractor has the right to hire an Independent Testing Agency approved by the Consultant and the Owner directly.) Furthermore, the Owner will have the right to reduce pay requests or final application of payment to the Contractor in an amount equal to the travel costs and man-hours expended by the Independent Testing Agency and Consultant and charged to the contractor. The Owner would then pay the Independent Testing Agency and Consultant from the funds withheld from the contractor.

3.4 SYSTEM DOCUMENTATION

- A. Prior to final acceptance tests, the Contractor shall submit to the Owner three copies of an operating and maintenance manual for the system that has been installed. These manuals will be used during the final acceptance testing of the system. Each manual will contain the following information:
1. As-built project drawings. Provide three copies.
 2. Manufacturer Operation and Maintenance manuals. Provide three copies.
 3. Where applicable, single line diagrams showing levels throughout system and impedances. Provide three copies.
 4. Copies of Training materials. Provide three copies
 5. Verification and Acceptance Test Reports. Provide three copies.

END OF SECTION

04/14/14

SECTION 27 05 00**BASIC COMMUNICATIONS MATERIALS AND METHODS****PART 1 – GENERAL****1.1 GENERAL REQUIREMENTS**

- A. Division 00 General Conditions and division 01 General Requirements apply to the work of this Section.
- B. The Contractor shall have a Project Manager with a RCDD on staff and submit a copy of their current credentials.

1.2 WORK INCLUDED

- A. This Section describes the scope of work, standards, products and execution to provide new and complete Voice and Data Backbone Cabling and routing on the (Yerba Buena High School) campus of the East Side Union High School District. This project includes the following types of cabling: single and multi-mode fiber (data backbones), and Category 3 copper (voice and speaker backbones). This is a cabling-only project, and does not include specifications for PBX, handsets, desktop PCs, or servers used for the generation of communication signals on the installed wiring.
 - 1. Installation of Outside Plant single and multimode Fiber Optic Backbone cabling from the new Building IDF to the Main Telecommunications Room (MDF) of the campus.
 - 2. Installation of Outside Plant Category 3 voice backbone cable from the new Building IDF to the MPOE of the campus.
 - 3. Installation of Inside Plant Category 6 horizontal distribution cable from the new Building IDF to wall and ceiling mounted outlets.
 - 4. Routing, suspension, and mounting of cabling.
 - 5. Termination of all cables in Telecommunications Spaces and other specified locations.
 - 6. Testing, labeling, and documentation of all cable and hardware installed under this contract.
 - 7. Preparation and submission of testing reports, as-built drawings and cabling documentation.
 - 8. Sealing of OSP entrance conduits and all penetrations after cabling is installed.
- B. It is the intent of the Drawings and Specifications to provide a cabling system ready for use. Any item not specifically drawn or called for in the Specifications, but normally required for a complete system, is considered to be part of the Contract.

1.3 RELATED WORK INCLUDED IN OTHER SECTIONS

- A. Sections of Division 26 00 00, Electrical General Requirements.
- B. Sections of Division 27 00 00 Communications.
- C. Sections of Division 28 00 00 Intrusion, Fire Alarm

1.4 SUBMITTALS

- A. The Contractor shall provide submittals within 30 working days of Notice to Proceed. The Contractor shall not deliver materials to the site until submittals are approved.

B. Product Data

1. Provide manufacturer's catalog information showing dimensions, colors, and configurations.
2. Submittals shall include all items called for in PART 2 – PRODUCTS of this document and the manufacturers cut sheets for the following:
 - a. All single mode fiber optic cable
 - b. All multimode fiber optic cable
 - c. All balanced twisted pair cable
 - d. All connectors and required tooling
 - e. All termination system components
 - f. All grounding and surge suppression system components
 - g. All test equipment to be used
3. Identify each submittal item by reference to Specification Section paragraph in which item is specified or Drawing and Detail number.
4. Organize submittals in the same sequence as they appear in Specification Sections, articles, or paragraphs.

1.5 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-installation conference at least seven calendar days prior to installing any equipment, devices or systems in the IDF Room. For projects with underground and/or roof mounted conduits convene a separate pre-installation meeting
- B. Attendance: Architect, Construction Manager, Contractor, Electrical Subcontractor, Low Voltage Subcontractor/s, District Low Voltage System Representative and Project Inspector.
- C. Agenda: Review all low voltage systems related to the project. Subcontractors shall come prepared to discuss how the low voltage systems are being installed and run throughout the building/s.

PART 2 – PRODUCTS**2.1 GENERAL**

- A. The voice and data cabling system is defined as all required equipment and cabling, including hardware, termination blocks, cross-connects, patch panels, patch cords, copper and fiber cabling.
- B. The Contractor shall supply the products as detailed in this specification. If not specified, the Contractor can select products of suitable quality and workmanship. For any products selected by the Contractor, the Contractor is required to submit product documentation including manufacturer's original literature, product specifications and testing reports as previously described.
- C. Equal Product may be considered for substitution for those products specified, however, any equivalent product(s) must be approved by the District IT Representative prior to installation, and show demonstrated and documented equivalence or superiority in performance and functionality to the product(s) specified.
- D. All material furnished shall be new and unused. All materials used shall bear the Underwriter's Laboratory, Inc. label, provided a standard has been established for the material in question. All products and materials to be clean, free of defects, and free of damage and corrosion.

- E. The Contractor must provide a 20 year Leviton / Superior Essex Outside Plant warranty and a Limited Lifetime Leviton/Berk-Tek warranty upon completion of this project. All warranties are processed by the contractor through Leviton Network Solutions and delivered directly to the Owner.

2.2 OUTSIDE PLANT COPPER BACKBONE CABLE

- A. All voice grade cable placed in the outside environment shall be solid, unshielded twisted pair, PE-89, 24 AWG Outside Plant Cable (OSP). Twenty five pair cable shall be Superior Essex 09-097-92 for speakers. Fifty pairs cable shall be Superior Essex 09-100-92 for analog lines and cameras.
- B. The copper twisted pair shall have a mutual capacitance at 1kHz of 83 nF/mile and meet ANSI/ICEA S-84-608 2007.
- C. The cable shall be resistant to mechanical damage, lightning, or damage from wildlife. The cable shall have a dual shield design with fully flooded shield interfaces.

2.3 BUILDING ENTRANCE PROTECTORS

- A. All OSP balanced twisted pair cable pairs shall be provided with protection at each building with an entrance cable protector panel. Circa Telecom 1880ECA1-50G regardless of the number of pairs required.
- B. The protector panel shall be equipped with a ground lug that will accept a 6 AWG copper bonding conductor.
- C. Each protector panel shall be fully loaded with 5-pin plug-in protector modules 4B1FS-240.

2.4 110-TYPE WIRING BLOCK KIT

- A. The wiring block kit shall support Category 3 applications and facilitate cross connection and interconnection using cross connect wire. Leviton 41MB2-3F4. Each kit shall be provided with a vertical cord manager, Leviton 41880-300.
- B. The wiring block shall be fire retardant, molded plastic consisting of horizontal index strips for terminating 25 pairs of conductors each. The index strips shall be marked with five colors on the high teeth, separating the tip and ring of each pair, to establish pair location. The wiring block shall accommodate 22 through 26-AWG conductors.
- C. The wiring block kit shall include multiple 100 pair blocks, mounting frame, horizontal cord manager and label holder.
- D. Provide C5 clips for ISP feeder terminations only. No station cabling is to be terminated directly onto 110 frames unless otherwise specified by District Low Voltage System Representative.
- E. Every 110 frame is to be provided fully loaded with C5 Clips.

2.5 RISER RATED BACKBONE CABLE

- A. Copper riser rated cable shall be solid, twisted pair Category 3, CMR, 24 AWG. Superior Essex 18-499-36 (25 PAIR) AND 18-579-36 (50 PAIR)
- B. The copper twisted pairs shall have a mutual capacitance at 1 kHz of 15.7 nF/1000 ft.

2.6 HYBRID FIBER OPTIC BACKBONE CABLE

- A. The fiber optic backbone cable shall be a 12 strand SM/12 strand MM 62.5micron outside plant rated composite cable in a loose tube construction with inner and outer jackets and corrugated steel armor. Berk-Tek OPAD12B024-012CB3510/25012AB0403. This is a long lead item. The contractor shall allow time for approval and ordering of the cable.

- B. The Singlemode fiber shall be ISO/IEC 11801 OS2, dispersion un-shifted fiber in a loose-tube design which meets the ITUT G.652d requirements.
- C. The 62.5/125 micron multimode fiber shall have a maximum attenuation of 3.4 dB/km at 850 nm, and 1.0 dB/km at 1300 nm. This fiber shall be ISO/IEC 11801 OM1.
- D. Provide Leviton 36" 12 strand break out kits 49887-12L.

2.7 FIBER OPTIC PANELS AND MODULES

- A. Low Profile 2U combination panel shelves, Leviton OPT-X5R2UH-S06 at each end, with 4 blank plates Leviton 5F100-PLT. The panel shelf shall be available in a 2U height fully enclosed shelf, with integrated front cable management trough included. The shelf shall be equipped with hinged front doors for easy access, front cable management trough, top cover panel, standard water-tight cable entry conduit connectors for OSP cable, and blank labels for identifying fiber terminations.
- B. Fiber modules shall be loaded with 12-strand LC fiber optic adapter panels. Leviton 5F100-2IL for multimode, and 5F100-2LL for Singlemode. Modules must be from the same manufacturer as the fiber shelf.
- C. LC Fiber Optic connectors shall utilize a pre-radiused zirconia ferrule and anaerobic adhesive for fiber alignment. Leviton 49990-MDL for multimode, and 49990-SDL for Singlemode.
- D. All the fiber needs to be installed in the panel in a "straight through" or A-A polarity configuration.

2.8 UTP STATION CABLE

- A. UTP Station cable shall consist of 4-pair Category 6, 23 AWG thermoplastic insulated conductors. All station cabling in plenum rated areas must have a minimum cable sheath rating of CMP. (All systems consist of CAT6 cabling)
 - 1. This cable must meet parameters of the Cat 6 Cable TIA/EIA-568-C and CAT 6 Permanent Link TIA/EIA-568-C Commercial Building Telecommunications Wiring Standard.
 - a. Input Impedance – 100 Ohms +/- 15% at 1-100 MHz
 - b. ACR at 250 MHz shall be a minimum of 8.7 dB/100m.
 - c. PS NEXT at 250 MHz shall be a minimum of 39.3 dB/100m.
 - d. Insertion loss at 250 MHz shall be a maximum 32.6 dB/100m.
 - 2. Data station cable jacket shall be blue, Berk-Tek LANmark-1000, 10032094 (CMP).
 - 3. Wireless cable jacket shall be green, Berk-Tek LANmark-1000, 10032097 (CMP).

2.9 COPPER OUTLET TERMINATIONS

- A. T568B eight position, 8-conductor RJ45 jacks with 110 style rear termination. These terminations shall meet or exceed the requirements of the Cat 6 Cable TIA/EIA-568-C and CAT 6 Permanent Link TIA/EIA-568-C Commercial Building Telecommunications Wiring Standard.
 - 1. Four Pair data station cables in surface wall boxes shall be terminated on blue jacks, Leviton 61110-RL6.
 - 2. Four pair cables for wireless outlets in ceiling mounted boxes shall be terminated on green jacks, Leviton 61110-RV6.
 - 3. Four pair cables for camera outlets shall be terminated on yellow jacks, Leviton 61110-RY6. (refer to surveillance section)
 - 4. Four pair cables for intrusion panel IP connectivity shall be terminated on gray jacks, Leviton 61110-RG6. (refer to intrusion section)

5. Four pair cables for speakers shall be terminated on purple jacks, Leviton 61110-RP6. (refer to paging section)
- B. Universal faceplates that will accept the jack of the connectivity solutions shall be used throughout this project. Material shall be stainless steel. Leviton 43080-1S2 (2 ports) and 43080-1S4 (4 ports).
- C. Wall phone faceplates to be provided under this scope shall accept the jacks used on this project. Leviton 4108W-OSP.
- D. Wireless face plates shall be Leviton Quick Port 2 Port Face Plate 41080-2IP.

2.10 COPPER PATCH PANELS

- A. High density unshielded twisted pair termination panels with space for 48 8P8C modules. Panels shall mount in a standard 19 inch equipment rack with universal hole spacing and allow for independent installation and removal of jack modules. Rear cable management bar shall be included with each patch panel. Cable termination modules shall be included as needed to complete the installation. All unused ports shall be covered with blank modules. Provide 20% additional patch panels for future growth.
 1. Modular jack panels shall be 48 ports in a 2U space. Leviton 49255-H48 for CAT6 cabling.

2.11 WIRE MANAGEMENT

- A. Horizontal and Vertical cable managers shall be capable of managing cables on the front and rear of a standard 19 inch equipment rack. Horizontal managers shall have pass through holes that incorporate integral bend radius control and fingers with rounded edges. Hinged covers shall allow access to the cable pathway without having to remove the cover from the wire manager. Install horizontal wire managers above and below each patch panel.
 1. Horizontal cable manager 2U high, Chatsworth 30530-719.
 2. Vertical cable managers shall be Chatsworth 30095-703.

2.12 TELECOMMUNICATIONS GROUNDING AND BONDING

- A. All grounding and bonding conductors shall be copper and may be insulated. When conductors are insulated, the sheath shall be green or marked with a distinctive green color, and shall be listed for the application. The minimum bonding conductor size shall be 6 AWG.
- B. The Telecommunications Ground Busbar (TGB) shall be dedicated and pre-drilled copper busbar provided with holes for use with standard sized lugs. This busbar shall have minimum dimensions of .25 inch thick, 4 inches wide, and be variable in length. The busbar shall be connected to a dedicated ground rod to be installed at each IDF/MDF.
- C. Two-hole compression ground lugs shall be Chatsworth 40162-901, 40162-904, 40162-909, and 40162-911, or equal, based on the size of the copper conductor to be terminated.
- D. All low voltage systems in this project are to be grounded and bonded.

2.13 LABELS

- A. The contractor shall provide tags, straps, and adhesive labels. These tags, straps, and adhesive labels must be of high quality that will endure heat, water, and time.

- B. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.
- C. Shall be pre-printed using a mechanical means of printing.
- D. Where used for cable marking, provide vinyl substrate with a white printing area and a clear "tail" that self laminates the printed area when wrapped around the cable. The cable marking should be immediately visible and be within two inches from the termination point.
- E. Where insert type labels are used, provide clear plastic cover over label.
- F. Copper patch panel labeling shall be completed with adhesive labeling kit specifically designed for the panel, Leviton 49257-QHD.
- G. Labeling P-touch font size 4MM bold, black on White, 3/8" labeling tape on all work stations, panels and devices.
- H. A round Avery label green in color Product Number: 5463 and a station label utilizing the same font size as on work station face plate must be installed on ceiling grid below each wireless cable location for identification. See type "D" Wireless Location Detail.
- I. Labels shall be numbered consecutively and separate for each type of use. Refer to Work Station Details and Floor Plan Device Numbering Example for additional information

2.14 EQUIPMENT AND LADDER RACK SYSTEM

- A. UL listed Chatsworth 19"W x 84"H x 15" D 45 RMU Aluminum 2 post rack P.N. 55053-703
- C. Ladder rack to wall support, Chatsworth Wall Angle Support Kit P.N. 11421-712
- C. Rack to runway support Chatsworth mounting plate P.N. 10595-712
- D. Ladder rack support system, Chatsworth Universal Cable Runway P.N. 10250-712
- E. Straight through ladder rack splice, Chatsworth Butt-Splice Kit P.N. 11301-701
- F. Ladder rack junction splice, Chatsworth Junction Splice Kit P.N. 11302-702
- G. Ladder rack protective end caps, Chatsworth Protective Rubber End Caps P.N. 10642-001
- H. Wall support for cable runway Chatsworth Triangular Support Bracket P.N. 11312-712
- I. Provide two single sided equipment shelves for each rack installed, Chatsworth P.N. 40074-700.
- J. Equipment rack bonding material Chatsworth Green Ground Jumper P.N. 40159-009 and Chatsworth Green Cable Runway Ground Strap Kit P.N. 40164-001. Remove paint under each ground lug

2.15 POWER DISTRIBUTION UNIT

- A. Rack mounted power distribution unit shall be a 19 inch wide 20 amp 125V horizontal unit with eight 5-20R receptacles and a standard 10 foot power cord with 5-20P straight blade plug, Geist RCURN082-102D20ST5-OD to be installed in the MDF/IDF.
- B. Add two dedicated 20 Amp 5-20R each, four-plex power receptacle per rack

2.16 OTHER EQUIPMENT

- A. Plywood Backboard: The Contractor shall provide fire-rated, A/C grade, void free, ¾"x4'x8' plywood. To reduce warping, fire rated plywood should be kiln dried to a maximum moisture content of 15%. Plywood shall be securely fastened to the wall. Plywood shall be painted with two coats of white paint. The Contractor shall not paint over the fire rating stamp. The plywood is to be mounted vertically and is to cover all walls of the IDF.
- B. Service loop mounts: The Contractor shall provide service loop mounts for management of the fiber and copper service loops at both ends. Leviton Storage Rings for OSP riser backbone cabling shall be provided. The Contractor shall provide a service loop equal to the maximum length allowable so as to not exceed a total of 50 feet of exposed cable from building entrance to termination. Leviton Storage Rings 48900-OFR.
- D. Fabric Innerduct: The contractor shall install 3 cell fabric innerduct in all sections of conduit, Maxcell or equal. Installation must follow manufacturer's installation requirements, using recommended installation tools. Fabric Innerduct size shall match manufacturer recommended maximum size. Fiber shall be installed within fabric innerduct.
- E. Patch Cords: The Contractor shall provide Leviton bootless / snagless patch cords for both station and IDF equipment end. Counts to support cable drop counts build out of all low voltage systems terminated on patch panels. Lengths and colors are as follows:
- 8' Blue patch cord Cat 6 bootless / snagless 6D460-08L
 - 7' Blue patch cord Cat 6 bootless / snagless 6D460-07L
 - 6' Green patch cord Cat 6 bootless / snagless 6D460-06G
 - 6' Yellow patch cord Cat 6 bootless / snagless 6D460-06Y
 - 6' Grey patch cord Cat 6 bootless / snagless 6D460-06S
 - 6' Purple patch cord Cat 6 bootless / snagless 6D460-06P
 - 6' Orange patch cord Cat 6 bootless/snagless 6D560-06O
- F. Fiber Patch Cords: The contractor shall provide and install (4) duplex SM Leviton UPDLC-S10 and (4) duplex MM Leviton 62DLC-M10 fiber patch cords not to exceed 15 meters each and which will not introduce a loss greater than 1.0 dB, including connectors. The contractor shall confirm actual length and connector types with the district IT representative.
- G. Cross-connects: Each IDF and MDF receives one CPI 11435-719 Cable Reel with four reels of Superior Essex cross-connect wire. One 1k roll of white/blue 02-001-13 for voice, one 1k roll of yellow/blue 02-002-13 for speakers, one 1k roll of red/blue 02-053-13 for stationary cameras and one two pair red/blue, red/orange 02-221-13 for ptz cameras.

2.17 FIRE STOP SYSTEM:

1. See project drawings for detailed fire caulk systems and products.
2. Intumescent fire caulk:
 - a. The firestop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure.
 - b. Firestop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.
 - c. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane

penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall use the proper firestop equipment.

- d. Firestop systems shall be UL Classified to ASTM E814 (UL 1479).
- e. Approved Fire Barrier/Caulk – 3M Fire Barrier CP25 or equal STI, PN# SSS100.

2.18 Re-Enterable Fire Stop System:

- 1. See project drawings for detailed fire thru systems and products.
 - a. The re-enterable fire stop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure.
 - b. No additional fire stopping material shall be required to obtain proper fire stopping.
 - c. The system shall offer full fire resistance whether it is empty or 100% visually filled.
 - d. The system shall be self-contained, and shall automatically adjust to differing cable loads.
 - e. The system shall allow add, moves, and changes without additional materials.
 - f. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate re-enterable fire stop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall use the proper fire stop equipment.
 - g. Fire stop systems shall be UL Classified to ASTM E814 (UL 1479).
 - h. The system shall be gang-able using wall plates for additional capacity.
 - i. Quantity: See Drawing for quantity and installation details.
 - j. Part #: Equal to STI
 - 1) STI PN# EZDP33FWS.
 - 2) STI PN# EZDP33WR.

PART 3 – EXECUTION

3.1 GENERAL

- A. Manufacturer's recommended installation practices shall be followed.

3.2 DAMAGES

- A. The Contractor shall be liable for any and all damages to portions of the existing Campus caused it, its employees or subcontractors, including, but not limited to:
 - 1. Damage to any portion of the Campus caused by the movement of tools, materials, or equipment.
 - 2. Damage to any component of the existing telecommunications spaces accessed by the Contractor.

3. Damage to the existing electrical, telecommunications, mechanical and/or life safety or other systems caused by inappropriate operation or connections made by the Contractor or other actions of Contractor.

3.3 OUTSIDE PLANT CABLE INSTALLATION

- A. Use pulling compound when necessary. Pulling compounds must be water-base lubricant that will not deteriorate cable or conduit.
- B. All cable/cabling shall be kept 30 inches away from any heat source; i.e. steam valves, etc.
- C. Cables shall be pulled free of sharp bends, kinks, twists, or impact damage to the sheath. Cables shall not be pulled across sharp edges. All conduits and sleeve with rough edges will be provided with bushings on both ends. Cables shall not be forced or jammed between metal parts, assemblies, etc.
- D. All outside plant cables will be terminated within 50 feet of the building entrance point. This is a maximum cable measurement and includes lengths for service loops, routing, backboard and patch panel mounting. If the cables cannot be terminated within the 50 foot length, the cables shall be extended in an uninterrupted rigid conduit from the point of building entry to within a 50 foot distance from the point of termination.
- E. Cable mountings and service loops on backboards will be installed efficiently to minimize the backboard space consumed. All cables will be routed at right angles, in accordance with the bend radius specifications for the type of cable being routed. Multi-pair copper cables will be tie wrapped every 4 feet. Fiber and Category 6 cables shall use Velcro wraps.
- F. Polarization for entire system shall be maintained as described in ANSI/EIA/TIA-568-Csection 12.7.1.

3.4 COPPER BACKBONE TERMINATIONS

- A. All copper shall be terminated on building entrance protector panels.
- B. The building Entrance blocks shall be fully populated with protection fuses.
- C. The OSP copper cable shall be exposed for no more than 50 feet from the point of entry in each building to where it is terminated on the protector panels as defined in Article 800-2 of the National Electrical Code.
- D. The Building Entrance protection blocks shall be grounded with a 6 AWG copper bonding conductor between the protector ground lug and the grounding bus bar.
- E. From the protector blocks, the Contractor shall provide ISP feeder to match OSP feeder count to new, wall mount 110 style blocks. All pairs shall be extended from the protector blocks to the 110 blocks.

3.5 FIBER OPTIC BACKBONE TERMINATIONS

- A. Fiber will directly terminate on the rack mount fiber shelves without additional splicing. Sufficient cable slack to allow for movement and relocation will be required.
- B. Field terminated LC connectors are required for all fiber strands in the telecommunications closets. All optical fiber strands shall be terminated. Connectors will be color-coded to distinguish core size.
- C. Fiber Patch Cords: The contractor shall provide and install (4) duplex each SM & MM fiber patch cords not to exceed 15 meters each and will not introduce a loss greater than 1.0 dB, including

connectors. The contractor shall confirm actual length and connector types with the district IT representative.

3.6 HORIZONTAL CABLE

- A. Place UTP cable so as to maintain the minimum cable bend radius limits specified by the manufacturer.
- B. To avoid damaging horizontal cable conductors during installation, do not exceed a 25 pound force pulling tension.
- C. Place copper cables transitioning between overhead pathways and cabinets in a neat and orderly manner without stressing, excessively bending, or pinching the bottom cables of the bundle.
- D. Directly terminate twisted pair cable on patch panels and outlets in standard color code order.
- E. Cable runs of low voltages cabling systems shall maintain a minimum of 4" clearance throughout entire length of runs. Bundling of different systems cables is not permitted.

3.7 LABELING

- A. Outside Plant
 - 1. The Contractor is required to provide labels for all cables at any vaults, pull box, or access panel crossing. The Contractor shall provide cable labels twelve inches from the end of the cable as it enters the building, on service loop mounts, and twelve inches from the end of the cable at the point of termination. Fiber Optic and Copper Cable Orange Laminate Tag (3.5" x 2") Hellemanntyton P.N. CT2003X2. Telephone Cable Yellow Laminate Tag (3.5" x 2") Hellemanntyton P.N. CT2012X2. Cable Orange Laminate Write-On Tag (4" x 1.5") Hellemanntyton P.N. WC1503X2. The Contractor shall provide adhesive labels on all termination hardware such as fiber distribution shelf, protector, and 110 blocks.
 - 2. All cables will be labeled according to the guidelines shown below as adapted from the EIA/TIA 606-A standard.
 - 3. Fiber and copper backbone cable labeling shall follow the convention to include:
 - a. Campus
 - b. The origination point (Building Room ID)
 - c. The destination point (Building Room ID)
 - d. The type of cable
 - e. The strand or pair count.
- B. Horizontal Distribution
 - 1. The Contractor is required to provide labels at all termination hardware such as patch panels and faceplate outlets and devices.
 - 2. Provide Room Number label at all patch panels. Coordinate with District Low Voltage System Representative prior to final labeling
 - 3. The Contractor shall provide 1/8 inch thick engraved plastic labels for new cabinets or racks installed. The engraving shall be white on black background.
 - 4. Labeling at Rooms
 - a. Start numbering at the room with the lowest number. Label clockwise starting at the room entry door
 - b. Computer Labs are to be labeled after all rooms have been labeled.

3.8 TESTING

- A. The Contractor's staff selected to provide the testing of this installation shall be certified by the manufacturer of the test equipment utilized, trained in all aspects of telecommunications acceptance testing procedures of the products described herein and shall have a minimum of five years experience in telecommunications acceptance testing.

The contractor shall notify the district prior to start of testing and provide the date that testing will start for the district to be present when the testing is started

- B. Field test instruments shall have a current calibration certificate on hand during testing and the latest software and firmware installed.
- C. All cables and termination hardware shall be 100% tested to verify cabling system performance under installed conditions. All pairs/strands of each installed cable shall be verified prior to system acceptance.
- D. **Balanced Twisted Pair Cable Testing**
1. CAT 6 test results must include the following tests and provided in electronic format upon completion of each site: Wire Map, Length; Propagation Delay; Delay Skew; Attenuation; NEXT, NEXT @ Remote; Power Sum NEXT, PSNEXT @ Remote; ELFEXT, ELFEXT @ Remote; Power Sum ELFEXT; Attenuation-to-Crosstalk Ratio (ACR), ACR @ Remote; Characteristic Impedance; DC Loop Resistance; Return Loss (RL), RL @ Remote.
- Each test page must be properly identified with School site, IDF and Station location, Example: "ST BLDG K W001A". All test results must be submitted in sequential order. All tests are to be "Permanent Link" type.
2. All pairs shall be tested with a copper test tool that conforms to the specifications of a certified Level II-E test set as described in TIA/EIA 568-B.2.
 3. Copper backbone cabling shall be tested for conformance to the specifications of EIA/TIA Category 3 for multi-pair cable. Test shall include opens, shorts, polarity reversals, transposition, TDR for length, DC resistance, and tip/ring per pair.
- E. **Optical Fiber Cable Testing**
1. The contractor shall conduct on reel test of all optical fiber cable prior to the installation.
 2. Optical fiber testing shall be performed on all terminated fiber in the completed end-to-end system. Testing shall consist of an end-to-end OLTS and OTDR test performed per TIA/EIA-526-7. These tests also include continuity checking and optical length measurement of each fiber.
 3. Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with sub clause 10.3 of ANSI/TIA/EIA 568-B.1. The polarity of the paired duplex fibers shall be verified using an OLTS.
 4. All singlemode fiber optic cabling shall be tested at both 1310 and 1550 nm per TIA/EIA 526-7 Methods "A.1" (OLTS) and "B" (OTDR). All multimode fiber optic cabling shall be tested at 850 and 1300 nm.
 5. Each fiber shall be tested in both directions.
 6. Link test results from the OLTS and OTDR shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation may be generated. All test results must be submitted in sequential order.

3.9 TEST RECORDS

A. General

1. All cables will be tested and the results in electronic format on CD-ROM, with the resulting file capable of being formatted with one test result per 8.5 inch by 11 inch page. A hard copy of all tests is to be submitted in a 3 ring binder.
2. Test results saved within the field test instrument shall be transferred to a Windows based database utility that allows for the maintenance, inspection, and archiving of the test records. The test records shall be uploaded to the PC unaltered, i.e. "as saved in the field test instrument". The file format CSV does not provide adequate protection of these records and shall not be used.
3. The database for the complete project shall be stored and delivered on CD-ROM prior punch walk and/or to the acceptance of the project. This CD-ROM shall include the software tools required to view, inspect, and print any selection of the test reports in the native format of the tester. All test results must be submitted in sequential order.

3.10 AS BUILT DOCUMENTATION

- A. The Contractor will be provided drawings in electronic format (DWG, AutoCAD release 14 or later) on which as-built construction information can be added.
- B. Upon completion of the project, the Contractor is to prepare as-built documentation showing actual site conditions and installation as constructed.
- C. The Contractor shall annotate the base drawings and return a hard copy and electronic form (AutoCAD release 14 or later).
- D. The Contractor shall provide and install a C-size framed floor plan with outlet and device locations for all low voltage systems. The floor plan shall be framed and installed in the new MDF/IDF Room. The drawing should be a plan of the building with a symbols legend showing where all the devices are and the labeling for each device only. Remove all general notes and details not applicable to the low voltage systems.

END OF SECTION

SECTION 27 51 16
PAGING SPEAKERS AND CLOCKS**PART 1 – GENERAL****1.1 GENERAL REQUIREMENTS**

- A. Division 00 General Conditions and division 01 General Requirements apply to the work of this Section.

1.2 WORK INCLUDED

- A. This Section specifies the requirements necessary to furnish and install:
1. Indoor speakers.
 2. Exterior speakers.
 3. Connection to new or existing Telecor equipment
 4. Wireless clocks.

1.3 RELATED WORK

- A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for basic communications materials and methods:
1. Sections of Division 26 00 00, Basic Electrical Materials and Methods.
 2. Sections of Division 27 00 00 Communications.
- B. In the event of conflict regarding requirements for communications materials and methods between this Section and any other section, the provisions of this Section shall govern.

1.4 SUBMITTALS

- A. Manufacturer's literature describing the product.
- B. Wiring diagrams clearly showing the interconnections of all major components.
- C. Maintenance manuals and parts lists. Manual shall include schematic drawings and service instructions.
- D. Floor plan drawings showing device locations, conduit routings, and number of conductors.

1.5 EXISTING SYSTEM FUNCTIONAL DESCRIPTION

- A. The existing campus public address system shall be extended to the new building.

1.6 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-installation conference at least seven calendar days prior to installing any equipment, devices or systems in the IDF Room. For projects with underground and/or roof mounted conduits convene a separate pre-installation meeting
- B. Attendance: Architect, Construction Manager, Contractor, Electrical Subcontractor, Low Voltage Subcontractor/s, District Low Voltage System Representative and Project Inspector.

- C. Agenda: Review all low voltage systems related to the project. Subcontractors shall come prepared to discuss how the low voltage systems are being installed and run throughout the building/s.

PART 2 – PRODUCTS

2.1 INTERIOR SPEAKERS

- A. Interior speakers shall be eighth inch diameter paper cone type with T25 25V line matching transformer. Frequency range to be 30 to 15,000 Hz. Telecor STB-11 or equal. Drop ceiling support shall be Telecor CC1, or equal. Interior wall mounted speakers shall be mounted in Atlas Sound VP-161A-APF backbox/baffle assembly. Atlas Sound SE161-R6 where surface mounted.

2.2 EXTERIOR SPEAKERS

- A. Exterior speaker assembly shall be Atlas APF-15TUC series loudspeaker with T-11 transformer in an Atlas SE161-R6 backbox and VP161-APF cover, or equal. Housing shall include a baffle and be painted to match surrounding surfaces.

2.3 CABLING

- A. Cable serving interior speakers shall be home run 23 AWG Category 6 CMP, Bertek LANmark 100 Cat6 white in color 11074738
- B. Cables are to be terminated at the IDF onto purple Leviton Cat 6 jacks 61110-RP6 and secured to ports 1-24 of a 48 port Leviton Multimedia panel 49255-H48 with a 49257-QHD. Ports utilized will depend on speaker counts.
- C. A 25 pair ISP cable is to terminate on Leviton Cat 6 jacks, black in color 61110-RE6 from ports 25-48 of the panel mentioned in 2.3 B to the 110 frame in the same IDF. Ports utilized will depend on speaker counts.

2.4 CONNECTION TO TELECOR EQUIPMENT

- A. The contractor shall program all new speakers to Telecor Equipment as directed by the district representative.
- B. Install TELECOR IOP-4 CARD with 50 FT. 25 pair CAT 3 Tail terminated into 110 frame. Contractor shall program one port of the new card(s) for each speaker installed. The bill schedule will be provided by the district Low Voltage System Representative.

2.5 CLOCKS

- A. Install new wireless clocks Primex Wireless Traditional Series round, black Arabic numerals, white face, black frame
- 1) Primex 14306 12.5" 120VAC Black Standard model for most installations
 - 2) Primex 14339 16" 120VAC Black Standard model for installations in larger volume spaces

Wireless clocks are to be electric not battery powered. An outlet will need to be provided behind each clock. Clocks shall be synchronized to existing campus clock system.

2.6 LABELS

- A. The contractor shall provide tags, straps, and adhesive labels. These tags, straps, and adhesive labels must be of high quality that will endure heat, water, and time.
- B. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.

- C. Shall be pre-printed using a mechanical means of printing.
- D. Where used for cable marking, provide vinyl substrate with a white printing area and a clear "tail" that self laminates the printed area when wrapped around the cable. The cable marking should be immediately visible and be within two inches from the termination point.
- E. Where insert type labels are used, provide clear plastic cover over label.
- F. Copper patch panel labeling shall be completed with adhesive labeling kit specifically designed for the panel, Leviton 49257-QHD.
- G. Labeling P-touch font size 4MM bold, black on White, 3/8" labeling tape on all work stations, panels and devices.
- H. Labels shall be numbered consecutively and separate for each type of use. Refer to Work Station Details and Floor Plan Device Numbering Example for additional information

PART 3 – EXECUTION

3.1 GENERAL COMMUNICATION CABLING METHODS

- A. Install cable after interior of building has been physically protected from the weather and work likely to damage conductors has been completed.
- B. Before installing cabling, ensure cable pathways are thoroughly cleaned. Inspect conduit and wireway installed by others.
- C. Cabling systems shall be separated by color and segregated along the paths.
- D. Pull tape with preprinted foot markers is usually provided when conduit and innerduct are installed; if not, provide pull tape in each empty communications conduit containing a bend or over 10 feet in length.
- E. All wiring shall be installed in conduit in concealed areas and in surface nonmetallic raceway in exposed locations.
- F. Provide pigtails of adequate length for neat, trained, and bundled connections.
- G. Provide protection for exposed cables where subject to damage.
- H. Provide abrasion protection for cable or wire bundles that pass through holes or across edges of sheet metal.
- I. All equipment except portable equipment shall be secured firmly in place. This shall include loudspeakers, amplifiers, cables, etc. Fastening and supports shall be adequate to support their loads with a safety factor of at least three (3). All switches, connectors, outlets, etc., shall be clearly, logically and permanently marked during installation.

3.2 TESTING

- A. The Contractor shall perform an operational check to assure that the system complies with all requirements of these specifications. Operation tests shall be made in the presence of the Engineer and Owner's representative who shall be notified of the test date a minimum of ten (10) days prior to that date.
- C. The Contractor, if requested to do so by the Owner, shall be prepared to show by "proof of performance" test that the equipment furnished is equal or superior to the equipment specifications. This proof shall be shown by actual tests and not be printed sales literature. To this end, the contractor

shall provide qualified audio technicians and such test equipment as required to perform this function. The following test equipment shall be considered minimum for the above stated purpose. Sound level meter, 1/3 and 1/10 octave-band wave analyzer, sine and square-wave generator, impedance (CRL) bridge, audio oscilloscope, distortion analyzer, graphic level recorder, calibrated microphone, real-time spectrum analyzer, beat-frequency oscillator, random-noise generator, etc. Instruments as manufactured by General Radio, Tektronix, Hewlett-Packard and Bruel & Kjaer are considered acceptable for measurements. Non-professional test equipment or "home-built kit" type gear shall not be acceptable under these specifications.

3.3 AS BUILT DOCUMENTATION

- A. The Contractor will be provided drawings in electronic format (DWG, AutoCAD release 14 or later) on which as-built construction information can be added.
- B. Upon completion of the project, the Contractor is to prepare as-built documentation showing actual site conditions and installation as constructed.
- C. The Contractor shall annotate the base drawings and return a hard copy and electronic form (AutoCAD release 14 or later).
- D. The Contractor shall provide and install a C-size framed floor plan with outlet and device locations for all low voltage systems. The floor plan shall be framed and installed in the new MDF/IDF Room. The drawing should be a plan of the building with a symbols legend showing where all the devices are and the labeling for each device only. Remove all general notes and details not applicable to the low voltage systems.

END OF SECTION

DOCUMENT 28 16 00**INTRUSION ALARM SYSTEM****PART 1 GENERAL****1.1 GENERAL REQUIREMENTS**

- A. Division 00 General Conditions and division 01 General Requirements apply to the work of this Section.

1.2 DESCRIPTION OF WORK

- A. Extension of existing campus Intrusion Alarm System or Installation of new Intrusion Alarm System.
- B. Projects where the ESUHSD is renovating or adding on to a building, the intrusion alarm contractor shall include all cost to de-commission the existing system before any new contraction can start. The district shall be advised in writing the date as to when the existing system will be de-commissioned. The contractor scope of work shall not degrade any function or operation of the remaining site intrusion alarm system. All de-commissioned devices shall be turned over to the ESUHSD. Should the remaining site intrusion alarm system malfunction, is turned off or degraded due to the construction activities, the contractor shall provide twenty hour security watch at its own expense.

1.3 RELATED WORK

- A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for basic communications materials and methods:
 - 1. Section 26 05 00, Basic Electrical Materials and Methods
 - 2. Sections of Division 27 00 00 Communications.

1.4 SUBMITTALS

- A. Manufacturer's literature describing the product.
- B. Wiring diagrams clearly showing the interconnections of all major components.

1.5 SYSTEM FUNCTIONAL DESCRIPTION

- A. The Intrusion Alarm System shall provide intrusion alarm notification via web IP address for motion detection within the building. Keypads shall arm and disarm the building system.

1.6 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-installation conference at least seven calendar days prior to installing any equipment, devices or systems in the IDF Room. For projects with underground and/or roof mounted conduits convene a separate pre-installation meeting
- B. Attendance: Architect, Construction Manager, Contractor, Electrical Subcontractor, Low Voltage Subcontractor/s, District Low Voltage System Representative and Project Inspector.
- C. Agenda: Review all low voltage systems related to the project. Subcontractors shall come prepared to discuss how the low voltage systems are being installed and run throughout the building/s.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Equipment shall bear U.L. label.
- B. All materials that make-up a complete system shall be U.L. listed.

2.2 INTRUSION CONTROL PANEL

- A. Existing to remain.
- C. No popits allowed in this project

2.3 POWER SUPPLY

- A. 12 VDC, 5 amp uninterruptible power supply with multi-regulator and battery charger in vented locking 11"H x 15"W x 4"D cabinet. AlarmSaf PS5-M003-UL.

2.6 MOTION DETECTORS and GLASS BREAKS

- A. Wall mounted passive infrared type. Bosch ISC-BPR2 Blue Line Gen2 PIR Motion Detector mount B335-3. Mount 4" below suspended ceilings. Mount between 10'-0" to 14'-0" where ceiling height is over 10'-0". In all cases the motion sensor should not be obstructed.
- B. Glass Break Detectors) Bosch DS1103i Flush-mount Glassbreak detector, Microprocessor-based sound analysis technology (SAT) , automatic environmental test circuitry, Sound check, Flush mounting.

2.7 EXTERIOR BELL

- A. Amseco ABB-1014 to match site standard.

2.8 KEYPADS

- A. Wall mounted alarm set/disable keypad with illuminated 16-character vacuum fluorescent display and sounder. Off-white case. Bosch D1255.

2.9 CABLE

- A. #22/4 Conductor cable. West Penn 25241.
- B. #18/4 Conductor cable. West Penn 25244.
- C. IDEAL #89-610 Barrier Strips for consolidation of power wires at the panel end.
- D. Berk-Tek 11074739 CAT 6+ data cable grey in color. 2 cables from the Intrusion panel to the IDF rack located in the same room and terminated onto grey Leviton CAT 6 61110-RG6 jacks on ports 47 and 48. At the intrusion panel the cables shall be terminated onto a (2) port SMB.

2.10 LABELS

- A. The contractor shall provide tags, straps, and adhesive labels. These tags, straps, and adhesive labels must be of high quality that will endure heat, water, and time.
- B. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.
- C. Shall be pre-printed using a mechanical means of printing.
- D. Where used for cable marking, provide vinyl substrate with a white printing area and a clear "tail" that self laminates the printed area when wrapped around the cable. The cable marking should be immediately visible and be within two inches from the termination point.
- E. Where insert type labels are used, provide clear plastic cover over label.

- G. Labeling P-touch font size 4MM bold, black on White, 3/8" labeling tape on all panels and devices.
- H. Labels shall be numbered consecutively and separate for each type of use. Refer to Work Station Details and Floor Plan Device Numbering Example for additional information

PART 3 – EXECUTION

3.1 GENERAL

- A. All wiring shall be installed in conduit in walls or hard ceilings or open wiring installed concealed above suspended ceilings. Open wiring shall be supported on rings not to exceed 24-inches on center. Separation of a minimum of 4" is required between low voltage systems throughout the cable run.
- B. Each device shall have a homerun from the device to the panel located in the IDF. No daisy chaining of power or alarm circuit wiring is permitted.
- C. End-of-line resistors shall be installed at the device end, not at the panel end.
- D. All devices shall be labeled and each end of the device. All cables are to be labeled with a p-touch labeler on both ends.
- E. All point assignments shall be coordinated and approved by the District IT personel prior to termination of device cabling at panel end. Refer to attached Point Assignment Template and Point Index Template.
- F. No popits are allowed in this project

3.2 PROGRAMMING AND TESTING

- A. The Contractor shall perform an operational check to assure that the system complies with all requirements of these specifications.
- B. The contractor shall program the system to report alarms to the overall campus system as directed by the owner.

3.3 AS BUILT DOCUMENTATION

- A. The Contractor will be provided drawings in electronic format (DWG, AutoCAD release 14 or later) on which as-built construction information can be added.
- B. Upon completion of the project, the Contractor is to prepare as-built documentation showing actual site conditions and installation as constructed.
- C. The Contractor shall annotate the base drawings and return a hard copy and electronic form (AutoCAD release 14 or later).
- C. The Contractor shall provide and install a C-size framed floor plan with outlet and device locations for all low voltage systems. The floor plan shall be framed and installed in the new MDF/IDF Room. The drawing should be a plan of the building with a symbols legend showing where all the devices are and the labeling for each device only. Remove all general notes and details not applicable to the low voltage systems.

END OF SECTION

FIRE ALARM SYSTEM

SECTION 28 31 00

FIRE ALARM SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish and install all materials and equipment including all required equipment, panels, raceways, conductors and connections, and provide all labor required and necessary to complete the work shown on the drawings and/or specified in all Sections of Division 26 and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete addressable fire alarm installation including all accessories and appurtenances required for testing the systems. It is in the intent of the drawings and specifications that all systems will be complete, and ready for operation. No extra charge will be paid for furnishing items required by regulations, but not specified herein, or on drawings.
- B. Fire Alarm system shall include a fire alarm control panel in every new or renovated building, connection to a new or existing main fire alarm control panel located in the Main MDF room, radio transceivers mounted at each fire alarm control panel to communicate point identification of each device to the central station, digital communicator for backup phone communication, a remote Annunciator located at the Administration office and all devices, wiring, etc as indicated on the plans.
- C. See site drawings for specific requirements for the site work of interconnecting of the Slave Building Fire Alarm System with the Main Site Fire Alarm Control Panel.
- D. Project where the ESUHSD is renovating or adding on to a building, the fire alarm contractor shall include all cost to de-commission the existing system before any new contraction can start. The district shall be advised in writing the date as to when the existing system will be de-commissioned. The contractor scope of work shall not degrade any function or operation of the remaining site fire alarm system. All de-commissioned devices shall be turned over to the ESUHSD. Should the remaining site fire alarm system malfunction, turned off or degraded, the contractor shall provide twenty hour fire watch at its own expense.

1.2 RELATED SECTIONS

- A. Section 26 05 00 – Basic Electrical Materials and Methods
- B. Section 26 05 33 – Raceways and Boxes.
- C. Section 26 05 53 – Identification for Electrical Systems
- D. Section 26 76 26 – Wiring Methods
- E. Section 27 05 00 – Voice Data.

1.3 REFERENCES

- A. Electrical Industries Association (EIA):
 - 1. RS-232-D – Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

FIRE ALARM SYSTEM

2. RS-485 – standard defining the electrical characteristics of drivers and receivers for use in balanced digital multipoint systems
- B. National Fire Protection Association (NFPA):
1. NFPA 70 – National Electrical Code (NEC).
 2. NFPA 72 – National Fire Alarm Code.
 3. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems.
 4. NFPA 101 – Life Safety Code.
 5. NFPA 5000 – Building Construction and Safety Code.
- C. Underwriters Laboratories (UL):
1. UL 268 – Standard for Smoke Detectors for Fire Alarm Signaling Systems.
 2. UL 864 – Standard for Control Units and Accessories for Fire Alarm Systems.
 3. UL 1971 – Standard for Signaling Devices for the Hearing Impaired.
 4. UL 2572 – Standard for Control and Communication Units For Mass Notification Systems.
- 1.4 DISTRICT STANDARDS AND REQUIREMENTS
- A. The District has certain standards and requirements that are required of all GW-FCI contractors bidding work in the District. Below are their standards for Authorized Contractors.
1. Installation of fire alarm cables, devices, panels, remote signal boosters, annunciators, horn/strobes shall be done by the Factory Authorized GW-FCI Distributor
 2. As the District is concerned with poor installation practices and non conforming cables, it shall be required that ALL cable, panels and device installation be performed by the Authorized GW-FCI Distributor.
 3. Installation of PIV's, OS&Y's, Tamper and Flow switches are noted in other sections, monitored by the GW-FCI panel.
 4. It is not in the Districts best interest for "Parts and Smarts" systems, and as such, all providing and installation of fire alarm panels and system materials, cables, wire and devices shall be performed by the Authorized GW-FCI distributor.
 5. Installation of the main fire alarm panel back box and signal booster back boxes shall be done by the electrical contractor. All power shall be provided by the electrical contractor.
 6. Electrical contractor shall supply and install all conduits, standard electrical back boxes, pull strings, terminal cabinets and all associated rough in materials.
 7. Installation of the complete fire alarm system shall be done by the Authorized GW-FCI Distributor with installers and technicians certified by the Department of Industrial Relations (DIR) with appropriate Fire/Life Safety Credentials.
 8. The GW-FCI E-3 fire alarm system and associated components shall be the standard of the District and as such, there shall be no substitution of panels, devices or systems.
 9. The E-3 FACP shall be located in the MDF with the LOC located in the main office.
 10. The E-3 FACP shall be interfaced to the site intercom system for announcements and voice messaging from the LOC.
 11. The Authorized GW-FCI distributor shall insure that the interface of the E-3 and the PA system to be seamless, integral and shall allow for independent operation of either system in the event of catastrophic failure of either system.
- 1.5 SYSTEM DESCRIPTION
- A. A new intelligent reporting, Style 7 networked, fully peer-to-peer, microprocessor-controlled fire detection and emergency voice alarm communication system shall be installed in accordance with the specifications and as indicated on the Drawings.
- B. Each Signaling Line Circuit (SLC) and Notification Appliance Circuit (NAC): Limited to only 80 percent of its total capacity during initial installation.
- C. Basic Performance:
1. Network Communications Circuit (NetSOLO) Serving Network Nodes: Using approved fiber optic cable between nodes.
 2. Signaling Line Circuits (SLC) Serving Addressable Devices: Wired Class B.

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3. Initiation Device Circuits (IDC) Serving Non-addressable Devices Connected to Addressable Monitor Modules: Wired Class B.
 4. Notification Appliance Circuits (NAC) Serving Strobes, Horns and Speakers: Wired Class B.
 5. Alarm Signals Arriving at INCC COMMAND CENTER: Not be lost following primary power failure until alarm signal is processed and recorded.
 6. Transponders:
 - a. Operate in peer-to-peer fashion with other panels and transponders in system.
 - b. Each transponder shall store copy of audio evacuation messages and tones.
 - c. Systems that use centralized message storage and control at main fire alarm control panel shall not be acceptable.
 7. Network Node Communications, Audio Evacuation Channels and Fire Phone Communications:
 - a. Communicated between panels and transponders on single twisted pair of copper wires or fiber optic cables.
 8. Signaling Line Circuits (SLC):
 - a. Reside in remote transponders with associated audio zones.
 - b. SLC modules shall operate in peer-to-peer fashion with all other panels and transponders in system.
 - c. On loss of INCC Command Center, each transponder shall continue to communicate with remainder of system, including all SLC functions and audio messages located in all transponders.
 - d. Systems that provide a "Degraded" mode of operation upon loss of INCC Command Center or short in riser shall not be acceptable.
 9. Audio Amplifiers and Tone-Generating Equipment: Electrically supervised for normal and abnormal conditions.
 10. Amplifiers: Located in transponder cabinets serving no more that 3 floors per transponder to enhance system survivability, reduce required riser wiring, simplify installation, and reduce power losses in length of speaker circuits.
 11. Speaker NAC Circuits: Arranged such that there is a minimum of 1 speaker circuit per fire alarm zone.
 12. Speaker Circuits:
 - a. Electrically supervised for open and short circuit conditions.
 - b. If short circuit exists on speaker circuit, it shall not be possible to activate that circuit.
 - c. Arranged for 70 VRMS and shall be power limited in accordance with NEC
 - d. 20 percent spare capacity for future expansion or increased power output requirements.
 13. Speaker Circuits and Control Equipment:
 - a. Arranged such that loss of any 1 speaker circuit will not cause loss of any other speaker circuit in system.
 - b. Systems utilizing "bulk" audio configurations shall not be acceptable.
 15. Voice Communication:
 - a. Connect telephone circuits to speaker circuits to allow voice communication over speaker circuit from push to talk microphone.
- D. Basic System Functional Operation: When fire alarm condition is detected and reported by 1 of the system alarm initiating devices, the following functions shall immediately occur:
1. System Alarm LEDs: Flash.
 2. Local Piezo-Electric Signal in Control Panel: Sound at a pulse rate.
 3. 80-Character LCD Display: Indicate all information associated with fire alarm condition, including type of alarm point and its location within protected premises.
 4. Historical Log: Record information associated with fire alarm control panel condition, along with time and date of occurrence. History Log shall have capacity for recording up to 4,100 events.
 5. System output programs assigned via control-by-event equations to be activated by particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
 - a. Close Fire Doors
 - b. Shot down air handlers as required by code
 - c. Notify the Central Station or Municipal Tie.
 6. Strobes flash synchronized continuously.
 7. Audio Portion of System: Sound alert tone followed by pre-recorded message determined by event and this scenario repeating or other message as approved by local authority until system is reset.
- E. Fire Alarm System Functionality:

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1. Provide complete, electrically supervised distributed, Class B networked analog/addressable fire alarm and control system, with analog initiating devices, integral multiple-channel voice evacuation.
2. Fire Alarm System:
 - a. Consist of multiple-voice channels with no additional hardware required for total of 4 channels.
 - b. Incorporate multiprocessor-based control panels, including model E3 Series modules includes Intelligent Network INCC Command Center(s) (INCC), Intelligent Loop Interface (ILI-MB-E3 or ILI95-MB-E3), Intelligent Network Transponders (INX), communicating over peer-to-peer token ring network with standard capacity of up to 64 nodes expandable to 122.
3. Each ILI-MB-E3 or ILI95-MB-E3 Node: Incorporate 2 Signaling Line Circuits (SLC), with capacity to support in Velociti ® mode up to 159 analog addressable detectors and 159 addressable modules per ILI-MB-E3 SLC or support in Apollo mode up to 126 detectors and modules per ILI95-MB-E3 SLC.
4. Voice, Data: Transmit over single pair of wires or fiber optic cable.
5. Each Intelligent Network Transponder: Capable of providing 16 distributed voice messages, fire fighter phones connections, SLC loop for audio control devices, and integral network interface.
6. Each Network Node: Incorporate Boolean control-by-event programming, including as a minimum AND, OR, NOT, and Timer functions.
7. Control Panels: Capability to accept firmware upgrades via connection with laptop computer, without requirement of replacing microchips.
8. Network:
 - a. Based on peer-to-peer token ring technology operating at 625 K baud, using Class A configuration.
9. Each Network Node:
 - a. Capability of being programmed off-line using Windows-based software supplied by fire alarm system manufacturer. Capability of being downloaded by connecting laptop computer into any other node in system. Systems that require system software to be downloaded to each transponder at each transponder location shall not be acceptable.
 - b. Capability of being grouped with any number of additional nodes to produce a "Region", allowing that group of nodes to act as 1, while retaining peer-to-peer functionality. Systems utilizing "Master/Slave" configurations shall not be acceptable.
 - c. Capability of annunciating all events within its "Region" or annunciating all events from entire network, on front panel LCD or touchscreen display without additional equipment.
10. Each SLC Network Node: Capability of having integral DACT (digital alarm communicator transmitter) that can report events in either its region, or entire network to single central station monitoring account.
11. Each Control Panel: Capability of storing its entire program, and allow installer to activate only devices that are installed during construction, without further downloading of system.
12. Password Protection: Each system shall be provided with 4 levels of password protection with up to 16 passwords.
13. Have the capacity for multiple pre-recorded messages (at least sixteen (16), but more if required by local AHJ) and address a list of subjects.
 - Fire evacuation and relocation
 - Intruder or hostile person sighted within or around the building grounds
 - Directions to occupants to take cover within building
 - Emergency weather conditions appropriate for local area
 - All Clear

F. Conduits:

1. Identification of Conduit: New conduits containing fire alarm system conductors shall be red, ¾" minimum. Junction-boxes, covers, gutters, and terminal cabinets, containing fire alarm system conductors, shall be painted red or provided red in color with engraved plastic identification signs permanently attached to the equipment.
2. Do not run fire alarm circuits in the same conduit with the non-fire alarm circuits. Do not run AC circuits in the same conduit with the DC circuits.
3. Provide wiring in rigid metal conduit for exterior installations.

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4. Conceal conduit in finished areas of new construction and wherever practical in existing construction. Conduit runs shall be straight, neatly arranged properly supported and parallel or perpendicular to walls and partitions. Identify conductors within each enclosure where a tap, splice, or termination is made.
5. Underground circuit or circuits in wet areas shall be gel filled cables in scheduled 40PVC conduit. There shall be no splicing of any underground cables.
6. Fabric Innerduct: The contractor shall install 3 cell fabric innerduct in all sections of conduit, Maxcell or equal. Installation must follow manufacturer's installation requirements, using recommended installation tools. Fabric Innerduct size shall match manufacturer recommended maximum size.

1.6 SUBMITTALS

- B. Comply with Section 01 32 19 (01 32 19) – Fire Alarm System Submittal Procedures and ESUHSD Standard Review Check list V.1.2015.09921
- C. Include sufficient information, clearly presented, to determine compliance with the specifications and the Drawings.
- D. Equipment Submittals:
 1. Cover Page: Indicate the following:
 - a. Project name and Address.
 - b. Engineered systems distributor's name and other contact information.
 - c. Installing contractor's name and other contact information.
 - d. Date of equipment submittals. Indicate on revised submittals the original submittal date and revised submittal date.
 2. Table of Contents: Lists each section of equipment submittal.
 3. Scope of Work Narrative: Detail indented scope of work.
 4. Sequence of Operations: Use matrix or written text format, detailing activation of each type of device and associated resulting activation of the following:
 - a. Control panel.
 - b. Annunciator panels.
 - c. Notification appliances.
 - d. Building fire safety functions, including elevator recall, elevator power shutdown, door lock release, door holder release, HVAC unit shutdown, smoke evacuation system activation, and stair pressurization fan activation.
 5. Bill of Material: Indicate for each component of system the following:
 1. Quantity.
 2. Model number.
 3. Description.
 6. SLC Circuit Schedule: Detail address and associated description of each addressable device. Clearly provide information that indicates number of both active and spare addresses.
 7. Battery Calculations: Show load of each of, and total of, components of system along with standby and alarm times that calculations are based on. Show calculated spare capacity and size of intended battery.
- E. Shop Drawings:
 - i. Cover Page: Indicate the following:
 1. Project name and address.
 2. Engineered systems distributor's name and other contact information.
 3. Installing contractor's name and other contact information.
 4. Date of equipment submittals. Indicate on revised submittals the original submittal date and revised submittal date.
 - ii. Floor Plans:
 - a. Provide separate floor plan for each floor.

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- b. If a floor plan must be split using match lines to fit on the page, provide match lines and match line references that refer to sheet number that shows area on opposite side of match line.
 - c. Prepare using AUTOCAD.
 - d. Prepare to scale 1/8 inch = 1'-0", unless otherwise required by the Architect or Engineer.
 - e. Show equipment and device locations.
 - f. Show wiring information in point-to-point format.
 - g. Show conduit routing, if required by the AHJ.
 - iii. Title Block: Provide on each sheet and include, at a minimum, the following:
 - 1. Project name.
 - 2. Project address.
 - 3. Sheet name.
 - 4. Sheet number.
 - 5. Scale of drawing.
 - 6. Date of drawing.
 - 7. Revision dates, if applicable.
 - iv. Control Panel: Provide sheet that details exterior and interior views of control panel and clearly shows associated wiring information.
 - v. Annunciator Panels: Provide sheet that details exterior and interior views of annunciator panels and clearly shows associated wiring information.
- F. Certification: Intrepid Electronic Systems to submit with equipment submittals and shop drawings, letter of certification from major equipment manufacturer, indicating proposed engineered system distributor is an authorized representative of major equipment manufacturer.
- G. Project Record Drawings:
 - 1. Intrepid Electronic Systems to submit complete project record drawings within 14 calendar days after acceptance test.
 - 2. Project record drawings shall be similar to shop drawings, but revised to reflect changes made during construction.
- H. Operation and Maintenance Manuals:
 - 1. Submit complete operation and maintenance manuals within 14 calendar days after acceptance test.
 - 2. Operation and maintenance manuals shall be similar to equipment submittals, but revised to reflect changes made during construction.
 - 3. Include factory's standard installation and operating instructions.

1.7 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. NFPA: System shall comply with the following NFPA codes and standards:
 - a. NFPA 70.
 - b. NFPA 72.
 - c. NFPA 90A.
 - d. NFPA 101.
 - 2. ADA: System shall conform to American with Disabilities Act (ADA).
- B. To ensure reliability and complete compatibility, all items of fire alarm system, including control panels, power supplies, initiating devices, and notification appliances, shall be listed by Underwriters Laboratories Inc. (UL) and shall bear "UL" label and approved by the Office of the California Fire Marshall.
- C. Fire Alarm Control Panel Equipment: UL-listed under UL 864 Ninth Edition and UL 2572.
- D. Equipment, Programming, and Installation Supervision:
 - 1. Intrepid Electronic Systems will provide dealer services for supplying of equipment, programming, and installation supervision.
- E. Software Modifications:
 - 1. Intrepid Electronic Systems will provide services of Nicet Level III Gamewell-FCI factory-trained and authorized technician to perform system software modifications, upgrades, or changes.

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2. Provide use of all hardware, software, programming tools, and documentation necessary to modify fire alarm system software on-site.
3. Modification includes addition and deletion of devices, circuits, zones, and changes to system operation and custom label changes for devices or zones.
4. System structure and software shall place no limit on type or extent of software modifications on-site.
5. Modification of software shall not require power-down of system or loss of system fire protection while modifications are being made.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- C. Handling: Protect materials from damage during handling and installation.

1.9 COORDINATION

- A. Coordinate the Work of this section with the Work of other sections.

1.10 WARRANTY

- A. Warranty Period for System Equipment: 1 year from date of final acceptance of the project.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Gamewell-FCI, Honeywell Fire Systems, 12 Clintonville Road, Northford, Connecticut 06472. Phone (203) 484-7161. Fax (203) 484-7118. Website: www.gamewell-fci.com.
- B. References to manufacturer's model numbers and other information is intended to establish minimum standards of performance, function, and quality. Equivalent equipment from Gamewell may be substituted for the specified equipment, as long as minimum standards are met. No other manufacturers, other than Gamewell-FCI, FCI, and Gamewell will be considered for use on this project.

2.2 DISTRIBUTED NETWORKED FIRE ALARM SYSTEM

- A. Distributed Networked Fire Alarm System: Gamewell-FCI E3 Series Expandable Emergency Evacuation Fire Alarm System.

2.3 INTELLIGENT NETWORK INCC COMMAND CENTER HARDWARE

- A. Intelligent Network INCC Command Center (INCC): Supply user interface, including LCD or touch-screen 1/4 VGA display Intelligent Loop Interface Modules (ILI-MB-E3/ILI95-MB-E3), manual switching, phone, and microphone inputs to the network. INCC shall consist of the following units and components:
 1. System Cabinet (B-, C-, or D-Size Cabinet) with associated inner door.
 2. Power Supply Module (PM-9) with batteries.
 3. Intelligent Network Interface Voice Gateway (INI-VG).
 4. NGA Display (LCD-E3).
 5. Intelligent Loop Main Board Interface (ILI-MB-E3 or ILI95-MB-E3).
 6. Optional Intelligent Loop Supplemental Interface (ILI-S-E3 or ILI95-S-E3).
 7. Optional DACT (DACT-E3).
 8. Optional Auxiliary Switch Module (ASM-16).
 9. Optional LED Driver Module (ANU-48)
 10. Optional Microphone Assembly (INCC-MIC).
 11. Optional AM-50 Series amplifiers (AM-50, AM-50-70).

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12. Optional Addressable Node Expander (ANX-SR, ANX-MR-FO, ANX-MR-UTP).
- B. System Cabinet:
1. Surface or semi-flush mounted with texture finish.
 2. Consist of back box, inner door, and door.
 3. Available in at least 3 sizes to best fit project configuration.
 4. Houses 1 or more PM-9 Power Supply Modules, INI-VG Intelligent Network Interface Voice Gateway, 1 or more ILI-MB-E3/ILI95-MB-E3 assemblies, and other optional modules as specified.
 5. Construction: Dead-front steel construction with inner door to conceal internal circuitry and wiring.
 6. Wiring Gutter Space: A minimum of 1-inch wiring gutter space behind mounting plate.
 7. Wiring: Terminated on removable terminal blocks to allow field servicing of modules without disrupting system wiring.
- C. Power Supply Module (PM-9): Use latest technologies to provide system power, incorporates the following features:
1. Power-saving switching technology using no step-down transformers.
 2. 9-amp continuous-rated output to supply up to all power necessary under normal and emergency conditions for INCC Command Center Modules.
 3. Integral battery charger with capacity to charge up to 55 amp-hour batteries while under full load.
- D. Batteries:
1. Sufficient capacity to provide power for entire system upon loss of normal AC power for a period of 24 hours with 15 minutes of alarm signaling at end of this 24-hour period, as required by NFPA 72, Local Systems.
- E. Intelligent Network Interface Voice Gateway INCC Command Center (INI-VG): INI-VG shall be a multi-function board interchangeable in both INCC and INX. Functions of board shall have the following features as a minimum:
1. Microprocessor shall monitor all system events and perform all system programs, for all control-by-event (CBE) functions. System program shall not be lost upon failure of both primary and secondary power. Programming shall supporting Boolean logic including AND, OR, NOT, TIMING functions for maximum flexibility.
 2. Network Interface: Operate at 625 K baud configurable with any combination of wire and/or fiber topologies. Interface shall communicate with up to 122 nodes in peer-to-peer fashion.
 3. Advanced Processing: INI-VG shall incorporate latest in digital signaling processing technology with supporting Boolean logic including AND, OR, NOT, TIMING, COUNT, SCHEDULE functions.
 4. Microphone Input: On-board and allow for addition of local microphone when used as INCC Command Center, including speaker circuit control.
 5. Signal Processing: INCC shall use advanced Digital Signal Processing (DSP) technology to allow maximum flexibility of digital audio and control capabilities and operation. Signals to and from INCC shall be transmitted over single pair of twisted unshielded wire or fiber optic pair.
 6. Field Programmable: INCC shall be capable of being fully programmed or modified by Field Configuration Program (FCP), to be downloaded via portable computer from any node in system.
 7. Control-by-Event Programming (CBE): INCC shall be capable of programming using Boolean logic including AND, OR, NOT, COUNT, TIMING, and SCHEDULE functions to provide complete programming flexibility.
 8. Remote INCC Command Center Options: System shall have capability of adding remote INCC Command Centers or re-locating INCC Command Centers utilizing only single pair of twisted unshielded wire or fiber optic pair for all functions.
 9. RS-485 Serial Output: System shall incorporate RS-485 bus via ribbon harness for connection of modules inside same cabinet, and via 4-wire quick connector for connection of modules up to 3,000 feet from cabinet.
 10. Class A Network: All communication between control panels and transponders shall be through supervised Style 7 token passing network. In event of single short, open, or ground, all system communication shall operate as normal and report fault. This protection shall incorporate all data, voice, and fire fighter phone transmissions. Upon single short, open, or ground of either system data, live voice, pre-recorded channels, or phone risers, the function of each of these items shall continue to operate. "Degrade" functionality shall not be acceptable. This shall be demonstrated at system acceptance.

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- F. LCD Display Module (LCD-E3):
1. LCD Display: 80-character RS-485 based textual annunciator with capability of being mounted locally or remotely. Provides audible and visual annunciation of all alarms and trouble signals. Provide dedicated LEDs for:
 - a. AC Power On: Green.
 - b. Alarm: Red.
 - c. Supervisory: Yellow.
 - d. System Trouble: Yellow.
 - e. Power Fault: Yellow.
 - f. Ground Fault: Yellow.
 - g. System Silenced: Yellow.
 2. 80-Character Alphanumeric Display: Provide status of all analog/addressable sensors, monitor and control modules. Display shall be liquid crystal type (LCD), clearly visible in dark and under all light conditions.
 3. Panel shall contain 4 functional keys:
 - a. Alarm Acknowledge.
 - b. Trouble Acknowledge.
 - c. Signal Silence.
 - d. System Reset/Lamp Test.
 4. Panel shall contain 3 configuration buttons:
 - a. Menu/Back.
 - b. Back Space/Edit.
 - c. OK/Enter.
 5. Panel shall have 12-key telephone-style keypad to permit selection of functions.
- G. Intelligent Loop Interface (ILI-MB-E3/ILI95-MB-E3): System shall be of multiprocessor design to allow maximum flexibility of capabilities and operation. Intelligent Loop Interface shall be capable of mounting in stand-alone enclosure or integrated with Intelligent Network INCC Command Center (INCC) as specified.
1. Field Programmable: System shall be capable of being programmed by Field Configuration Program (FCP), allowing programming to be downloaded via portable computer from any node on network.
 2. RS-232C Serial Output: Supervised RS-232C serial port shall be provided to operate remote printers and/or video terminals, accept downloaded program from portable computer, or provide 80-column readout of all alarms, troubles, location descriptions, time, and date. Communication shall be standard ASCII code operating from 1,200 to 115,200 baud rate.
 3. RS-485 Serial Output: Each ILI-MB-E3/ILI95-MB-E3 shall incorporate RS-485 bus via ribbon harness for connection of modules inside same cabinet, and via 4-wire quick connector for connection of modules up to 3,000 feet from cabinet. RS-485 bus shall support up to 16 ASM-16 auxiliary switch modules, 6 LCD-E3 main annunciators, and 5 LCD-7100 annunciators.
 4. Peer-to-Peer Panel Configuration: All Loop Interface Modules shall incorporate own programming, log functions, Central Processor Unit, and control-by-event (CBE) programming. If any loop becomes disabled, each remaining loop driver shall continue to communicate with remainder of network and maintain normal operation. "Degrade" configurations under these conditions shall not be acceptable.
 5. Control-by-Event (CBE) Program: ILI-MB-E3/ILI95-MB-E3 shall be capable of programming using Boolean logic including AND, OR, NOT, TIMING, COUNT, SCHEDULE functions to provide complete programming flexibility.
 6. Alarm Verification: Smoke detector alarm verification shall be standard option while allowing other devices such as manual stations and sprinkler flow to create immediate alarm. This feature shall be selectable for smoke sensors that are installed in environments prone to nuisance or unwanted alarms.
 7. Alarm Signals: All alarm signals shall be automatically latched or "locked in" at control panel until operated device is returned to normal and control panel is manually reset. When used for sprinkler flow, "SIGNAL SILENCE" switch may be bypassed, if required by AHJ.
 8. Electrically Supervised:
 - a. Each SLC and NAC circuit shall be electrically supervised for opens, shorts, and ground faults. Occurrence of fault shall activate system trouble circuitry, but shall not interfere with proper operation of other circuits.
 - b. Yellow "SYSTEM TROUBLE" LEDs shall light and system audible sounder shall steadily sound when trouble is detected in system. Failure of power, open or short circuits on SLC or NAC circuits, disarrangement in system wiring, failure of microprocessor or any identification

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module, or system ground faults shall activate this trouble circuit. Trouble signal shall be acknowledged by operating "TROUBLE ACKNOWLEDGE" switch. This shall silence sounder. If subsequent trouble conditions occur, trouble circuitry shall resound. During alarm, all trouble signals shall be suppressed with exception of lighting yellow "SYSTEM TROUBLE" LEDs.

9. Drift Compensation – Analog Smoke Sensors: System software shall automatically adjust each analog smoke sensor approximately once each week for changes in sensitivity due to effects of component aging or environment, including dust. Each sensor shall maintain its actual sensitivity under adverse conditions to respond to alarm conditions while ignoring factors which generally contribute to nuisance alarms. System trouble circuitry shall activate, display "DIRTY DETECTOR" and "VERY DIRTY DETECTOR" indications and identify individual unit that requires maintenance.
10. Analog Smoke Sensor Test: System software shall automatically test each analog smoke sensor a minimum of 3 times daily. Test shall be recognized functional test of each photocell (analog photoelectric sensors) and ionization chamber (analog ionization sensors) as required annually by NFPA 72. Failure of sensor shall activate system trouble circuitry, display "Test Failed" indication, and identify individual device that failed.
11. Off-Premises Connection:
 1. Fire Alarm System: Fire signals to be transmitted via AES-Intelligent Wireless Mesh Network to Crime Alert central station.
 2. A second redundant pair of IP-Links 7170 Link Remote Receivers will be furnished and installed at Independence High School.
12. Network Annunciator Option: Each ILI-MB-E3 or ILI95-MB-E3 and associated display shall provide option of being configured as network annunciator. Options for annunciation shall default as regional annunciator with capability of selecting global annunciation to provide system-wide protection and Acknowledge, Silence, and Reset capabilities.
13. Redundant History Log: Each ILI-MB-E3 or ILI95-MB-E3 shall contain full 4100 event history log supporting local and network functions. If a main processor or network node is lost the entire log shall be accessible at any other Loop Interface board. This shall be demonstrated by removing power from INCC Command Center followed by extraction of history log from any loop driver location, including INCC Command Center or Transponder.
14. LEDs Indicator and Outputs: Each ILI-MB-E3/ILI95-MB-E3 Loop Interface shall incorporate as a minimum the following diagnostic LED indicators:
 - a. Power: Green.
 - b. Alarm: Red.
 - c. Supervisory: Yellow.
 - d. General Trouble: Yellow.
 - e. Ground Fault: Yellow.
 - f. Transmit: Green.
 - g. Receive: Green.
15. Auxiliary Power Outputs: Each ILI-MB-E3/ILI95-MB-E3 Loop Interface shall provide the following supply outputs:
 - a. 24 VDC non-resettable, 1 amp. maximum, power limited.
 - b. 24 VDC resettable, 1 amp. maximum, power limited.
16. Microprocessor: Loop interface shall incorporate 32-bit RISC processor. Isolated "watchdog" circuit shall monitor microprocessor and upon failure shall activate system trouble circuits on display. Microprocessor shall access system program for all control-by-event (CBE) functions. System program shall not be lost upon failure of both primary and secondary power. Programming shall support Boolean logic including AND, OR, NOT, TIME DELAY functions for maximum flexibility.
17. Auto Programming: System shall provide for all SLC devices on any SLC loop to be pre-programmed into system. Upon activation of auto programming, only devices that are present shall activate. This allows for system to be commissioned in phases without need of additional downloads.
18. Environmental Drift Compensation: System shall provide for setting Environmental Drift Compensation by device. When detector accumulates dust in chamber and reaches unacceptable level but yet still below allowed limit, control panel shall indicate maintenance alert warning. When detector accumulates dust in chamber above allowed limit, control panel shall indicate maintenance urgent warning.
19. NON-FIRE Alarm Module Reporting: Non-reporting type ID shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel

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operation nor shall it display message at panel LDC. Activation of NON-FIRE point shall activate control by event logic, but shall not cause indication on control panel.

20. 1-Man Walk Test:
 - a. System shall provide both basic and advanced walk test for testing entire fire alarm system. Basic walk test shall allow single operator to run audible tests on panel. All logic equation automation shall be suspended during test and while annunciators can be enabled for test, all shall default to disabled state. During advanced walk test, field-supplied output point programming shall react to input stimuli, such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch input. Advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device, and wiring operation/verification.
 - b. Test feature is intended to provide for certain random spot testing of system and is not intended to comply with requirements of testing fire alarm systems in accordance with NFPA 72, as it is impossible to test all functions and verify items such as annunciation with only 1 person.
 21. Signaling Line Circuits: Each ILI-MB-E3 module shall provide communication with analog/addressable (initiation/control) devices via 2 signaling line circuits. Each signaling line circuit shall be capable of being wired Class B, Style 4 or Class A, Style 6. Circuits shall be capable of operating in NFPA Style 7 configuration when equipped with isolator modules between each module type device and isolator sensor bases. Each circuit shall communicate with a maximum of 159 analog sensors and 159 addressable monitor/control devices. Unique 40-character identifier shall be available for each device. Devices shall be of the Velocity series with capability to poll 10 devices at a time with a maximum polling time of 2 seconds when both SLCs are fully loaded.
 22. Notification Appliance Circuits: 2 independent NAC circuits shall be provided on ILI-MB, polarized and rated at 2 amperes DC per circuit, individually over current protected and supervised for opens, grounds, and short circuits. They shall be capable of being wired Class B, Style Y or Class A, Style Z.
 23. Alarm Dry Contacts: Provide alarm dry contacts (Form C) rated 2 amps at 30 VDC (resistive) and transfer whenever system alarm occurs.
 24. Supervisory Dry Contacts: Provide supervisory dry contacts (Form C) rated 2 amps at 30 VDC (resistive) and transfer whenever system supervisory condition occurs.
 25. Trouble Dry Contacts: Provide trouble dry contacts (Form C) rated 2 amps at 30 VDC (resistive) and transfer whenever system trouble occurs.
- H. Auxiliary Switch Module (ASM-16):
1. Each ASM-16 has 16 programmable push-button switches.
 2. Each push-button switch has 3 associated status LEDs (red, yellow, and green), configurable to indicate any combination of functions.
 3. Flexible switch configurations to allow flexible set-up of phone, speaker, and auxiliary function circuits.
 4. An insertable label to identify function of each switch and LEDs combination.
 5. Provide capability to communicate with up to 16 ASM-16 modules locally, up to 3,000 feet from INCC Command Center.
 6. Specialty modules that only perform 1 task such as speaker, phone, or auxiliary shall not be acceptable.
- I. Microphone Assembly: Include the following items:
1. Mounting cabinet which occupies 1 module location on inner door of INCC.
 2. Interconnect cable for connection of microphone to INI-VG.
 3. 1 noise canceling microphone with push-to-talk button.
- J. Addressable Node Expander (ANX):
1. Addressable Node Expander shall provide interconnection between the Fire Alarm Control Panel networks.
 2. ANX-MR-FO (Addressable Node Expander Multi-Ring with Fiber Optic connectors) and ANX-MR-UTP (Addressable Node Expander Multi-Ring with Fiber Optic and Twisted Pair connectors) shall expand the E3 Series network from 64 nodes to 122 nodes. ANX-SR (Addressable Node Expander Single Ring) will function in single 64 node systems.
- K. Network Repeater Module (RPT-E3):

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1. Intelligent Network Interface shall provide interconnection and protection of remote INCC Command Centers and Transponders. Repeater shall regenerate and condition token passing, 625 K baud signal between units. Repeater shall be available in wire, or wire/fiber configurations as determined by field conditions.
 2. Interface shall have jumper to allow selection of ground detection of wiring when used in wire mode. Interface shall have integral LEDs to display current status of board.
 3. Fiber configurations shall use:
 - a. Multi-Mode ST-type connectors with a maximum attenuation of 8db with 62.5/125 micron cable.
 - b. Single-Mode LC-style connector with a maximum attenuation of 30db with 9/125 micron cable.
- L. Network Graphic Annunciator (NGA): Network able, 1/4 VGA, touch-screen annunciator with the following characteristics:
1. Custom Graphics: Panel shall permit uploading of custom bit-mapped graphic to display screen. Graphic shall display when all systems are normal.
 2. Intuitive Functions: In alarm or trouble condition, annunciator shall display only information pertaining to event, including control switches.
 - a. Trouble Condition: Display shall indicate cause of trouble. Only controls available to operator shall be Acknowledge and Reset functions.
 - b. Alarm Condition: Display shall indicate cause of alarm. Only controls available to operator shall be Acknowledge, Silence, and Reset functions.
- 2.4 INTELLIGENT NETWORK TRANSPONDER (INX)
- A. System shall be of multiprocessor design to allow maximum flexibility of capabilities and operation. INX shall receive, transmit, and regenerate voice, fire fighter phones, and data over single pair of wire or fiber optic cable.
 - B. INX shall provide full multi-channel distributed voice messaging, with integrated switching amplification, and SLC and extended phone riser. INX shall communicate with network system in true peer-to-peer fashion operating at 625 K baud over any combination of fiber or wire media. INX shall consist of the following units and components.
 - C. System Cabinet: System cabinet shall be surface or semi-flush mounted with texture finish and shall consist of 4 parts, back box, back plate, inner door, and outer door. System cabinet houses INI-VG, PM-9 power supply, up to 4 - AM50, microphone, and related circuitry.
 - D. Intelligent Network Interface Voice Gateway (INI-VG): INI-VG shall be a multi-function board interchangeable in both INCC and INX. Functions of board shall include the following features as a minimum:
 1. Network interface operating at 625 K baud configurable with any combination of wire and/or fiber topologies. Interface shall communicate with up to 122 total INCC, INX, and E3 and S3 control panels in peer-to-peer fashion.
 2. Signaling Line Circuit (SLC): INI-VG shall generate local SLC to communicate with and control up to 16 AOM-TEL modules and 32 AOM-2S or AOM-MUX circuits for fire phone interfacing and additional split-speaker circuits.
 3. RS-485: Provide capability to communicate with up to 16 ASM-16 modules, when used in INX mode up to 3,000 feet.
 4. Advanced Processing: INI-VG shall incorporate latest in digital signaling processing technology with supporting Boolean logic including AND, OR, NOT, TIME DELAY functions.
 5. Voice Generation: INI-VG shall incorporate all processing to allow for 16 distinct pre-recorded messages used in priority fashion with message 1 as highest priority. Total length for 1 to 16 messages shall be up to 3 minutes.
 - E. Power Supply Module (PM-9): PM-9 power supply shall supply all power necessary under normal and emergency conditions. Power supply shall provide capacity to charge up to 55 amp-hour batteries while under full load. Technology used shall be of power-saving switching configuration, eliminating need of stepping transformer.
 - F. Audio Amplifier (AM-50): Include as a minimum, the following features:

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1. 50-watt switching audio amplifier:
 - a. AM-50-70.7 amplifier produces 70V_{RMS} at 50 watts digital audio output.
2. 2 individually addressable speaker circuits, each with capability of handling part or all of 50-watt supplied power.
3. Power shall be 24 VDC supplied via terminal block from local PM-9 power supply.
4. Ability to select from 1 of 16 pre-programmed messages in INI-VG, and paging from locally or from INCC Command Center.
5. Back-up amplification configurable so 1 AM-50 can perform back-up or 3, or perform 1-to-1 back-up if configured to do so in programming.
6. Status LEDs to indicate normal operation and trouble condition.

2.5 SUPPLEMENTAL NOTIFICATION APPLIANCE CIRCUIT (HPF24)

- A. Supplemental Notification Appliance Circuit (HPF24) shall be Model [HPF24S6] offering [up to 6.0 amps (4.0 amps continuous)] [8.0 amps (6.0 amps continuous)] of regulated 24-volt power. HPF24 shall include the following features:
 1. Integral Charger: Charge up to 18.0 amp-hour batteries and support 60-hour standby.
 2. 2 Input Triggers. Input trigger shall be Notification Appliance Circuit (from fire alarm control panel) or relay.
 3. Surface-mount back box.
 4. Ability to delay AC fail delay in accordance with applicable NFPA requirements.
 5. Power limited circuitry in accordance with applicable UL standards.
 6. Operates as sync follower or a sync generator.
- B. Supplemental Notification Appliance Circuit (HPFF) shall be Model [HPFF8] [HPFF12] offering [up to 8.0 amps (8.0 amps continuous)] [12.0 amps (12 amps continuous)] of regulated 24-volt power. HPFF shall include the following features:
 1. Integral Charger: Charge up to 18.0 amp-hour batteries and support 60-hour standby.
 2. 2 Input Triggers. Input trigger shall be Notification Appliance Circuit (from fire alarm control panel) or relay.
 3. Surface-mount back box.
 4. Ability to delay AC fail delay in accordance with applicable NFPA requirements.
 5. Power limited circuitry in accordance with applicable UL standards.
 6. Operates as sync follower or a sync generator.
- C. Supplemental Notification Appliance Circuit (GFPS) shall be Model [GFPS-6] [GFPS-9] offering [up to 6.0 amps (6.0 amps continuous)] [9.0 amps (12.0 amps continuous)] of regulated 24-volt power. GFPS shall include the following features:
 1. Integral Charger: Charge up to 35.0 amp-hour batteries and support 60-hour standby.
 2. 2 Input Triggers. Input trigger shall be Notification Appliance Circuit (from fire alarm control panel) or relay.
 3. Surface-mount back box.
 4. Ability to delay AC fail delay in accordance with applicable NFPA requirements.
 5. Power limited circuitry in accordance with applicable UL standards.
 6. Operates as sync follower or a sync generator.

2.6 SYSTEM PERIPHERALS – Apollo XP95

- A. ILI95-MB-E3 and ILI95-S-E3 Addressable Devices – General:
 1. Provide address-setting means using card inserts which are built into the base or module.
 2. Use simple to install and maintain binary-type (numbered 1 to 64) address switches by using breaking the tabs to set address.
 3. Detectors: Analog and addressable. Connect to fire alarm control panel's Signaling Line Circuits.
 4. Addressable Thermal and Smoke Detectors: Provide 1 status LED. The LED shall flash under normal conditions, indicating detector is operational and in regular communication with control panel, and the LED shall be placed into steady illumination by control panel, indicating alarm condition has been detected. If required, flashing mode operation of detector LED can be programmed off via fire control panel program.
 5. Fire Alarm Control Panel: Permit detector sensitivity adjustment through field programming of system. Sensitivity can be automatically adjusted by panel on time-of-day basis.

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6. Using software, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. Detectors shall be listed by UL as meeting calibrated sensitivity test requirements of NFPA 72, Chapter 7.
 7. Detectors shall be ceiling-mounted and shall include separate twist-lock base with tamper-proof feature.
 8. Following bases and auxiliary functions shall be available:
 - a. Standard base with remote LED output.
 - b. Sounder base rated at 85 dBA minimum.
 - c. Form-C relay base rated 30 VDC, 2.0 A.
 - d. Isolator base.
 9. Detectors shall provide test means whereby they will simulate alarm condition and report that condition to control panel. Such test shall be initiated at detector itself by canned smoke or initiated remotely on command from control panel.
 10. Detectors shall store internal identifying type code that control panel shall use to identify type of device (ION, PHOTO, THERMAL).
- B. Addressable Manual Stations (MS95-L):**
1. Manual Fire Alarm Stations: Non-code, non-break glass type, equipped with key lock so they may be tested without operating handle.
 2. Operated Station: Visually apparent, as operated, at a minimum distance of 100 feet (30.5 m) from front or side.
 3. Stations shall be designed so after actual activation, they cannot be restored to normal except by key reset.
 4. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on cover. The word FIRE shall appear on front of stations in raised letters, 1.75 inches (44 mm) or larger.
 5. Addressable manual stations shall, on command from control panel, send data to panel representing state of manual switch and addressable communication module status.
- C. Intelligent Thermal Detectors (XP95-T):** Intelligent addressable devices rated at 194 degrees F (90 degrees C) and have rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. Connect via 2 wires to fire alarm control panel signaling line circuit.
- D. Intelligent Photoelectric Smoke Detectors (XP95-P):** Use photoelectric (light-scattering) principal to measure smoke density and shall, on command from control panel, send data to panel representing analog level of smoke density.
- E. Intelligent Ionization Smoke Detectors (XP95-I):** Use dual-chamber ionization principal to measure products of combustion and shall, on command from control panel, send data to panel representing analog level of products of combustion.
- F. Intelligent Multi-Criteria Detectors (XP95-M):**
1. Addressable device designed to monitor a minimum of photoelectric and thermal technologies in single-sensing device. Include ability to adapt to its environment by utilizing built-in microprocessor to determine its environment and choose appropriate sensing settings. Allow wide sensitivity window, with no less than 1 to 4 percent per foot obscuration. Utilize advanced electronics that react to slow smoldering fires and thermal properties within single sensing device.
 2. Microprocessor: Capable of selecting appropriate sensitivity levels based on environment type it is in, such as office, manufacturing, or kitchen, and then have ability to automatically change setting as environment changes, as when walls are moved or as occupancy changes.
 3. Intelligent multi-criteria detection device shall include ability to combine signal of thermal sensor with signal of photoelectric signal to react hastily in event of fire situation. Include inherent ability to distinguish between fire condition and false alarm condition by examining characteristics of thermal and smoke sensing chambers and comparing them to database of actual fire and deceptive phenomena.
- G. Intelligent Duct Smoke Detectors (SL-DAA-P/SL-DAA-N):**
1. In-Duct Smoke Detector Housing: Use on-board intelligent photoelectric or ionization detector, which provides continuous analog monitoring and alarm verification from panel.

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2. When sufficient smoke is sensed, alarm signal is initiated, and appropriate action taken to shut down or change over air handling systems to help prevent rapid distribution of toxic smoke and fire gases throughout areas served by duct system.
 3. Duct Smoke Detectors Mounted Above Ceiling or Otherwise Obstructed from Normal View: Provide with remote alarm indicator.
 4. Each Detector: Install in either supply side or return side duct in accordance with local mechanical code.
- H. Addressable Dry Contact Monitor Modules (PID-95/PID-95P):
1. Provide to connect 1 supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to 1 of the fire alarm control panel SLCs.
 2. Mount in standard deep electrical box or plastic plate.
 3. IDC Zone: Suitable for Style B operation.
- I. Addressable Dry Contact Monitor Modules (CZI-95):
1. Provide to connect 1 supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device) to 1 of the fire alarm control panel SLCs.
 2. Mount in 4-inch (102-mm) square, 2-1/8-inch (54-mm) deep electrical box.
 3. IDC Zone: Suitable for Style B, C, D or Style E operation.
 4. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
- J. Addressable Control Modules (SCE-95):
1. Provide to supervise and control operation of 1 conventional NAC of compatible, 24-VDC powered, polarized audio/visual notification appliances or UL-listed polarized relays for fan shutdown and other auxiliary control functions.
 2. Mount in standard 4-inch (101.6-mm) square, 2-1/8-inch (54-mm) deep electrical box or to surface-mounted back box.
 3. Control Module NAC: Wire for Style Z or Style Y (Class A/B) with 2 amps of resistive signal operation. Relay coil shall be magnetically latched to reduce wiring connection requirements and to ensure 100 percent of all auxiliary relay or NACs shall be energized at same time on same pair of wires.
 4. Audio/Visual Power: Provide by separate supervised power circuit from main fire alarm control panel or from supervised, UL-listed remote power supply.
- K. Addressable Relay Modules (RCE-95):
1. Available for HVAC control and other building functions. Relay shall have 1 Form C set of contacts and are rated for a minimum of 2.0 amps resistive. Relay coil shall be magnetically latched to reduce wiring connection requirements and to ensure 100 percent of all auxiliary relay or NACs shall be energized at same time on same pair of wires. The device shall provide positive feedback of the controlled equipment's status annunciating upon activation.
 2. Mount in standard 4-inch (101.6-mm) square, 2-1/8-inch (54-mm) deep electrical box or to surface-mounted back box.
- L. Addressable Building Control Modules (BCE-95):
1. Available for building functions that require three position (On/Off/Auto) control capability. Relay shall have 1 Form C set of contacts and are rated for a minimum of 2.0 amps resistive. Relay coil shall be magnetically latched to reduce wiring connection requirements and to ensure 100 percent of all auxiliary relay or NACs shall be energized at same time on same pair of wires. The device shall provide positive feedback of the controlled equipment's status annunciating upon activation.
 2. Mount in standard 4-inch (101.6-mm) square, 2-1/8-inch (54-mm) deep electrical box or to surface-mounted back box.
- M. Isolator Modules (XP95-LI):
1. Provide to automatically isolate wire-to-wire short circuits on SLC Class A or Class B branch. Isolator module shall limit number of modules or detectors that may be rendered inoperative by short-circuit fault on SLC loop segment or branch. At least 1 isolator module shall be provided for each floor or protected zone of building. No more than 20 devices shall be connected to 1 isolator module.

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2. If wire-to-wire short occurs, isolator module shall automatically open-circuit (disconnect) SLC. When short-circuit condition is corrected, isolator module shall automatically reconnect isolated section.
 3. Does not require address-setting, and its operations shall be totally automatic. Not necessary to replace or reset isolator module after normal operation.
 4. Mount in unique base, eliminating addressable sensors from being installed incorrectly.
 5. Single LED: Flash to indicate isolator is operational and illuminate steadily to indicate short-circuit condition has been detected and isolated.
- N. Conventional Heat Detectors:
1. Combination rate-of-rise and fixed temperature rated at 135 degrees F (57.2 degrees C) for areas where ambient temperatures does not exceed 100 degrees F (37.7 degrees C), and 200 degrees F (93.3 degrees C) for areas where temperature does not exceed 150 degrees F (65.5 degrees C).
 2. Low profile, ceiling-mount type with positive indication of activation.
 3. Rate-of-Rise Element: Air chamber, flexible metal diaphragm, and factory-calibrated, moisture-proof, trouble-free vent, and operate when rate of temperature rise exceeds 15 degrees F (9.4 degrees C) per minute.
 4. Fixed-Temperature Element: Fusible-alloy retainer and actuator shaft.
 5. Smooth Ceiling Rating: 2,500 square feet (762 m²).
- O. Conventional Photoelectric Area Smoke Detectors:
1. 24-VDC, 2-wire, ceiling-mounted, light-scattering type using LEDs light source.
 2. Each Detector: Remote LEDs output and built-in test switch.
 3. Provide on twist-lock base.
 4. Perform calibrated sensitivity and performance test on detector without need for generation of smoke. Test method shall test all detector circuits.
 5. Visual Indication of Alarm: Provide by dual-latching LEDs on detector, seen from ground level over 360 degrees. LEDs shall flash every 10 seconds, indicating power is applied to detector.
 6. Detector shall not go into alarm or trouble when exposed to air velocities of up to 3,000 feet (914.4 m) per minute.
 7. Detector Screen and Cover Assembly: Easily removable for field cleaning of detector chamber.
 8. Field-Wire Connections: Made to base through use of clamping plate and screw.
- P. Conventional Ionization-Type Smoke Detectors:
1. 2-wire, 24-VDC type using dual uni-polar chamber.
 2. Each Detector: Remote LEDs output and built-in test switch.
 3. Provide on twist-lock base.
 4. Perform calibration sensitivity and performance test on detector without need for generation of smoke.
 5. Visual Indication of Alarm: Provide by dual-latching LEDs over 360 degrees, on detector, seen from ground level. LEDs shall flash every 10 seconds, indicating power is applied to detector.
 6. Detector shall not alarm or trouble when exposed to air velocities of up to 1,200 feet (365.76 m) per minute.
 7. Detector Screen and Cover Assembly: Easily removable for field cleaning of detector chamber.
 8. Field-Wire Connections: Made to base through use of clamping plate and screw.
- Q. Sprinkler Waterflow Switches (provided and installed by the sprinkler contractor):
1. Integral, mechanical, non-coded, non-accumulative retard type.
 2. Alarm transmission delay time conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30 to 45 seconds.
 3. Single manufacturer and series.
 4. Where possible, locate waterflow switches a minimum of 1 foot from fitting which changes direction of flow and a minimum of 3 feet from valve.
 5. Waterflow switches shall be provided and connected under this section but installed by the mechanical contractor.
- R. Sprinkler and Standpipe Valve Supervisory Switches (provided and installed by the sprinkler contractor):
1. Each sprinkler system water supply control valve riser, zone control valve, and standpipe system riser control valve shall be equipped with supervisory switch. Standpipe hose valves, test valves, and drain valves shall not be equipped with supervisory switches.
 2. PIV (Post Indicator Valve) or Main Gate Valves: Equip with supervisory switch.

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3. Mount not to interfere with normal operation of valve and adjust to operate within 2 revolutions toward closed position of valve control, or when stem has moved no more than one-fifth of distance from normal position.
4. Contain in weatherproof aluminum housing, which shall provide 3/4-inch (19-mm) conduit entrance and incorporate necessary facilities for attachment to valves.
5. Switch Housing Finish: Red baked enamel.
6. Entire Installed Assembly: Tamper proof and arranged to cause switch operation if housing cover is removed or if unit is removed from mounting.
7. Valve supervisory switches shall be provided and connected under this section and installed by mechanical contractor.

2.7 SYSTEM PERIPHERALS – E3 SERIES

A. NGA Network Graphic Annunciator

1. Main Menu
 - a. Configure allows Auto-configuration of ILI-MB-S/ and ILI95-MB-E3/ILI95-S-E3 and NGA or ANX.
 - b. Walk/Drill enables Walk Test and Fire Drill function.
 - c. I/O Allows enable/disable input and output devices.
 - d. Clock system real-time clock.
 - e. View system configuration information
 - f. NGA log displays, stores, prints and clears the 4100 event history log.
 - g. Service provides Network Query functions.
 - h. (More spec items – Text messaging, custom logo, custom screensaver, max amount of text on screen at one time)

B. Speakers:

1. Operate on 70.7 VRMS with field-selectable output taps from 0.5 to 2.0 watts.
2. Speakers in Corridors and Public Spaces: Produce nominal sound output of 84 dBA at 10 feet (3 m). Red
3. Frequency Response: Minimum of 400 Hz to 4,000 Hz.
4. Back of Each Speaker: Sealed to protect speaker cone from damage and dust.

C. Strobes:

1. Compliance: ADA and UL 1971.
2. Maximum Pulse Duration: 0.2 second.
3. Strobe Intensity: UL 1971.
4. Flash Rate: UL 1971.
5. Strobe Candela Rating: Determine by positioning selector switch on back of device.

D. Speaker/Strobes:

1. Operate on 70 VRMS or with field-selectable output taps from 0.5 to 2.0 watt, Red
2. Speakers in Corridors and Public Spaces: Produce nominal sound output of 84 dBA at 10 feet (3 m).
3. Frequency Response: Minimum of 400 Hz to 4,000 Hz.
4. Back of Each Speaker: Sealed to protect speaker cone from damage and dust.
5. Audibility: NFPA 72.
6. Maximum Pulse Duration: 0.2 second.
7. Strobe Intensity: UL 1971.
8. Flash Rate: UL 1971.
9. Strobe Candela Rating: Determine by positioning selector switch on back of device.

2.7 DEVICE DESCRIPTORS

A. Definitions:

1. Address: These series of numbers identify each device on the E3 system.
 - a. The numbers are based on the node, the module and the device number (e.g., 02:135-068).
 - i. Nodes are numbered from 01 to 64
 - ii. Modules are numbered from 001 to 253
 - iii. Devices are numbered from 001 to 254. §□ The standard

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address format is as follows: NN:MMM-DDD

2. Descriptor: This is the line of text that identifies and locates the device corresponding to the address.
 3. Device: This is the type of device. It is identified by an abbreviation or code from the following table below. Examples are PS for a Pull Station or AUD for an audible device such as a horn or bell.
 4. Equipment ID: The ID number of the piece of equipment that the device is monitoring (e.g., HV-5A)
 5. Building Number: This is the number assigned to the building containing the device (e.g., Bld5 for building 5).
 6. Floor Number: This is the number of the floor where the device is located (e.g., F3 for the third floor).
 7. Description: This is a description of the location of the device. It may be a room number or name (e.g., Rm 2105 or Lobby). It may also be a directional guide (e.g., N.E. Corridor).
- B. Constraints:
1. Address: The address is established during the design and programming of the system's CSGM.
 2. Descriptor: The descriptor is limited to 32 characters. This includes letters, numbers, spaces, and punctuation marks.
- C. ESUHSD Descriptor Protocol:
1. Descriptors at ESUHSD E3 panels shall be developed following this standard ESUHSD protocol. No exceptions are allowed.
 2. Address, Device, Equipment ID (if needed), Building Number, Floor Number, Description
 3. If the device is monitoring or controlling a piece of equipment, then that equipment's ID shall immediately follow the Device. (e.g., TRI HV-5A).
 4. If the description is to contain a single compass point, it should be spelled out (e.g., North). If the description uses multiple compass points such as North East it should be abbreviated (e.g., N.E.).
 5. If the description contains a room number, then state the building number followed by a dash and then the three digit room number. (e.g., 2-105)
 6. Examples:
 - a. 02:002-007 PS Bld2 F1 RM 2-105
 - b. 02:001-047 SD Bld1 F3 MECH RM
 - c. 02:004-034 DD Bld7 F3 N.E. CORRIDOR
 - d. 02:004-059 TRI HV-5A Bld7 F1 MCC

PART 3 EXECUTION**3.1 EXAMINATION**

- A. Examine areas and surfaces to receive fire alarm system.
1. Notify Architect of conditions that would adversely affect installation or subsequent use.
 2. Do not begin installation until unacceptable conditions are corrected.

3.2 INSTALLATION

- A. Install fire alarm system in accordance with NFPA 72, NFPA 70, state and local codes, manufacturer's instructions, and as indicated on the Drawings.
- B. Conceal conduit, junction boxes, and conduit supports and hangers in finished areas. Conceal or expose conduit, junction boxes, and conduit supports and hangers in unfinished areas.
- C. Do not install smoke detectors before system programming and test period. If construction is ongoing during this period, take measures to protect smoke detectors from contamination and physical damage.
- D. Flush-mount fire detection and alarm system devices, control panels, and remote annunciators in finished areas. Flush-mount or surface-mount fire detection and alarm system devices, control panels, and remote annunciators in unfinished areas.

FIRE ALARM SYSTEM

- E. Ensure manual stations are suitable for surface mounting or semi-flush mounting as indicated on the Drawings. Install not less than 42 inches, nor more than 48 inches, above finished floor measured to operating handle.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide service of competent, factory-trained technician authorized by manufacturer to technically supervise and participate during pre-testing and acceptance testing of system.

- B. Testing:

1. Conduct complete visual inspection of control panel connections and test wiring for short circuits, ground faults, continuity, and insulation before energizing cables and wires.
2. Close each sprinkler system control valve and verify proper supervisory alarm at INCC Command Center.
3. Verify activation of flow switches.
4. Open initiating device circuits and verify that trouble signal actuates.
5. Open signaling line circuits and verify that trouble signal actuates.
6. Open and short notification appliance circuits and verify that trouble signal actuates.
7. Ground initiating device circuits and verify response of trouble signals.
8. Ground signaling line circuits and verify response of trouble signals.
9. Ground notification appliance circuits and verify response of trouble signals.
10. Check alert tone and prerecorded voice message to alarm notification devices.
11. Check installation, supervision, and operation of intelligent smoke detectors.
12. Introduce on system each of the alarm conditions that system is required to detect. Verify proper receipt and proper processing of signal at INCC Command Center and correct activation of control points.
13. Consult manufacturer's manual to determine proper testing procedures when system is equipped with optional features. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality, and similar.

- C. Acceptance Testing:

1. Before installation shall be considered completed and acceptable by AHJ, a complete test using as a minimum, the following scenarios shall be performed and witnessed by representative approved by Engineer. Monitoring company and/or fire department shall be notified before final test in accordance with local requirements.
2. Contractor's job foreman, in presence of representative of manufacturer, representative of Owner, and fire department shall operate every installed device to verify proper operation and correct annunciation at control panel.
3. Open signaling line circuits and notification appliance circuits in at least 2 locations to verify presence of supervision.
4. Completely disconnect INCC Command Center from rest of network, including Voice INCC Command Center. Activate initiating device from transponder. All speaker circuits activated from each transponder shall transmit the correct evacuation or alert message. These messages shall be same messages transmitted with INCC Command Center activated. Default tones or messages shall not be acceptable.
5. Completely disconnect INCC Command Center from rest of network. Activate initiating device. All control outputs supported by transponder SLC circuits shall operate under project programming mode. Default or degrade mode programming shall not be acceptable.
6. All audio risers shall be directly shorted between INCC Command Center and first audio transponder, followed by activation of alarm initiating device. Correct pre-recorded messages shall transmit from all speakers, including evacuation and alert channels. Default or degrade messages shall not be acceptable.
7. When testing has been completed to satisfaction of both Contractor's job foreman and representatives of manufacturer and Owner, a notarized letter co-signed by each attesting to satisfactory completion of said testing shall be forwarded to Owner and fire department.
8. Leave fire alarm system in proper working order and, without additional expense to Owner, replace defective materials and equipment provided within 1 year (365 days) from date of final acceptance by the owner.

3.4 DEMONSTRATION AND FACTORY TRAINING

FIRE ALARM SYSTEM

- A. Intrepid Electronic Systems to provide instruction as required for operating fire alarm system. Schedule (3) district staff for a factory training session. Intrepid Electronic System to provide all cost for transportation, housing and meals.
- B. Intrepid Electronic Systems to provide hands-on demonstrations of operation of fire alarm system components and functions. Two training classes will be provided.

3.5 SPARE PARTS TO BE PROVIDED BY INTREPID ELECTRONIC SYSTEMS

- A. Manual Pull Stations : 30 each
- B. Smoke Detectors : 30 each
- C. Duct Smoke Detectors : 30 each
- D. Heat Detectors : 30 extra
- E. Addressable Interface Devices : 10 of each type
- F. Specialty Devices : 5 each of each type
- G. Spare control boards and parts one of each type used

3.6 PROJECT CLOSEOUT

- A. As Built Drawings:
 - 1. Provide a complete set of reproducible "as-built" and AutoCAD drawings showing installed wiring, color coding, and wire tag notations for exact locations of all installed equipment, specific interconnections between all equipment, and internal wiring of the equipment upon completion of system.
- B. Operating and Instruction Manuals:
 - 1. Operating and Instruction manuals shall be submitted prior to testing of the system. Four complete sets of operation and instructions manuals shall be delivered to the owner upon request.
 - 2. Complete, accurate, step-by-step testing instructions giving recommended and required testing frequency of all equipment, methods for testing each individual piece of equipment, and troubleshooting manual explaining how to test the preliminary internal parts or each piece of equipment shall be delivered upon completion of the system.
- C. Maintenance instructions shall be complete, easy to read, understandable, and shall provide the following information:
 - 1. Instructions on replacing any components of the system, including internal parts.
 - 2. Instructions on periodic cleaning and adjustment of equipment with a schedule of these functions.
 - 3. A complete list of all equipment and components with information as to the address and telephone number of both the manufacturer and local supplier of each item.
 - 4. User operating instructions shall be provided prominently displayed on a separate sheet located next to the control unit in accordance with U.L. Standard 864.

END OF SECTION

SECTION 31 00 00 - EARTHWORK

1.00 GENERAL

1.01 DESCRIPTION

A. Principal work in this Section:

1. All excavating, filling, backfilling, compacting and grading required for the Project.
2. Adjusting manhole rims, grates, valve boxes, etc. to finished grade indicated.
3. Pumping, draining, shoring, cribbing and other protective measures.
4. Importing fill materials.
5. Shoring and cribbing.
6. Removing excess and unsatisfactory excavated materials from the site.

B. Related work in other Sections:

1. Selective Demolition: Section 02 41 13.
2. Site Clearing: Section 31 10 00.
2. Trenching, backfilling and compacting for utilities: Section 31 23 33.
3. Disconnecting utilities: Section 02 41 13.
4. Re-routing utilities: Sections 33 00 00, 33 10 00, 33 30 00 and 33 40 00.
5. Aggregate base under asphalt paving: Section 32 12 16.
6. Finish grading for landscaping and asphalt paving: Section 32 12 16.

1.02 QUALITY ASSURANCE

A. Lines and levels: All construction staking shall be provided by Contractor.

B. Inspections and tests: The Owner will employ a Geotechnical Consultant to inspect and test the work of this Section. At completion of this work, the Geotechnical Consultant will be required to submit written report certifying that the site was developed with acceptable materials in accordance with these Specifications and the recommendations of the Soil Investigation Report.

1. The Geotechnical Consultant will:

- a. Make the tests and inspections of the structural subgrades required by the nature of the subsurface conditions discovered during the progress of the earthwork operations.
- b. Approve for use of imported fill material.
- c. Inspect all filling, backfilling, and compacting of the soils.

1.03 SUBMITTALS

- A. Imported fill materials: Submit samples of proposed imported materials, minimum 40 lbs., tagged with source location and manufacturer to the Owner's Representative at least 15 days prior to import. Material shall not be imported to job site without written approval by the Owner's Representative.

1.04 GEOTECHNICAL INVESTIGATION

- A. A geotechnical investigation report has been prepared for the site by Cleary Consultants, Inc. (650) 948-0574, (Project No. 978.7H/Ser. 6226, dated May 10, 2019) and is available for the Contractor's review from the Owner, the Owner's Representative or the Geotechnical Engineer. All grading, excavation, compaction, and expansive soil remediation shall be per the geotechnical investigation report.
- B. Neither the Owner nor the Owner's agents assume any responsibility for conclusions the Contractor may draw from the soil investigation report. The investigation is not a guarantee of subsurface conditions other than at the boring locations. The Contractor/Bidder shall examine the site and determine all conditions affecting the performance of the work.
- C. In case of conflict between these Specifications and the recommendations of the geotechnical investigation, the geotechnical investigation shall govern.

2.00 PRODUCTS

2.01 FILL MATERIALS

- A. Select (porous) fill under building slab-on-grade and behind retaining and basement walls: Clean gravel or crushed rock complying with CalTrans Standard Specifications, Section 68, Class 2.
- B. Imported fill materials and on-site select materials shall be granular in nature, non-expansive, free of organic materials, with a plasticity index of less than 12, and an expansion index of less than 20 and graded as follows:

Sieve Size	Percentage Passing Sieve
3"	100
No. 4	60 - 100

No. 200

Less than 20

- C. On-site materials, less debris and organic matter, shall be approved by the Geotechnical Engineer.
- D. Import shall be approved by the Geotechnical Engineer.

3.00 EXECUTION

3.01 PROTECTIVE MEASURES

- A. Underground utilities: Report any lines encountered that are not indicated, or are in location other than indicated, on the Drawings to the Engineer's attention who will issue instruction for proceeding with the work.
- B. Moisture control: Remove water and debris, which would interfere with construction, from excavated areas and keep working areas dry when work is in progress. Grade perimeter of excavations so that water run-off drains away from the excavations.
 - 1. Keep excavations free from loose material and water while fill is placed and compacted.
 - 2. Dispose of water resulting from dewatering operations in a manner that will not cause damage to public or private property, or constitute a nuisance or menace to the public.
 - 3. Make sure that debris and dirt generated by this work does not block existing storm drain system. Keep adjacent paving (outside Contract area) broom clean and free of debris and dirt. Clean any existing facilities that become plugged.
- C. Shoring, cribbing and bracing: Provide and install shoring, cribbing and bracing of the excavations as necessary to prevent cave-ins and to support and protect adjacent construction in accordance with Federal, State and local laws. Contractor shall be completely responsible for adequacy and safety of shoring design, construction, and removal.
- D. Benchmarks and monuments: Protect benchmarks, monuments and other reference points against displacement and damage. Repair or replace benchmarks, monuments and other permanent survey data that becomes displaced or damaged due to the performance of the work of this Section.
- E. Dust palliation: Keep down dust at the site by intermittent watering and sprinkling while the work of this Section is being performed. Earthwork operations shall be conducted so as to prevent windblown dust and dirt. Assume liability for all claims related to windblown dust and dirt. Apply water in accordance with applicable provisions of Section 17 of California Transportation Standard Specifications and with Section 1590 (e) of CAL/OSHA, Title 8.

- F. Protection of existing facilities and landscape: Protect all trees, plants, utilities and existing improvements to remain from injury and damage resulting from the work of this Section. Replace all damaged landscaping, improvements or utilities in kind. Refer to Section 31 10 00 for additional requirements on tree protection. Clean staging and other use areas of debris and dust upon completion of project. Re-stripe portions of parking lot where, in the opinion of the Owner's Representative, the striping was damaged or destroyed by Contractor's operations.
- G. Protection of completed work:
 - 1. Protect finished areas from weather damage to prevent erosion of graded areas.
 - 2. Hauling and other activities on prepared grades which will deform them from required cross sections will not be permitted. Repair and re-compact damage to prepared grades caused by such operations at no additional cost to the Owner.

3.02 EXCAVATING AND FILLING

- A. Site clearing is specified in Section 31 10 00 and/or soils report. Verify that existing paving, curbs, light posts and other improvements, and all debris are removed from the site.
- B. After site has been properly cleared, stripped, and excavations to rough grade have been made, exposed surface soils in those areas to receive engineered fills, concrete slabs-on-grade, or pavements should be scarified to a depth of 12 inches, moisture conditioned, and compacted (see D). In building areas to receive concrete slabs-on-grade, sub-grade preparation shall extend at least 5 feet beyond the limits of the proposed structures and any adjoining flat work. In pavement areas and for exterior flatwork not connected to buildings, sub-grade preparation shall extend at least 2 feet beyond the back of the curbs or outside limits of flatwork.
- C. Any portions of the site which are disturbed or softened by standing water shall be re-graded and re-compact to 90% of maximum density (ASTM D-1557) as recommended by the Owner's Representative. Portions of the site which show evidence of "pumping" or movement under load shall be excavated, dried out, or filled with bridging rock or other material determined to be suitable by the Owner's Representative, then recompact to the above standards. All this work shall be done at no additional cost to the Owner.
- D. Place fill materials in loose lifts no more than 8" in uncompacted thicknesses. Compaction of fill should be accomplished by mechanical means only. Compact engineering fills consisting of expansive clay soil between 88% to 93% relative compaction at soil moisture content of between 3 and 5 percent above the laboratory optimum moisture content. Compact on-site or imported soils with low expansion potential to at least 90% relative compaction at soil moisture content of between 1 and 3 percent above the laboratory optimum moisture content. In pavement areas, the upper 12 inches of sub-grade shall be compacted to at least 95% percent relative compaction at soil moisture content 1 to 3 percent above optimum value. Aggregate base material in pavement areas shall be compacted slightly above the optimum moisture content to at least 95% relative compaction. Behind retaining walls, care should be taken to avoid over-compaction of the

backfill materials. Avoid excessive wall movements and lateral pressures use lightweight hand-operated equipment to compact backfill within 3 feet behind retaining walls.

- E. Do not place fill during unfavorable weather conditions. If work is interrupted by heavy rain, do not resume operations until the proper moisture content and density of the materials have been achieved.
- F. Earth and rock, regardless of character and subsurface conditions, shall be excavated to depths shown on Drawings and to the neat dimensions of the footings wherever practicable, to permit pouring of footings and grade beams without use of side forms, except at slab perimeters.

3.04 BACKFILLING

- A. Place backfill in loose layers not exceeding 8" thick, as construction operations permit, but not before work to be covered has been inspected and approved, and loose soils and debris have been removed from the excavations.
- B. Do not place backfill during unfavorable weather conditions as specified for fill above.
- C. Compact backfill to 95% of maximum density (ASTM D1557).
- D. Where backfill is required on both sides of a structure, place it simultaneously so that the height of fill remains approximately equal on both sides at all times.
- E. Brace construction which has not been designed to withstand eccentric loading during backfilling.
- F. Backfill only after the structure to be backfilled against has attained its design strength or has been properly braced, to resist the load of the backfill. No compacting by jetting permitted.
- G. Keep rollers and other heavy equipment at least 4 feet from footings, foundations, piers and walls of building and appurtenances.

3.05 GRADING

- A. The locations and elevations of all construction are indicated on the Drawings and, unless inconsistencies are brought to the Owner's Representatives attention prior to commencement of work, the Contractor will be held responsible for the proper location and elevations of the completed work.
- B. Grade all areas to the lines and levels required. Keep grades straight between changes in elevations. Finish grading tolerance shall not exceed plus or minus one half inch ($\frac{1}{2}$ ") of required elevations, if evenly distributed.
- C. The required subgrade elevation shall be such that when subbase and indicated construction are added, the final elevations will be those shown on the Drawings.

3.07 FRAMES, COVERS, GRATES AND VALVE BOXES

- A. Adjust frames, grates, valve boxes, and covers of existing manholes, inlets, or other facilities to grade in conformance with Sections 15 of the CDT Standard Specifications.
- B. A structure located in a paved area shall not be constructed to final grade until the adjacent pavement or surfacing has been compacted.

3.08 DISPOSAL OF SURPLUS AND UNSUITABLE EXCAVATED MATERIALS

- A. Remove these materials from the Owner's site and dispose of them in a legal manner; this includes materials resulting from all excavations including elevator cylinder, concrete piles and utility excavations. Burning and burying materials on-site is prohibited.

3.09 FIELD QUALITY CONTROL

- A. Field density tests: To check the degree of compaction of native soils and fill will be taken by the Owner's Representative. The location and frequency of the tests will be at the Owner's Representative discretion.
- B. Verification of elevations: Owner will provide the services of a licensed Civil Engineer or Land Surveyor upon completion of earthwork operations to verify that grades are within the tolerances specified. Should the grades be found to be out of tolerance, the site shall be reworked and resurveyed by the Owner at the Contractor's expense.

END OF SECTION 31 00 00

SECTION 31 10 00 - SITE CLEARING

1.00 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes, but is not limited to, the following:

1. Protection of existing trees.
2. Removal of trees and other vegetation.
3. Topsoil stripping.
4. Clearing and grubbing.
5. Removing above-grade improvements.
6. Removing below-grade improvements.

- B. Related work in other Sections: The following sections are noted as containing requirements that relate to this Section, but may not be limited to this listing.

1. Earthwork: Section 31 00 00.
2. Selective Site Demolition: Section 02 41 13.

1.03 PROJECT CONDITIONS

- A. Traffic: Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities, unless otherwise noted, without permission from authorities having jurisdiction.

- B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.

1. Protect improvements on adjoining properties and on Owner's property.
2. Restore damaged improvements to their original condition, as acceptable to property owners.

- C. **Protection of Existing Trees and Vegetation:** Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
1. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.
 2. Provide protection for roots over 1-1/2 inch diameter that are cut during construction operations. Coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
 3. Repair or replace trees and vegetation indicated to remain which are damaged by construction operations, in a manner acceptable to Architect. Employ a licensed arborist to repair damages to trees and shrubs.
 4. Replace trees which cannot be repaired and restored to full-growth status, as determined by arborist.
- D. **Improvements on Adjoining Property:** Authority for performing removal and alteration work on property adjoining Owner's property will be obtained by Owner prior to award of contract.
1. Extent of work on adjacent property is indicated on Drawings.
- E. **Salvable Improvements:** Carefully remove items indicated to be salvaged (to remain property of Owner), and store on Owner's premises where indicated or directed.

2.00 PRODUCTS (Not Applicable)

3.00 EXECUTION

3.01 SITE CLEARING

- A. **General:** Remove trees, shrubs, grass and other vegetation, improvements, or obstructions as required to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. "Removal" includes digging out and off-site disposing of stumps and roots or other material.
1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner, where such roots and branches obstruct installation of new construction.
- B. **Topsoil:** Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4 inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and

other objects over 2 inches in diameter, and without weeds, roots, and other objectionable material.

1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material.
2. Stockpile suitable topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent wind erosion.
3. Dispose of unsuitable or excess topsoil same as specified for disposal of waste material, or use for fill if approved by Architect or Soils Engineer.

C. **Clearing and Grubbing:** Clear site of trees, shrubs and other vegetation, except for those indicated to be left standing.

1. Completely remove stumps, roots, and other debris protruding through ground surface.
2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

D. **Removal of Improvements:** Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.

1. Abandonment or removal of certain underground pipe or conduits may be indicated on civil, plumbing, mechanical or electrical drawings. Removal of abandoned underground piping or conduit is included under this Section.
2. Back-filling of underground trenches resulting from removal of piping or conduits shall be completed as follows per specification section 31 23 33.

3.02 DISPOSAL OF WASTE MATERIALS

- A. **Burning on Owner's Property:** Burning is not permitted on Owner's property.
- B. **Removal from Owner's Property:** Remove waste materials and unsuitable or excess topsoil from Owner's property, except as otherwise noted.

END OF SECTION 31 10 00

SECTION 31 23 33 - TRENCHING, BACKFILLING & COMPACTING

1.00 GENERAL

1.01 DESCRIPTION

A. Principal work in this Section:

1. Trenching, backfilling and compacting.
2. Surface restoration.

B. Related work in other Sections:

1. Selective demolition: Section 02 41 13 .
2. Earthwork: Section 31 00 00.
3. Storm Drainage Utilities: Section 33 40 00.
4. Piped Utilities: Section 33 00 00.
5. Sanitary Sewerage Utilities: Section 33 30 00.
6. Water Utilities: Section 33 10 00.

1.02 QUALITY ASSURANCE

A. Reference standards: The applicable provisions of the following govern the work of this Section.

1. American Society for Testing and Materials (ASTM).
 - a. D1556: Density of Soil in Place by Sand Cone Method.
 - b. D1557: Moisture Density Relations of Soils and Soil-Aggregate Mixtures Using a 10 lb (4.5 kg) Rammer and 18" (457mm) drop.
2. California Department of Transportation (CDT).
 - a. Standard Specifications.
 - b. Standard Test Methods: No. 202, 216, and 231.
3. CAL/OSHA Regulation for Construction: Section 29 CFR.

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- B. The degree of compaction specified herein shall be determined by California Test Method No. 216 or No. 231. Unless otherwise noted, the percentage specified shall be the minimum allowable.

1.03 SUBMITTALS

- A. Submit Product Data under 2.01 Materials, certifying that each material item complies with specified requirements.

1.04 SITE CONDITIONS

- A. Comply with OSHA Construction Safety Orders, and specifically with those provisions dealing with trenching and underground construction.

1.05 SYSTEM DESCRIPTION

- A. Definitions:

1. A trench is defined as an excavation in which the depth is greater than the width of the bottom of the excavation.
2. Excavations for appurtenant structures, such as but not limited to manholes, transition structures, junction structures, vaults, valve boxes, catch basins, thrust blocks, and boring pits shall be deemed to be in the category of trench excavation.

- B. Unless otherwise indicated on the Drawings, excavation for pipelines shall be open cut.

2.00 PRODUCTS

2.01 MATERIALS

- A. Select backfill material:

1. Sand or granular materials, free from organic matter, of the quality herein specified. Select backfill material shall have a size and gradation falling within the following limits when determined by California Test No. 202:

Sieve Size	Percentage Passing Sieve
1"	100
No. 4	50-100
No. 200	5 max.

2. The minus 200 portion of the material expressed as a percentage multiplied by the Plasticity Index shall not exceed 100.

- B. Detectable tape: Detectable tape shall be 5.0 mil composition film containing metalized foil laminated between layers of inert plastic film, such as Detectable Terra Tape or approved equal. The tape shall be highly resistant to alkalis and acids found in the soil.

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The tape, when buried 4' deep, shall be detectable by buried pipe or cable locating equipment. The tape shall be 3" wide and bear a continuous printed message warning of the type of utility buried beneath.

3.00 EXECUTION

3.01 PREPARATION

A. General:

1. Prior to trenching excavate at locations where new lines cross other utilities of uncertain depth and determine the elevation of the utility in question to ensure that the new line will clear the potential obstruction.
2. If, after excavation, the crossing utility does present an obstruction, then the line and grade of the new line will be adjusted as directed by the Engineer to clear the utility.

3.02 TRENCHING

A. General:

1. Trenching shall include removal of all water and materials that interfere with construction. Remove water which may be encountered in the trench by pumping or other methods during the pipe laying, bedding and backfill operations. Material shall be sufficiently dry to permit approved jointing.
2. Excavation shall include the construction and maintenance of bridges required for vehicular and pedestrian traffic, support for adjoining structures and where necessary, the rearrangement and repair of adjoining utilities.
3. It shall be the Contractor's responsibility to direct vehicular and pedestrian traffic through or around his work area at all times.
4. Except as specified in other Sections, the Contractor shall relocate, reconstruct, replace or repair, at his own expense, existing utilities, walls, fences, services, other structures or improvements of what ever nature, which are in the line of construction or which may be damaged, removed, disrupted or otherwise disturbed by the Contractor whether specifically identified on the Drawings or not. The Contractor shall connect such utilities to existing systems and leave all in a workable and operating condition.
5. Tree roots over 2" in diameter and crossing pipelines shall be protected by using hand excavation; refer to Section 31 10 00. Hand excavation shall mean excavation using the smallest piece of motorized equipment available in combination with manual use of hand equipment, with the intent to minimize the damage to low hanging tree limbs, tree roots and utilities.

- B. Existing paving and concrete: The following supplements the requirements of Section 31 10 00.

TRENCHING, BACKFILLING & COMPACTING

1. Existing pavement over trench shall be sawcut, removed and hauled away from the job. Existing pavement shall be neatly sawcut along the limits of excavations. If a longitudinal pavement joint or edge of pavement is located within 3' of the limit of excavation, all intervening pavement shall be removed and replaced after completion of backfilling.
2. Existing concrete over the trench shall be sawcut to a minimum depth of 1½" in straight lines either parallel to the curb or at right angles to the alignment of sidewalk. No section to be replaced shall be smaller than 30" in either length or width. If the sawcut would fall within 30" of a construction joint, expansion joint, or edge, or within 12" of a score mark, the concrete shall be removed to the joint, edge or mark.
3. Place boards or other suitable material under backhoe outrigging to prevent damage to paved surfaces.

C. Trench Width:

1. The maximum allowable trench widths at the top of the pipe shall be the following:

Pipe Type	Trench Width (Max.)
Cast-iron	Outside diameter of barrel plus 18"
Ductile-iron	Outside diameter of barrel plus 18"
PVC	Outside diameter of barrel plus 18"
VCP	Outside diameter of barrel plus 18"
Concrete cylinder	Outside diameter of barrel plus 18"
Welded steel	Outside diameter of barrel plus 18"
Corrugated metal	Outside diameter of barrel plus 18"
RCP	Outside diameter of barrel plus 18"

- a. The maximum trench width shall be inclusive of all shoring.
 - b. If the maximum trench width is exceeded, the Architect may direct the Contractor to embed or cradle the pipe in concrete at no additional charge to the Owner.
2. In no case shall the free working space on each side of the pipe barrel be less than 6".

D. Open trench:

1. The maximum length of open trench shall be 300' or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is greater. No trench shall be left open at the end of the day.
2. Provisions for trench crossings and free access shall be made at all street crossings, driveways, water gate valves and fire hydrants.

E. Excavation bracing:

1. The excavation shall be supported and excavation operations conducted in accordance with the California Industrial Accident Commission, State of California, Division of Industrial Safety requirements, and OSHA.
2. The Contractor shall, at his own expense, furnish, put in place, and maintain such sheeting and bracing as may be required to support the sides of all excavations (whether above or below the pipe grade), and to prevent any movement which could in any way diminish the required trench section or otherwise injure or delay the work. The sheeting and bracing shall be withdrawn to prevent any earth movement that might overload the pipe.

F. Excavated material:

1. Material excavated and not required for backfill shall be immediately removed and properly disposed of off the Owner's site.
2. Material excavated in streets and roadways shall be laid alongside the trench and kept trimmed to minimize inconvenience to public traffic.
3. Provisions shall be made whereby all storm and wastewater can flow uninterrupted in gutters or drainage channels.
4. Excavated material shall not be stored on landscaping.

3.03 PIPE BEDDING

A. Bedding excavation: Excavate the trench below the grade of the pipe bottom to the following minimum depths:

Pipe Type	Depth
Cast-iron	6"
Ductile-iron	6"
PVC	6"
VCP	6"
Concrete cylinder	4"
Welded steel	4"
Corrugated metal	3"
RCP	3"

B. Stabilization of trench bottom: When the trench bottom is unstable due to wet or spongy foundation, trench bottom shall be stabilized with gravel or crushed rock. The Engineer will determine the suitability of the trench bottom and the amount of gravel or crushed rock needed to stabilize a soft foundation. Soft material shall be removed and replaced with gravel or crushed rock when ordered by the Soils Consultant.

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- C. Placement of bedding material: Sufficient select backfill material as specified in Paragraph 2.01 A (above) shall be placed in trench and tamped to bring trench bottom up to grade of the bottom of pipe. The relative compaction of tamped material shall be not less than 90% as determined by ASTM D1556 or California Test 216. It is the intent of these Specifications to provide uniform bearing under the full length of pipe to a minimum width of 60% of the external diameter.

3.04 TRENCH BACKFILL

A. Initial backfill:

1. Prior to trench backfill, the Owner's Representative will inspect the condition of the trench and laying of pipe.
2. Select backfill material as specified in Paragraph 2.01 A (above) shall be used for initial backfill. After the pipe has been properly laid and inspected, select backfill material shall be placed on both sides of the pipe and compacted to final depth as follows:

Pipe Type	Depth
Cast-iron	12" above top of pipe
Ductile-iron	12" above top of pipe
PVC	12" above top of pipe
VCP	12" above top of pipe
Concrete cylinder	12" above top of pipe
Welded steel	12" above top of pipe
Corrugated metal	½ outside diameter of pipe
RCP	(Pipe spring line)

3. Compaction:

- a. Initial backfill compaction shall be by mechanical means. The initial backfill material shall be hand tamped in layers not exceeding 4" in uncompacted depth and shall be brought up uniformly on both sides of the pipe to avoid bending or distortional stress. After hand tamping, the relative compaction of the initial backfill material shall be not less than 90%.
 - b. Compaction testing will be in accordance with one or more of the following methods: California Test No. 216, California Test No. 231, ASTM 1556, or ASTM 1557.
- B. Detectable Tape: In trenching continuing non-metallic pipes, detectable tape shall be placed on top of the initial backfill, except with reinforced concrete pipe where the tape shall be placed 12" above top of pipe.
- C. Subsequent Backfill:

TRENCHING, BACKFILLING & COMPACTING

1. Above the level of initial backfill, the trench shall be backfilled with native material from trench excavation or with select imported material. Subsequent backfill shall be free of vegetable matter, stones, or lumps exceeding 3" in greatest dimension, and other unsatisfactory material. The Soil Engineer shall approve the backfill material prior to replacement.
 2. Subsequent backfill compaction shall be by mechanical means. The backfill material shall be placed in layers not exceeding 6" in loose depth, and each layer shall be thoroughly compacted before succeeding layers are placed. The use of machine tampers, except manually held types, shall not be permitted.
 3. Relative compaction shall be at least 90%.
- D. Backfill Cap: trench backfill shall be capped with 12 inches of backfill compacted to 95% of relative compaction. Lift shall be no more than 6".

3.05 TRENCH SURFACING

- A. General: In areas to be improved under separate contract, the trench shall be backfilled and graded to the level of adjacent surfaces. No mounds of earth shall be left along the trench.
- B. Temporary surfacing in areas to remain in use by the public:
1. Temporary surfacing shall be 2½" of cut back asphalt on 12" of Class 2 aggregate base.
 2. Temporary surfacing shall be laid within one day after backfilling.
 3. Before the trenching area is opened to traffic, excess dirt, rock and debris shall be removed and the street surface shall be swept clean.
 4. Temporary surfacing shall be maintained to prevent the occurrence of mudholes and prevent the surface from settling below 1" or rising more than 1" from the existing pavement grade.

3.06 INSPECTION

- A. Pipes shall be inspected/tested prior to backfilling and compaction, tests as required shall be performed to ensure compliance with these Specifications. The test(s) shall be conducted at no cost to the Owner.
- B. A final inspection upon completion of the paving operation shall be made to ensure conformity with the existing pavement surface.

END OF SECTION 31 23 33

SECTION 32 13 12 - SITE CONCRETE REINFORCING

1.00 GENERAL

1.01 DESCRIPTION

A. Principal work in this Section:

1. Reinforcing steel for site cast in place concrete.
2. Accessories such as chairs and tie wires.

B. Related work in other Sections:

1. Curb and Gutters: Section 32 16 00.
2. Site Cast-in-Place Concrete: Section 32 13 13.

1.02 QUALITY ASSURANCE

A. Source quality control:

1. The Contractor shall ensure that the material delivered for use is that represented by the mill reports and obtain copies of mill reports, examine them, certify whether the material represented complies with Specifications requirements, and make distribution of reports as required. Report chemical composition of each heat, as determined by ladle analysis.
2. Where materials proposed for use cannot be identified, the Contractor shall pay for an approved testing laboratory to make one series of tests (tensile and bend) from each 2.5 tons, or fraction thereof, of each size and kind of reinforcing steel.

B. Standards: The applicable provisions of the following govern the work of this Section:

1. ACI 301 Specifications for Structural Concrete for Buildings.
2. ACI 318 Building Code Requirements For Reinforced Concrete.
3. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.
3. ACI SP 66 American Concrete Institute Detailing Manual.
4. ANSI/ASTM A497 Welded Deformed Steel Wire Fabric for Concrete Reinforcement.

1.03 SUBMITTALS

- A. Submit bar drawings, schedules and placing diagrams for reinforcing steel. Submit bar drawings and schedules with the corresponding placing diagrams. Drawings shall be complete for any specific area of Project at the time they are submitted.

1.04 HANDLING

- A. Comply with the requirements of Specification.
- B. Marking and shipping reinforcement: Bundle and tag with suitable identification. Transport to and store at the site to avoid damage to material. Maintain tags after bundles are broken.

2.00 PRODUCTS

2.01 MATERIALS

- A. Reinforcement Steel - Bar Reinforcement - ASTM A 615 Grade 60 (ASTM A 615M Grade 400), deformed.
- B. Reinforcement Steel - Reinforcing Fabric - Welded wire fabric - ASTM A 185, welded steel wire fabric.
- C. Stirrup steel: ANSI/ASTM A1064.
- D. Tie wire: 16 gauge (min.) annealed steel wire.
- E. Chairs and similar support items:
 - 1. Standard manufactured products conforming to CRSI Manual of Standard Practice, MSP-2.
 - 2. Use dense precast concrete bar support with embedded wire ties for reinforcement placed on grade; elsewhere reinforcement shall be supported by wire bar supports.

2.02 FABRICATION

- A. General: Except as modified by the Drawings and the Specifications, comply with CRSI and WCRSI Manual of Standard Practice for Reinforced Concrete Construction, for fabrication of reinforcing steel.
- B. Bending and forming:
 - 1. Fabricated steel bars, wire and fabric of indicated sizes, lengths, and gauges and accurately form to shapes indicated by methods that will not injure the materials.
 - 2. Do not heat reinforcement for bending. Do not install bars with unscheduled kinks or bends.

3.00 EXECUTION

3.01 PLACING

- A. Cleaning: Clean reinforcement of oil or other coating that might destroy or reduce its bond with concrete before placing it.
- B. Placing: Conform to the Manual of Standard Practice for Reinforced Concrete Construction by CRSI and WCRSI, and the following:
 - 1. Accurately place reinforcement and securely tie in position with steel wire at points where bars cross to hold them against displacement.
 - 2. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- C. Spacing of reinforcement:
 - 1. Space reinforcement to maintain the proper distance and clearance between parallel bars and between bars and forms. Provide metal spreaders and spacers to hold horizontal steel in position.
 - 2. Support steel at proper height by using galvanized "S" chairs, or "Support Bars" and galvanized "S" chairs, with hangers, or in other manner, as necessary.
 - 3. Where "Support Bars" are used to hold the slab reinforcement in place, space chairs under the support bars not to exceed the distances specified previously.
- D. Splicing:
 - 1. Stagger all lap splices. Bars shall be in contact, unless noted otherwise on the Drawings, at lapped splices and shall be firmly wired together before placing concrete. Lap bars as indicated.
 - 2. Extend stubs and dowels required to receive and engage subsequent work a sufficient length to develop the strength of the bar. Place dowel and stub bars in the forms and secure against displacement during placing of concrete.
- E. Maintain clear distances between reinforced steel and face of concrete indicated on the Drawings.
- F. Dowels in existing concrete:
 - 1. When drilling for dowels in existing concrete, use sharp bits, drill hole full depth and slightly oversize, fill with a 6000 psi epoxy and hammer dowel to refusal

END OF SECTION 32 13 12

SECTION 32 13 13 - SITE CAST-IN-PLACE CONCRETE

1.00 GENERAL

1.01 DESCRIPTION

A. Principal work in this Section:

1. Site Cast-in-place concrete.
2. Shotcrete.
3. Replacement concrete (patios, walks, steps, etc.).

B. Related work in other Sections:

1. Site Reinforcing steel: Section 32 13 12.
2. Earthwork: Section 31 00 00.

1.02 QUALITY ASSURANCE

A. Reference standards: Applicable provisions of the following govern the work of this Section.

1. ACI 301, Specifications for Structural Concrete for Buildings.
2. ACI302, Recommended Practice for Concrete Floor and Slab Construction.
3. ACI 304, Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
4. ACI 305, Recommended Practice for Hot Weather Concreting.
5. ACI 306, Recommended Practice for Cold Weather Concreting.

B. Source quality control:

1. Employ a testing laboratory, acceptable to the Owner, and Engineer, to test the materials for conformance with these Specifications before concrete mixes are established, and when source is changed, unless recent test results of materials to be used on the Project, performed by an acceptable testing laboratory, are accepted by the Engineer.
2. Testing coarse aggregates:
 - a. Test aggregate before and after concrete mix is established and whenever the character source of material is changed, but not less than one test for each 50 cubic yards.

- b. Perform a sieve analysis to determine conformity with limits of gradation. Perform sampling and testing according to ASTM C33, and as follows:
 - 1) Sampling of aggregates: ASTM D75. Take samples of aggregates at source of supply, or if source of supply has been approved, from storage bunkers at ready-mixed concrete plant.
 - 2) Testing of aggregates shall include:
 - a) Sieve analysis: ASTM C136.
 - b) Organic impurities: ASTM C40. Fine aggregate shall develop a color not darker than the referenced standard color.
 - c) Soundness: ASTM C88. Loss after 5 cycles not over 8% for coarse aggregate, nor 10% for fine aggregate.
 - d) Abrasion of concrete aggregate: ASTM C131. Weight loss not over 10-1/2% after 100 revolutions, nor 42% after 500 revolutions.
 - e) Deleterious materials: ASTM C33.
 - f) Materials passing No. 200 sieve: ASTM C117, not over 1% for gravel, 1.5% for crushed aggregate per ASTM C33.
 - g) Reactive materials: ASTM C289. aggregates shall indicate no potential deleterious reactivity.
 - h) Definitions: ASTM C125.

3. Cement test:

- a. The cement mill laboratory will be acceptable as testing laboratory for this purpose when approved by the Building Department. Submit evidence to show that the cement mill laboratory is qualified to perform tests. The laboratory shall make tests for every 500 barrels or fraction thereof for of cement used in accordance with ASTM C150.
- b. Make tensile strength test at 7 days. Tag the cement for identification at the location of sampling. A representative of the Testing Laboratory shall certify that materials being used are taken from the lots sampled and tested for this report.

2.00 PRODUCTS

2.01 MATERIALS

- A. Portland cement: ASTM C150, Type I or II low alkali with air entrainment as required. Do not change brand or type of cement without Engineer's written approval.
- B. Aggregates:
 - 1. Hardrock aggregates: ASTM C33 graded so that coarse aggregates nominal size is not larger than 1/5 the narrowest dimensions between form faces; nor 3/4 of the minimum clear spacing between individual reinforcing bars or bundles of bars, but never greater than 3/4" in any dimension for slabs 4" thick or less; 1-1/2" at all other locations.
- C. Admixtures: ASTM C494, Type A, admixtures shall contain no chlorides and may be used only with the Engineers approval, except as specified. Submit manufacturer's data for products proposed for use to the Engineer.
- D. Pozzolanic Fly Ash: ASTM C618, Class F.
- E. Water: Fresh, clean, and free of oil and other materials injurious to concrete.
- F. Concrete curing compound:
 - 1. Liquid membrane-curing compound containing a fugitive dye, conforming to ASTM C309, Type I, guaranteed not to affect the bond, adhesion, or effectiveness of finishes and surface treatment specified herein to be applied to concrete.
- G. Expansion joint materials:
 - 1. Joint filler: Homex Expansion Joint by Homasote Co. or equal non-bituminous product compatible with sealant specified in Section 07 90 00 per ASTM D 1751.
 - 2. Joint sealant and back-up rod: As specified in Section 07 90 00.
- H. Dry pack and grout: One of the following or equal.
 - 1. Masterflow 713 by Master Builders.
 - 2. Five Star Grout by U.S. Grout Corporation.
 - 3. Fondag Nonshrink Grout by Specrete Products, Ltd.
- I. Aggregate Base: Class 2 aggregate base, three quarter inch (3/4") maximum size, as specified in Section 26 of the CalTrans Standard Specifications.

2.02 MIXES

- A. Mix design:

1. Employ a testing laboratory, acceptable to the Owner's Representative, to design all structural concrete mixes required for the Project to provide:
 - a. Normal weight concrete with 3000 psi 28-day compressive strength, unless noted otherwise on the Drawings.
 - b. Adequate workability and proper consistency to permit concrete to be worked readily into the forms and around reinforcement without segregation and excessive bleeding.
 - c. Other requirements of these Specifications.
 2. Proper proportions for design mixes shall be in accordance with ACI 211 or ACI 318.
 3. Proper water-cement ratio shall be determined by the preliminary test made in accordance with ASTM C192.
 4. Slump limits: Proportion and design mixes to result in the following concrete slump at point of placement.
 - a. Tieback anchors: Not more than 7".
 - b. Piers: Not less than 4" and not more than 6".
 - c. All other concrete: Not less than 1" and not more than 4".
 5. Use air-entering admixture in all concrete, unless otherwise shown or specified. Add air-entering admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content within 3% to 6%.
 6. Tests shall be conducted in accordance with ASTM C39.
- B. Submit report showing results of sieve analysis, mix design and results of compression tests. Make test specimens from not less than 3 batches of each design specimens from not less than 3 batches of each design mix. The trial batch strength for each mix shall exceed indicated f_c by 25% or a lesser amount based on standard deviations of strength test records according to ACI 318. Do not start concrete production until mixes have been reviewed and are acceptable to the Engineer.
- C. For each batch, weigh the fine and coarse aggregate separately, measure cement and water separately and introduce separately into the mix so that proportions can be accurately controlled and easily checked.
- D. Do not change proportions established by the accepted mix design without the Engineer's written approval.
1. Cement: If concrete develops less than required minimum strength, adjust mix proportions and increase the amount of cement, as necessary.

2. Water: Do not exceed predetermined amount of water because of slowness of discharge from mixer necessary to produce concrete that will work readily into corners and angles of forms and around reinforcements, without segregation of materials and without free water collecting on the surface.
3. Aggregates: Reasonable variations in grading will be allowed by the Engineer because of characteristics of available materials and the need for workability and strength.

E. Concrete mixing:

1. Mixing and delivery shall comply with ASTM C94, these Specifications, and applicable Building Code requirements. If the referenced specifications, these Specifications or the Building Code conflict, comply with the most restrictive requirement.
2. The Owner's Testing Agency will perform check sieve analysis of the aggregates being used, check compliance with mix design and the cement being used against mix design; check that water has been removed from the drum before adding mix ingredients for the following load and shall witness the loading of mixing trucks. The Owner's Testing Agency will send a written report of each inspection to Engineer indicating compliance with these Specifications.
3. Provide a ticket signed by an authorized representative of the batching plant with each mixer truck of concrete delivered to the site indicating:

Name of Project.
Date of Delivery
Supplier of Concrete.
Brand of Cement.
Truck Identity and
Cement Content.
Ticket Serial Number.
Strength Classification.
Batching Time.
Admixture Content.
Point of Deposit.
Name of Contractor.
Total Amount of Water.
Water Added at Jobsite.
Name of Driver.
Weight of Aggregate.
Time loaded and First
Daily Temperature
Mixing Concrete.
Number of Cubic Yards
Reading of Revolution in Load.

4. Store batch tickets at time concrete is delivered in job file for reference at the site.
5. Remove all materials, including water, remaining in the ready-mix truck drum completely before ingredients for the following loads are introduced into the drum.
6. Retempered concrete: Do not use concrete which has not been placed 30 minutes after leaving the mixer, or concrete that is not placed within 60 minutes after water is introduced into the mix.

3.00 EXECUTION

3.01 PREPARATION

- A. Inspect excavations, subgrades and formwork, as applicable for each placing operation, for accuracy of lines, levels, elevations and dimensions. Make necessary corrections to obtain concrete within the tolerances specified.
- B. Inspect placement of reinforcement and accessories for proper positions, sizes, clearances, fastenings, laps and splices.
- C. Moisten, do not saturate, earth subgrade and bearing surfaces. Moisten the sand base under slabs-on-grade the day before concrete is to be cast thereon.
- D. Wet wood forms thoroughly when they are not treated with form release agent. Wet other materials sufficiently to reduce suction and maintain concrete workability.
- E. Recompact disturbed gravel fill and install vapor barrier under building slabs on grade. Lap joints 4". Lap on walls 2". Cut patches at penetrations for a tight fit. Tape all joints to make moisture tight. Cover vapor barrier with a minimum of 2" of damp concrete sand.
- F. Embedded items including, but not limited to, conduits, anchors and rough hardware, built into concrete as indicated or required.
 1. Do not embed piping and conduits, other than electrical conduits, in structural concrete. Locate conduits so as to reduce strength of the structure the least amount, as approved by the Engineer, and as indicated on the Drawings.
 2. Embed bolts, inserts and other items in the concrete, accurately secured so that they are not displaced during concrete placing and compacting operations.
 3. Set embedded bolts for materials and equipment attached to concrete to template, layouts and shop drawings. Verify size, length and location of electric conduit with respect to equipment supports.
- G. Do not proceed with placement of concrete until all conditions are satisfactory.

3.02 CONVEYING

- A. Rapid handling: Transport concrete from the mixer to location of placing as rapidly as practical to avoid separation or loss of ingredients.
- B. Transporting methods: Use cranes, carts, buggies or other approved means to deliver concrete to final locations. Do not use delivery systems (pipe, chutes, etc.) formed of aluminum for transporting concrete. If pumping of concrete is contemplated, first obtain Engineer's approval for the design mix and the placement method before placing concrete.
- C. Free fall: Not more than 4 ft. in concrete which will remain exposed in the Work; no more than 6 ft. elsewhere. Avoid large concentration of concrete in one location which would produce unacceptable deflection in supporting formwork or on one side of steel soldier beam.
- D. Lifts: No more than 2 ft. high.
- E. Concrete flow: Carry concrete up uniformly for the length of walls being placed to reduce lateral flow of concrete to 5 ft. maximum.
- F. Runways: Construct substantial runways and scaffolding to avoid movement and vibration in the forms and reinforcing steel as a result of transporting and placing concrete.

3.03 PLACING

- A. General: Comply with ACI 304. Do not place concrete in or under water.
- B. Consolidation: Thoroughly consolidate concrete and work it around reinforcement and embedded items and into corners and angles of forms, by spading, rodding and tamping to exclude rock pockets, air bubbles and "honeycombs" and to obtain required density and strength.
- C. Internal vibration:
 - 1. Use mechanical vibrators to consolidate each layer with that previously placed, to completely consolidate the concrete in forms. Take care to avoid over-vibration, causing separation of ingredients. Keep extra standby vibrator at the site.
 - 2. Vibration of pier concrete below grade is not required.
- D. Flow of concrete: Keep surface of concrete level during placing, with a minimum of concrete allowed to flow from one position to another. Place concrete in a continuous operation until each section or panel has been completed.
- E. Record: Keep records showing location, date and time of placement of all concrete batches.

- F. Temperature: Do not place concrete when the ambient temperature is above +85°F or below +40°F. at the time of placing, or if it is likely to go above +85°F or below +40°F before the concrete has taken its initial set, unless special precautions recommended by ACI 305 and 306 are provided.
- G. Construction joints:
1. Location:
 - a. Locate construction joints where indicated. When not shown, submit layout showing location of construction joints and placing procedure, for the Engineer's approval, before placing concrete.
 - b. Locate construction joints to least impair the strength and appearance of structure.
 - c. Off-set construction joints not less than 5 ft. with a minimum of 2 offsets.
 2. Joints in channels: Locate as detailed on the Drawings.
 3. Contact surfaces: Keep exposed face of construction joints continuously moist from time of initial set until subsequent placing of concrete against them, but not to exceed the curing period.
 - a. Clean contact surfaces thoroughly by chipping entire surface not earlier than 5 days after initial placing.
 - b. As an option, jet wash or sandblast the surface to expose clean aggregate solidly embedded in the mortar matrix; remove wash water entirely from surface.
 - c. If a contact surface becomes coated with foreign materials of any nature, after being cleaned, chip or rechip the surface completely, to suitable condition.
- H. Tolerances: In compliance with ACI 117 as follows.
1. Paragraph 2.1, except for reference to slip-forming.
 2. Paragraph 2.2, Class AX.
 3. Paragraph 3.6.

3.04 FINISHING

- A. Formed concrete surfaces:
1. General:

- a. Remove fins, laitance and loose material from concrete surfaces when forms are removed.
 - b. Repair concrete honeycombs, rock pockets, sand runs, spalls, or otherwise damaged surfaces by removing the damaged or unsatisfactory area to sound concrete, with slightly undercut edges, and filling-in with the same mix as the adjacent concrete minus the coarse aggregate.
 - c. Tamp and float the patch flush with adjacent surface.
2. Shotcrete walls: Provide a "rubbed finish" as defined in ACI 301 to produce a uniform surface by float trowel or rub board immediately after shotcrete is applied.
 3. Clean surface of pier cast below grade by sandblasting. Apply a sand-cement mortar, trowel and rub to match shotcrete finish.
- B. Top of grade beams, footings and pier caps: Screed to elevations indicated.
- C. Channels:
1. Protection: Protect exposed flatwork as necessary to prevent damage resulting from impact or from subsequent work.
 - a. Protect work of other trades from damage by covering it with heavy kraft paper securely taped in place. Leave protection in place as long as its need exists.
 - b. Control the use of water and other contaminants within the area so that no damage to previously installed work or existing structure and finish occurs.
 2. Compacting and floating:
 - a. Bring channels to proper elevations and strike off with a straightedge. Remove excess water and laitance.
 - 1) Compact by rolling with weighted rollers or by tamping with grid tampers. Thoroughly hand-tamp areas not accessible to rollers.
 - 2) Float and test surfaces with a 10 ft. straightedge and eliminate high and low spots to comply with tolerances specified.
 - 3) From this point, use the methods and tools necessary to produce surface tolerances and finishes specified.
 - b. Use screeds to type and spacing required to produce specified channel tolerance.

3. Moisture control: In addition to other finishing requirements, use a water fog spray to reduce plastic shrinkage cracks during flatwork finishing operations when conditions of low humidity and/or high temperature exist.
 - a. Immediately after concrete has been brought to a flat surface and the shiny film of moisture disappears, restore it and maintain until final troweling by applying a light film of moisture with an atomizing type fog sprayer.
 - b. Use frequent light applications of moisture rather than excessive amounts at any one time. Adjust the amount and frequency of fog spray as required by variable conditions of weather, wind, temperature and humidity.
 4. General requirements:
 - a. Finish surfaces to produce a uniform appearance throughout area involved and throughout adjacent areas with the same treatment.
 - b. Where concrete finishing occurs adjacent to finished metal or other surfaces, particularly where serrated or indented surfaces before allowing to harden.
 - c. Use no troweling machines within 12" of electrical junction and outlet boxes which are set to finish flush with concrete floors. Float and trowel such areas by hand with wood floats and steel trowels, taking care to see that concrete is finished flush with box cover and matches adjacent surfaces.
 5. Schedule of finishes:
 - a. Float surfaces to produce a uniform broom sweep texture and finish throughout.
 - b. Provide an equivalent of a medium salted finish along concrete surfaces at slopes of less than 6%.
 - c. Provide an equivalent of a heavy broom slip resistant finish along concrete surfaces at slopes of 6% and greater.
- D. Curbs: Immediately after removing forms, finish faces and top with a steel trowel.

3.05 CURING

- A. Formed concrete:
 1. Wet the tops and exposed portions of formed concrete and keep moist until forms are removed.

2. If forms are removed before 14 days after concrete is cast, coat concrete with curing compound as specified for flatwork below.
- B. Concrete flatwork:
1. After finishing, spray the specified curing compound uniformly in 2 coats at 90° to each other not exceeding coverage rates recommended by the manufacturer.
 2. Inspect treated surfaces daily for 14 days for evidence of drying. Re-wet the surfaces and apply a new application of curing compound if premature drying occurs, as soon as can be done after finishing without marring the surfaces.
- C. Pits, trenches and curbs: Construct pits for transformers, sumps, valves, trenches, curbs, gutters, and other miscellaneous concrete work.
- D. Grouting and drypacking: Install as indicated and required, except for items grouted by other trades.
1. Mix material, in accordance with its manufacturer's instructions, with sufficient water so it flows under its own weight for grout, and to just moisten and bind the materials together for drypack.
 2. Place drypack by forcing and rodding to fill all voids and provide complete bearing under plates. Place fluid grout from one side only and puddle to completely fill voids; do not remove dams or forms until grout attains initial set. Finish exposed surfaces smooth, and damp cure at least 3 days.
- E. Splash block: Precast in tight molds, to the dimensions and profiles indicated. Use a mix with coarse aggregates passing 3/8" sieve to obtain a compressive strength of 3,500 psi minimum at 28 days. Steel trowel unformed surface.

3.06 PROTECTING AND CLEARING

- A. Protect finished surfaces from stains or abrasions. Do not allow fire in direct contact with concrete. Provide adequate protection against injurious action by sun or wind. Protect fresh concrete from heavy rain and mechanical injury.
- B. Upon completion, wash and clean exposed concrete and leave free of oil, paint, plaster and foreign substances, ready to receive applied finishes or to be left exposed.

3.07 DEFECTIVE CONCRETE

- A. Concrete finishes which are not within the specified tolerances nor finished as specified which do not connect properly to adjoining work, do not slope to drains or are not

properly cured, or do not meet other provisions of the Specifications, will be deemed defective.

- B. Remove defective concrete as directed by Engineer and replace with concrete of specified strength.

3.08 FIELD QUALITY CONTROL

- A. Concrete quality control (refer also to Section 01 40 00): The following will be performed by the Owner's Testing Agency.
 - 1. Samples will be taken during progress of the work for determination of slump, compression strength, aggregate sieve analysis, and grout-mix tests, with assistance furnished by the Contractor.
 - 2. 3 cylinders will be made for each day's pour or for each 100 cubic yards or less, or once for each 5,000 square feet of surface area, whichever is less, for each type of concrete being cast.
 - 3. 1 cylinder will be tested at 7 days, and 1 cylinder at 28 days. The remaining cylinder will be kept in reserve in case tests are unsatisfactory.
 - 4. Samples will be made in accordance with ASTM C172.
 - 5. Specimens will be made and laboratory cured in accordance with ASTM C31.
 - 6. The 28-day values will be the criteria for acceptance of concrete regarding strength only.
 - a. 7-day tests may be regarded as indicative of compliance or non-compliance with the 28-day strength requirements, and the Contractor should be guided accordingly in matter of adjusting proportions, if necessary, and notify the Engineer.
 - b. 7-day tests shall also be a guide to the Contractor regarding time for form removal.
 - 7. Slump tests will be made for each set of tests cylinders in accordance with ASTM C142.
- B. Tests evaluation:
 - 1. Concrete cylinder test will be evaluated in accordance with ACI 214 and 318.
 - 2. If 28-day test results indicate the concrete strength is not as specified, core concrete as directed by the Engineer in accordance with ASTM C42.
 - a. Plug core hole solid as specified in Article 3.04 of this Section.
 - b. The cost of cores, tests and patching shall be borne by the Contractor.

3. In the event that additional core tests do not show strength required, or as determined by load tests made in accordance with ACI 318, the defective concrete shall be removed and replaced or shall be reinforced as directed by the Engineer at the Contractor's expense.
4. If core tests results fall below design strength specified, adjust the concrete mix or water content for future batches, at not additional cost to the Owner.

END OF SECTION 32 13 13

SECTION 32 16 00 - CURBS AND GUTTERS

1.00 GENERAL

1.01 DESCRIPTION

A. Principal work in this Section:

1. Construction of concrete curbs, gutters, walks, driveway cuts, pedestrian ramps and other concrete surfacing as required.
2. Concrete retaining wall.

B. Related work in other Sections:

1. Earthwork: Section 31 00 00.
2. Asphalt concrete paving: Section 32 12 16.

1.02 QUALITY ASSURANCE

A. Reference standards: The applicable provisions of the following govern the work of this section.

1. American Society for Testing Materials (ASTM).
 - a. A615: Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
 - b. C150: Portland Cement.
2. California Department of Transportation (CDT), Standard Specifications: Sections 51, 52, 73 and 90.

1.03 SUBMITTALS

- A. If requested, submit mill test reports on the cement, reinforcement bars and aggregates, showing compliance with the respective specifications. The Owner's Testing Agency may make concrete test cylinders and slump tests as deemed necessary to determine compliance with Specifications.

2.00 PRODUCTS

2.01 PORTLAND CEMENT CONCRETE (PCC)

- A. Concrete: Class A (6 sacks of cement per cubic yard of concrete) conforming to Section 90 of the CDT Standard Specifications.

- B. Cement: Type II conforming to ASTM C150 as modified by Section 90 of the CDT Standard Specifications.
- C. Aggregate: $\frac{3}{4}$ " maximum size conforming to Section 90 of the CDT Standard Specifications.
- D. Water: Clear and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances.
- E. Reinforcing Bars: ASTM A615, intermediate grade, deformed in accordance with Section 52 of the CDT Standard Specifications.
- F. Filled Joints: Unless noted otherwise on the Drawings $\frac{1}{2}$ " thick, the full depth of the concrete section and conforming to Section 51 of the CDT Standard Specifications.
- G. Joint Filler: bitumen-treated fiber board per CDT Standard Specifications, Section 51. Premolded expansion joint filler shall conform to the requirements in ASTM Designation D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- H. Waterproof Joint Sealant: flexible polyurethane.
- I. Carbon black shall be added to concrete for curbs, gutters and sidewalks as required to match existing work.
- J. No admixtures will be allowed without Owner's Representative approval.
- K. Maximum water cement ratio (w/c) of 0.50.
- L. Maximum slump of 4".
- M. Aggregate Base: Class 2 aggregate base, three quarter inch ($\frac{3}{4}$ ") maximum size, as specified in Section 26 of the CalTrans Standard Specifications.

3.00 EXECUTION

3.01 CONCRETE CONSTRUCTION

- A. Concrete shall be mixed in accordance with applicable provisions of Section 90 of the CDT Standard Specifications.
- B. Construction of concrete substances shall conform to applicable provisions of Section 51 of the CDT Standard Specifications. Unless noted otherwise in these Specifications, exposed surfaces of structure shall have Class 1 surface finish.
- C. Construct concrete curbs and sidewalks in accordance with applicable provisions of Section 73 of the CDT Standard Specifications.

- D. Curing shall conform to applicable portions of Section 90 of the CDT Standard Specifications. Do not use pigment in curing compounds.
- E. All work shall be subject to inspection. No concrete shall be placed until the Owner's Representative has approved the forms and reinforcement.
- F. Place expansion joints on curbs, gutters and walks at 20' on center, adjacent to structures, and at all returns, and fill with joint filler. Score joints shall be formed at 10' on center; the score shall be 1" deep.
- G. Do not drop concrete freely where reinforcing bars will cause segregation, nor more than 6'-0" vertically. Use spouts, elephant trunks, or other approved means to prevent segregation.

END OF SECTION 32 16 00

SECTION 32 31 15 - DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel Ornamental Fence
 - 2. Cast-in-place concrete footings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Fence and posts, rails, and fittings.
- B. Design Mixtures: For each concrete mixture
- C. Shop Drawings: For each type of fence and gate assembly.
 - 1. Include plans, elevations, sections, details, and attachments to other work.

1.4 INFORMATIONAL SUBMITTALS

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

1.5 QUALITY ASSURANCE

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

1.6 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Fence frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.
- B. Lightning Protection System: Maximum resistance-to-ground value of 25 ohms at each grounding location along fence under normal dry conditions.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior fencing by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 CONCRETE, GENERAL

- A. Comply with the following sections of ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents:
 - 1. "General Requirements."
 - 2. "Concrete Mixtures."
 - 3. "Handling, Placing, and Constructing." B.
 - 4. Comply with ACI 117 (ACI 117M).

2.3 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer. B. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150/C 150M, Type I/II.
- C. Normal-Weight Aggregate: ASTM C 33/C 33M, 1-1/2-inch (38-mm) nominal maximum aggregate size.
- D. Water: ASTM C 94/C 94M.

2.4 CONCRETE MIXTURES

- A. Comply with ACI 301 (ACI 301M).
- B. Normal-Weight Concrete:
 - 1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
 - 2. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm).

2.5 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
- B. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

2.6 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.7 STEEL AND IRON

- A. Tubing: ASTM A 500/A 500M (cold formed) or ASTM A 513.
- B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.8 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.9 HARDWARE

- A. Provide hardware as shown on Drawings.

2.10 STEEL ORNAMENTAL FENCE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Ameristar Montage Plus Majestic Panel Fence

- 1. Or equal.

- B. Design:

- 1. Length: Per drawings
 - 2. Height: Per drawings
 - 3. Steel: Commercial steel with a minimum yield strength of 45 ksi.
 - 4. Top & Bottom Rail: 1-1/2 inch square, 12 gage thick.
 - 5. Pickets: 3/4 inch square, 18 ga thick tubing, spaced 4-3/4 inches o.c. with end caps.
 - 6. Posts: Minimum 2.5 inches square by 16 gage with end caps
 - 1 Flat mount bracket

2.11 FABRICATION

- A. General: Fabricate fencing to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.
- B. Assemble fencing in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate fencing with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds; no evidence of a welded joint.
- I. Close exposed ends of hollow fencing members with prefabricated end fittings.
- J. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect fencing members to other work unless otherwise indicated.
- K. For fencing posts set in concrete, provide steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.12 GENERAL FINISH REQUIREMENTS

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

2.13 STEEL AND IRON FINISHES

- A. Fence: Factory prefinished with thermosetting epoxy powder coating with a minimum thickness of 2 mils, and polyester powder coat finish with minimum thickness of 2 mils.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing fencing. Set fencing accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
1. Do not weld, cut, or abrade surfaces of fencing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- D. Adjust fencing before anchoring to ensure matching alignment at abutting joints.

3.2 CONCRETE PLACEMENT

- A. Comply with ACI 301 (ACI 301M) for placing concrete.
- B. Do not add water to concrete during delivery, at Project site, or during placement.
- C. Consolidate concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).

3.3 ANCHORING POSTS

- A. Use steel pipe posts preset and anchored into concrete. Leave anchorage joint exposed with 1/8inch (3-mm) buildup, sloped away from post.

3.4 INSTALLATION

- A. Posts shall be set in accordance with the spacings shown in the construction plans.
- B. The "Concrete" sections of this specification shall govern post base material requirements.

3.5 CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

3.6 PROTECTION

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

END OF SECTION 32 31 15

SECTION 33 00 00 - PIPED UTILITIES

1.00 GENERAL

1.01 DESCRIPTION

A. Principal work in this Section:

1. Connection to existing systems.
2. Pipe installation and connection to building stubouts.

B. Related work in other Sections:

1. Trenching, backfilling and compacting: Section 31 23 33.
2. Storm Drainage Utilities: Section 33 40 00.
3. Sanitary Sewerage Utilities: Section 33 30 00.
4. Water Utilities: Section 33 10 00.

1.02 QUALITY ASSURANCE

A. Refer to specific utility Sections as noted above.

1.03 HANDLING

- A. Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, insulation, joint materials, fittings, valves and rubber gaskets under cover out of direct sunlight. Do not store materials directly on ground. Keep interiors of pipes and fittings free of dirt and debris.
- B. Handle pipe, fittings, valves and other accessories in such a manner as to ensure deliver to the trench in sound and undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry pipe to the trench; do not drag it.
- C. The pipe will be inspected at destination to assure compliance with specified requirements. Any pipe or couplings that are found to be defective or that do not meet the requirements of the Specifications shall be replaced. Rejection of 10% of any shipment shall be cause of, and will be considered sufficient reason for, rejection of the entire shipment.

2.00 PRODUCTS

- A. Refer to specific utility Sections as noted above.

3.00 EXECUTION

- A. Any connections to public improvements require notification of, and inspection by the City or Public Utility Company.

3.01 CONNECTION TO EXISTING SYSTEM(S)

- A. Make connections to existing lines at a time which will cause a minimum of disruption to the existing system. Any service interruption(s) shall be coordinated with and approved by the Engineer. Overtime costs shall be paid for by the Contractor.
- B. Contractor shall coordinate with and arrange for "hot" tap connections to existing mains by forces of the Water Service Agency. Owner will pay separately for work to be done by the Water Service Agency.

3.02 PIPE INSTALLATION

- A. Laying and jointing of pipe and fitting shall be in accordance with the manufacturer's recommendations. Joint deflections shall not exceed the maximum recommended by the manufacturer. There shall be no shoulder or unevenness along the interior of the pipe at the shoulder joints.
- B. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, valves, fittings or other appurtenances into trenches. Do not drag pipe with preformed rubber joint seals against trench walls and damage the seals.
- C. Cut pipe accurately to measurements established at the site and work into place without springing or forcing. Do not use pipe or fitting that does not allow sufficient space for proper installation of jointing material.
- D. Pipe fittings, valves and accessories shall be carefully inspected before and after installation and those found defective shall be replaced. Remove fins and burrs from pipe and fittings. Before the pipe is laid, the interior of the joint of the preceding pipe and fitting shall be carefully cleaned. After each section of the pipe has been laid to line and grade and jointed to the preceding section, and after jointing procedure has commenced, there shall be no movement of the pipe in subsequent operations.
- E. Take care to place sand under the haunches on either side of the pipe. Lay bell and spigot pipe with the bell end pointing in the direction of laying. Drainage and sewerage pipe shall be laid uphill commencing at the lowest invert elevation. Grade the pipeline in straight lines, taking care to avoid the formation of any dips or low points. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints and couplings.

- F. Before the Contractor leaves the work at any time, the pipe shall be securely closed at its open end. After the work is completed, the pipe shall be carefully and thoroughly cleaned of all refuse, earth or any objectionable material.

3.03 STRUCTURES AND APPURTENANCES

- A. Structures and appurtenances shall be installed at the locations and to the lines and dimensions and/or as herein specified.
- B. Valves shall be set plumb and valve boxes shall be centered over valve stems.
- C. Connections in manholes shall be constructed with concrete channels directed toward the outlet pipe or as indicated on the plans.
- D. Penetrations into manholes, vaults and building walls shall be by preformed breakout or coredrill holes. Breakout or coredrill holes in concrete structures shall be grouted all around to prevent groundwater infiltration.

END OF SECTION 33 00 00

SECTION 33 10 00 - WATER UTILITIES

1.00 GENERAL

1.01 DESCRIPTION

A. Principal work in this Section:

1. Water Service Connections.

B. Related work in other Sections:

1. Ductile Iron Pipe, (ANSI/AWWA)
2. Gate Valves, (ANSI/AWWA)
3. Fire Hydrants, (ANSI/AWWA)
4. Trenching, backfilling and compacting: Section 31 23 33.
5. Piped utilities: Section 33 00 00.

1.02 QUALITY ASSURANCE

A. Reference standards: The applicable provisions of the following govern the work of this Section:

1. American Water Works Association (AWWA) standards.
 - a. Sections C100 through C900.
2. National Fire Protection Agency (NFPA)
 - a. NFPA 24 Installation of Private Fire Service and Their Appurtenances.

1.03 SUBMITTALS

A. Submit the following:

1. Product data for piping, valves, hydrants, backflow prevention devices, etc.
2. Shop Drawings for pre-cast concrete valve boxes, including frames and covers.

2.00 PRODUCTS

- A. All products, materials and procedure shall comply with the Standards of the Water Service Agency. Agency standards shall govern in case of conflict.

- B. All materials used or installed in the underground private fire service piping installation are to be new and comply with the Standard and Appendices of National Fire Protection Association pamphlet No. 24, except that piping materials and fittings shall also be limited to those listed by UL.
- C. All fire protection improvements shall be subject to the review and approval of the Agency Fire Marshall.
- D. Domestic service shall use Schedule 80 PVC or better.

2.01 GATE VALVES

- A. All iron, bronze mounted, resilient sealed wedge type parallel seats, non-rising stem with square operating nut turned counter-clockwise to open in accordance with AWWA C509 and "O" ring packing. Gate valves 4" and larger shall have mechanical joint or flanged ends.

2.02 WATER VALVE BOXES

- A. Provide a valve box for each buried valve. Water valve boxes shall be precast concrete with steel or cast iron traffic cover marked "WATER"; per new Water Service Agency Standards for valve boxes. Precast grade rings shall be used as required per Water Service Agency Standards.

2.03 DETECTOR CHECK VALVE

- A. To be furnished by Contractor per Water Service Agency Standards.

2.04 POST INDICATOR VALVE (PIV)

- A. Valve shall be UL listed, designed for use with indicator post, and have mechanical joint or flanged ends; Mueller P-2360 or equal per Fire Department Water Service Agency Standards.

2.05 INDICATOR POST

- A. UL listed and designed for use with indicator valve; Mueller A-20806, or equal per Fire Department Water Service Agency Standards.

2.06 FIRE DEPARTMENT CONNECTION

- A. 4" x 2½" x 2½", UL listed, rough brass finish with hose threads conforming to the governing Fire Department's requirements. Fire Department connection shall be Potter Roemer 5761, or equal, per Fire Department and Water Service Agency Standards.

2.07 FIRE HYDRANTS

- A. A wet barrel Clow 960 or equal, per Fire Department and Water Service Agency Standards.

2.08 SWING CHECK VALVE

- A. Iron body, bronze mounted, UL listed, gravity operated and flanged ends; Mueller A-2120-6/A-2122-6 or equal per Water Service Agency Standards.

2.09 CORPORATION STOP VALVE

- A. Service clamp shall be double strap-type of all bronze construction per Water Service Agency Standards.

2.10 WATER METER

- A. Water service shall be installed and meters furnished in accordance with Water Service Agency (latest Standard) "Domestic Water Meter" is not allowed because of fire flow requirements and minimum domestic water flows). All meters shall be furnished in accordance with Water Service Agency Standards unless approved otherwise by the Director of Maintenance Services.
- B. Water meters: per Water Service Agency Standards.
- C. A water meter box shall be provided for each water meter. Meter boxes shall be precast reinforced concrete box with concrete cover and removable concrete reading lid marked "WATER METER"; Christy B36 utility box with E70 lid or equal.

2.11 TRACER TAPE

- A. A polyethylene tape shall be embedded in the trench 6" above non-metallic water lines to facilitate locating these pipes with a pipe detector. The tape shall be connected to all valves and be continuous between valves. The tape shall be 3" wide, blue and be marked "CAUTION WATER LINE BURIED BELOW". Either the tape shall contain a 0.35-mil thick metallic foil core (Terra-Tape D or equal) or a bare No. 8 copper wire shall be embedded in the trench with the tape and be connected to all valves.

3.00 EXECUTION

3.01 STRUCTURES AND APPURTENANCES

- A. Structures and appurtenances shall be constructed and installed in accordance with the applicable sections of AWWA C600 and AWWA C603. Jointing of valves shall conform to applicable portions of AWWA C504 and AWWA C500 per Water Service Agency Standards.
- B. Fire Service Assemblies shall be installed in accordance with Water Service Agency Standards.
- C. All public and private service pipes, conduits and appliances uncovered due to work of the Subcontractor, whether within or without the property lines, shall be suitably supported,

protected and maintained in operation and shall be protected against settlement when excavations are refilled.

- D. Excavation, trenching, installation of underground piping and back-filling shall be in accordance with the Standard and Appendices of National Fire Protection Association Pamphlet No. 24, and local public authorities.

3.02 THRUST BLOCKS

- A. Per Water Service Agency Standards.
- B. All required thrust blocks are not detailed on the Drawings, but blocks shall be provided for all pressure pipe fittings, and at all other points where there is a possibility of putting a joint under pressure. Provide anchors and supports where necessary for fastening work into place. Make proper provisions for expansion or contraction of pipelines. Blocks shall be placed between solid ground and the pipe or fittings to be anchored as detailed on the drawings.
- C. Backfilling operations may begin as soon as the concrete has set sufficiently to remain in position and withstand the weight of the earth. Concrete shall not be disturbed or pressure loaded for at least 5 days after placing.

3.03 TESTING AND DISINFECTION

- A. Hydrostatic testing, disinfection, and flushing shall conform to the Standard Specifications of the Water Service Agency. Contractor shall be responsible for testing, disinfection and flushing of all main appurtenances and those portions of service line within his work. See Water Service Agency Standard.
- B. In addition to normal testing, etc., fire service lines will, in addition, require testing and flushing per NFPA 24.

3.04 SANITIZATION

- A. General:
1. All lines, mains and branches shall be sterilized by chlorination in accordance with AWWA C601 and as herein specified. Chlorine shall be a 1% solution (containing 10,000 parts per million available chlorine) or shall be obtained by use of dry chlorine in tablet form firmly attached to interior walls of the pipe.
 2. The weight of chlorine or chlorine compound required to make a 1% chlorine solution is as follows:

Product	Amount of Compound	Quantity of Water (Gallons)
High-test calcium Hypochlorite	1 lb.	7.50

(65-70% C1)

Chlorinated Lime 2 lb. 7.50
(32-35% C1)

Liquid Laundry 1 Gallon 4.25
Bleach
(5.25% C1)

Liquid Chlorine 0.62 lb. 7.50
(100% available
chlorine)

3. The required concentration of chlorine in the pipe is 50 parts per million. This concentration may be attained by adding 5 gallons of the chlorine solution to 1,000 gallons of water.
4. The required concentration of chlorine in the mains may be obtained by the use of HTH tablets produced by Olin Mathieson in the following quantities:

HTH TABLE (70%) DOSAGE
Number of Tablets per Length of Pipe

Length of Section	Diameter of Pipe				
	4"	6"	8"	10"	12"
13'	1	2	3	3	5
18'	1	2	3	5	6
20'	1	2	3	5	7
30'	2	3	5	7	10
36'	2	3	5	8	12
40'	2	4	6	9	14
100'	4	9	15	23	30

- B. Liquid chlorine solution method: All foreign matter shall be flushed from mains, branch runs, hydrant runs, and installed services. Liquid chlorine solution shall be introduced at appropriate locations to assure uniform distribution through the facilities at the proper concentration. Install copper service lines shall not be used to convey the concentrated solution to the mains. The sanitizing solution shall be retained in the facilities for a period of 24 hours after which each service, hydrant run, branch run and dead end shall be flushed until the residual chlorine is less than one part per million or is no greater than the concentration of chlorine in the water supplied for flushing.
- C. HTH tablet method: Tablets shall be fastened to the inside top surface of each length of pipe using hot tar of "Permatex No. 1" at time of pipe laying. Tablets shall not be available at any time for casual pilferage by the general public or by children. The new facilities are to be slowly filled with water. Air is to be exhausted from each dead end, branch run, hydrant run, and installed service. Water shall be retained for a period of 24 hours, after which each service, hydrant run, branch run and dead end shall be thoroughly flushed to

clear foreign matter and until the residual chlorine concentration is less than one part per million or is no greater than the concentration of chlorine in the water supplied for flushing.

D. Bacteriological testing:

1. Samples shall be gathered and tests conducted at the Contractor's expense by a laboratory acceptable to Owner's Representative. Samples are to be taken at representative points as required by the Owner's Representative.
2. The new facilities shall remain isolated and out of service until satisfactory test results have been obtained which meet the requirement of the California Department of Public Health and until the Engineer has accepted the results as indicative of the bacteriological condition of the facilities. If unsatisfactory or doubtful results are obtained from the initial sampling, the chlorination process shall be repeated until acceptable test results are reported.

END OF SECTION 33 10 00

SECTION 33 30 00 - SANITARY SEWERAGE UTILITIES

1.00 GENERAL

1.01 DESCRIPTION

A. Principal work in this Section:

1. Sanitary sewer pipelines.
2. Pipeline testing.

B. Related work in other Sections:

1. Trenching, backfilling and compacting: Section 31 23 33.
2. Piped Utilities: Section 33 00 00.

1.02 QUALITY ASSURANCE

- A. Reference Standards: Applicable provisions of the Sanitation Agency Design and Construction Standards govern the work of this Section.

1.03 SUBMITTALS

A. Submit the following:

1. Product data for sanitary sewer piping specialties.
2. Shop Drawings for pre-cast concrete sewer manholes, cleanout boxes, including frames and covers.

2.00 PRODUCTS

2.01 SANITARY SEWER PIPES

A. One of the following:

1. Vitrified clay pipe (VCP) conforming to ASTM C700. Pipe shall be extra strength, unglazed, with bell and spigot joints conforming to ASTM C425 per Sanitation Agency Standards.
2. Polyvinyl chloride (PVC) pipe per ASTM D3034, SDR 26.

2.02 MANHOLES

SANITARY SEWERAGE UTILITIES

- A. Manholes: Precast concrete of the size and shape shown on the Drawings and conforming to ASTM C478. Equivalent cast-in-place structures may be used at the Contractor's option per Sanitation Agency Standards.
- B. Frames and covers: Cast iron conforming to Section 55-2.03 and 75-1.02 of the CDT Standard Specifications. Manhole covers shall have the words SANITARY SEWER in letters not less than 2" high cast into the cover. The clear opening for manhole covers shall be 24"; Phoenix Iron Works P-1090 or equal per Sanitation Agency Standards.

3.00 EXECUTION

3.01 PIPELINE TESTING

- A. New sections of sanitary sewer shall be air tested in accordance with the Sanitation Agency Standards or using the following procedures:
 - 1. Test is conducted between two consecutive manholes, or as directed by the Owner's Representative.
 - 2. The test section of the sewer line is plugged at each end. One of the plugs used at the manhole must be tapped and equipped for the air inlet connection for filling the line from the air compressor.
 - 3. Service laterals, stubs and fittings into the sewer test section shall be properly capped or plugged and carefully braced against the internal pressure to prevent leakage by slippage and blow outs.
 - 4. Connect air hose to tapped plug selected for the air inlet. Then connect the other end of the air hose to the portable air control equipment which consists of valves and pressure gauges used to control the air entry rate to the sewer test section and to monitor the air pressure in the pipe line. More specifically, the air control equipment includes a shut off valve, pressure regulating valve, pressure reduction valve and a monitoring pressure gauge having a pressure range from 0-5 psi. The gauge shall have minimum divisions of .10 psi and an accuracy of + 0.40 psi.
 - 5. Connect another air hose between the air compressor (or other source of compressed air) and the air control equipment. This completes the test equipment set-up. Test operations may commence.
 - 6. Supply air to the test section slowly, filling the pipe line until a constant pressure of 3.5 psig is maintained. The air pressure must be regulated to prevent the pressure inside the pipe from exceeding 5.0 psig.
 - 7. When constant pressure of 3.5 psig is reached, throttle the air supply to maintain the internal pressure above 3.0 psig for at least 5 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall. During this stabilization period, it is advisable to check all capped and plugged fittings with a soap solution to detect any leakage at these connections. If leakage is detected at any cap or plug, release pressure in the line and tighten leaky caps

and plugs. Then start the test operation again by supplying air. When it is necessary to bleed of the air to tighten or repair a faulty plug, a new five minute interval must be allowed after the pipe line has been refilled.

8. After the stabilization period, adjust the air pressure to 3.5 psig and shut off or disconnect the air supply. Observe the gauge until the air pressure reaches 3.0 psig. At 3.0 psig commence timing with a stop watch which is allowed to run until the line pressure drops to 2.5 psig at which time the stop watch is stopped. The timer required, as shown on the stop watch, for a pressure loss of 0.5 psig is used to compute the air loss.
9. If the time, in minutes and seconds, for the air pressure to drop from 3.0 to 2.5 psig is greater than that shown in the following table for the designated pipe size, the section undergoing test shall have passed and shall be presumed to be free of defects. The test may be discontinued at the time.
10. If the time, in minutes and seconds, for the 0.5 psig drop is less than that shown in the following table for the designated pipe size, the section of the pipe shall not have passed the test; therefore, adequate repairs must be made and the line retested.

Time Requirements for Air Testing

Pipe Size (In Inches)	Time	
	Min.	Sec.
4	2	32
6	3	50
8	5	6
10	6	22
12	7	39
14	8	56
15	9	35
16	10	12
18	11	34
20	12	45
21	13	30

(For larger diameter pipe, use the following: Minimum time in seconds = 462 x pipe diameter in feet)

11. For 8" and smaller pipe, only: If, during the five minute saturation period, pressure drops less than 0.5 psig after the initial pressurization and air is not added, the pipe section undergoing test shall have passed.
12. Multi pipe sizes: When the sewer line undergoing test is 8" or larger diameter pipe and includes 4" or 6" laterals, the figures in the table for uniform sewer main sizes will not give reliable or accurate criteria for the test. Where multi pipe sizes are to undergo the air test, the Owner's designated representative can compute the "average" size in inches which is then multiplied by 38.2 seconds. The results will

give the minimum time in seconds acceptable for a pressure drop of 0.5 psig for the "averaged" diameter pipe.

13. Adjustment required for ground water.
- a. An air pressure correction is required when the ground water table is above the sewer line being tested. Under this condition, the air test pressure must be increased 0.433 psi for each foot the ground water level is above the invert of the pipe.
 - b. Where ground water is encountered or is anticipated to be above the sewer pipe before the air testing will be conducted, the following procedure shall be implemented at the time the sewer main and manholes are constructed.
 - 1) Install ½" diameter pipe nipple (threaded one or both ends, approx. 10" long) through the manhole wall directly on top of one of the sewer pipes entering the manhole with threaded end of nipple entering inside the manhole.
 - 2) Seal pipe nipple with a threaded ½" cap.
 - 3) Immediately before air testing, determine the ground water level by removing the threaded cap from the nipple, blowing air through the pipe nipple to remove any obstructions, and then connecting a clear plastic tube to the pipe nipple.
 - 4) Hold plastic tube vertically permitting water to rise in it to the ground water level.
 - 5) After water level has stabilized in plastic tube, measure vertical height of water, in feet, above invert of sewer pipe.
 - 6) Determine air pressure correction, which must be added to the 3.0 psig normal starting pressure of test, by dividing the vertical height in feet by 2.31. The result gives the air pressure correction in pounds per square inch to be added.

EXAMPLE

If the vertical height of water from the sewer invert to the top of the water column measures 11.55' the additional air pressure required would be:

$$\frac{(11.55)}{(2.31)} = 5.0 \text{ psig}$$

Therefore, the starting pressure of the test would be 3.0 plus 5 or 8.0 psig, and then 1/2 drop becomes 7.5 psig. There is no change in the allowable drop (0.5 psig) or in the time requirements established for the basic air test.

END OF SECTION 33 30 00

SECTION 33 40 00 - STORM DRAINAGE UTILITIES

1.00 GENERAL

1.01 DESCRIPTION

A. Principal work in this Section:

1. Storm drain pipe and appurtenances.
2. Concrete inlet and outlet structures, manholes, and miscellaneous drainage structures.

B. Related work in other Sections:

1. Trenching, Backfilling and Compacting: Section 31 23 33.
2. Piped Utilities: Section 33 00 00.

1.02 QUALITY ASSURANCE

A. Reference Standards: Applicable provisions of the following govern the work of this Section.

1. American Association of State Highways and Transportation Officials (AASHTO), M36.
2. American Society for Testing and Materials (ASTM):
 - a. A74: Cast Iron Soil Pipe and Fittings.
 - b. A615: Deformed and Plain Billet-Steel Bars for Reinforcement.
 - c. B32: Solder Metal.
 - d. C76: Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
 - e. C150: Portland Cement.
 - f. C478: Precast Reinforced Concrete Manhole Sections.
 - g. C700: Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.
 - h. D3030: Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
3. California Department of Transportation (CDT), Standard Specifications: Sections 51, 52, 55, 66, 70, 72, 75 and 90.

1.03 SUBMITTALS

A. Submit the following:

1. Submit product data for drainage piping specialties.
2. Submit shop drawings for pre-cast concrete storm drainage manholes, catch basins, and cleanout boxes, including frames, covers, and grates.

2.00 PRODUCTS

2.01 REINFORCED CONCRETE PIPE (RCP)

- A. Reinforced Concrete Pipe: ASTM C76 with tongue-and-groove or bell-and-spigot joints. Unless indicated otherwise on the Drawings, reinforced concrete pipe shall be of Class shown on the Drawings, 1350-D pipe. Joint grout shall conform to Section 65 of CDT Standard Specifications.

2.02 ASBESTOS-CEMENT PIPE (ACP)

- A. Asbestos-cement storm drain pipe: Asbestos-Cement pipe is NOT allowed on this project.

2.03 CAST IRON PIPE (CIP)

- A. Cast Iron Pipe and fittings: ASTM C74. Joints shall be rubber-gasket bell-and-spigot type.

2.04 POLYVINYL CHLORIDE PIPE (PVC)

- A. Polyvinyl chloride pipe and fittings: ASTM D3034, SDR 35 with bell-and-spigot type rubber-gasket joints.

2.05 VITRIFIED CLAY PIPE (VCP)

- A. Vitrified clay pipe fittings: ASTM C700, extra strength.

2.06 MANHOLES AND CATCH BASINS

- A. Precast drainage structures: Section 70-1.02H of the CDT Standard Specifications and ASTM C478 and of size and shape indicated. Equivalent cast-in-place structures may be used at Contractor's option.
- B. Frames and covers: Cast iron conforming to Section 55-2.03 and 75.1.02 of the CDT Standard Specifications. Manhole covers shall have 24" clear opening with the words STORM SEWER in letters not less than 2" high cast into the cover (except where grated covers are shown on the Drawings).
- C. Grates for catch basins shall have reticulon bars suitable for use in area with bicycle and pedestrian traffic, ½" maximum gaps perpendicular to flow of traffic.

2.07 FILTER FABRIC

- A. One of the following:
1. Mirafi 140N.
 2. Typar 4 oz.
 3. True Tex MG-100.
 4. Bidim C-22.

2.08 PAINT

- A. For exterior galvanized metal:
1. First coat: Zinc dust, zinc oxide primer house and trim paint.
 2. Second coat: Type and color to match existing building walls and/or trim where applicable.
- B. For exterior ungalvanized metal:
1. First coat: Rust Block primer.
 2. Second coat: House and trim paint, type and color to match existing building walls and/or trim where applicable.

2.09 PORTLAND CEMENT CONCRETE

- A. Concrete: Class A concrete conforming to Section 90 of the CDT Standard Specifications.
- B. Cement: Type II cement conforming to ASTM Designation C150 as modified by Section 90 of the CDT Standard Specifications.
- C. Aggregate: $\frac{3}{4}$ " maximum size conforming to Section 90 of the CDT Standard Specifications.
- D. Water: Clear and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances.
- E. Reinforcing bars: ASTM A615, intermediate grade, and deformed in accordance with Section 52 of the CDT Standard Specifications.
- F. No admixtures will be allowed without Owner's Representative approval.

3.00 EXECUTION

3.01 PIPE INSTALLATION

- A. Install in conformance with Section 33 00 00, Piped Utilities.

3.02 CAST-IN-PLACE CONCRETE

- A. Mix concrete in accordance with standards for class B concrete per Section 90 of the CDT Standard Specifications.
- B. Construction of concrete structures shall conform to applicable provisions of Section 51 of the CDT Standard Specifications. Unless noted otherwise in these Specifications, exposed surfaces of structure shall have Class 1 surface finish.
- C. Curing shall conform to applicable portions in Section 90 of the CDT Standard Specifications. No pigment shall be used in curing compounds.
- D. Work is subject to inspection. No concrete shall be placed until the Owner's designated representative has approved the forms and reinforcement.

END OF SECTION 33 40 00