

REQUEST FOR PROPOSALS

FOR

**VIDEO SURVEILLANCE SYSTEM
SPECIFICATIONS**

LANE COUNTY SCHOOL DISTRICT 4J
EUGENE PUBLIC SCHOOLS
EUGENE, OREGON

Proposal Due Date:

June 14, 2018

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FAXED PROPOSALS NOT ACCEPTED

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CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

1.2 RELATED REQUIREMENTS

- A. Section 00 72 00 - General Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.
- C. Individual Product Sections: Warranties required for specific products or Work.

1.3 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Record Documents:
 - 1. Submit one copy of Record Drawings and Record Project Manual.
 - a. Organize Record Prints and newly prepared Record Drawings into manageable sets.
 - b. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Submit one copy of Record Transparencies of Record Drawings.
 - a. Organize into unbound sets matching Record Prints.
 - b. Place transparencies in durable tube-type drawing containers with end caps.
 - c. Mark end cap of each container with identification. If container does not include a complete set, identify Drawings included.
 - 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect and Owner's Project Manager.
 - e. Name of Contractor.
- C. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- D. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.

3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 1. Drawings.
 2. Specifications.
 3. Addenda.
 4. Change Orders and other modifications to the Contract.
 5. Reviewed shop drawings, product data, and samples.
 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
- F. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
- G. Mark important additional information that was either shown schematically or omitted from original Drawings.
- H. Note Alternate numbers, Change Order numbers, and similar identification, where applicable.
- I. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Addenda and modifications.
- J. Product Data: Assemble one copy each required Product Data Submittal.
 1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.
- K. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 1. Measured depths of foundations in relation to finish first floor datum.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 4. Field changes of dimension and detail.
 5. Revisions to routing of piping and conduits.
 6. Revisions to electrical circuitry.
 7. Actual equipment locations.
 8. Duct size and routing.
 9. Locations of concealed internal utilities.
 10. Changes made by Change Order.
 11. Changes made following Architect's written orders
 12. Record information on the Work that is shown only schematically.

13. Details not on original Contract drawings.

3.2 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.3 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 - 1. Product data, with catalog number, size, composition, and color and texture designations.
 - 2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional information as specified in individual product specification sections.
- E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- F. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

3.4 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Include color coded wiring diagrams as installed.
- E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

- G. Provide servicing and lubrication schedule, and list of lubricants required.
- H. Include manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Provide control diagrams by controls manufacturer as installed.
- L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- O. Include test and balancing reports.
- P. Additional Requirements: As specified in individual product specification sections.

3.5 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- D. Prepare data in the form of an instructional manual.
- E. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- F. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- G. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- H. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- I. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- J. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- K. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- L. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
- M. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Photocopies of warranties and bonds.
- N. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.
- O. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect, Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

3.6 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION

COMMON WORK RESULTS FOR ELECTRICAL**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. The provisions of This Section, Common Work Results for Electrical, apply to all sections in Division 26.
- C. All Sections of Division 26, ELECTRICAL, are interrelated. When interpreting any direction, material, and method specified in any section of Division 26, consider it within the entirety of Work in Division 26.

1.2 SUMMARY

- A. The intent of Division 26 Specifications and Drawings is to provide a complete and workable facility, with complete systems as required by applicable codes, as indicated, and as specified.
- B. Include all work specified in Division 26 and indicated on Drawings, including appurtenances, connections, fasteners, and accessories required to make a complete working system, whether indicated or not indicated.
- C. The Division 26 Specifications and the accompanying Drawings are complementary, and what is called for by one shall be as binding as if called for by both.
 - 1. Items shown on the Drawings are not necessarily included in the Specifications and vice versa.
 - 2. In case of conflict, Specifications supersede Drawings.
- D. Imperative language used in Division 26 Sections addresses the Contractor, as specified in Division 1 Section, "Summary".

1.3 REFERENCES

- A. The latest adopted revisions of the publications listed below apply to these Specifications as referenced:
 - 1. Oregon Structural Specialty Code. (OSSC)
 - 2. National Electrical Code (NEC).
 - 3. National Fire Protection Association (NFPA).
 - 4. National Electrical Manufacturers Association (NEMA).
 - 5. National Electrical Contractors Association (NECA).
 - 6. American National Standards Institute (ANSI).
 - 7. Institute of Electrical and Electronic Engineers (IEEE).
 - 8. Underwriters Laboratories (UL).
 - 9. Oregon Administrative Rules (OAR). The publications are referred to in the text by acronym or initials in parentheses above.

1.4 SYSTEM DESCRIPTION

- A. System Identification:
 - 1. Clearly identify all elements of the Project electrical system to indicate the loads served, or the function of each item of equipment, connected under this work.
 - 2. Comply with requirements of Division 26 Section, "Identification," and with applicable codes.

- B. Drawings:
1. The Drawings are diagrammatic: they do not show every offset, bend, tee, or elbow which may be required to install work in the space provided and avoid conflicts with other construction.
 - a. Prior to installing work, take field dimensions, and note conditions available for, installation.
 - b. Follow the Drawings as closely as practical to do so, and install additional bends, offsets, and elbows where required by installation conditions.
 - 1) Additional offsets, bends, and other connectors are subject to approval by Project Engineer.
 - 2) Install additional offsets, bends, and other connectors without additional cost to Owner.
 - c. The right to make any reasonable changes in outlet location prior to roughing in is reserved to the Owner's Representative.

1.5 SUBMITTALS

- A. Comply with Division 1, Submittal Procedures”.
- B. Shop Drawings and Equipment Data:
1. Combine electrical shop drawings and equipment data in Submittal binders.
 2. Include in Submittal binders:
 - a. A complete index of materials and equipment required by Specifications to be documented by submittals.
 - b. Manufacturer's detailed specifications and data sheets to fully describe equipment furnished.
 - c. All deviations from the Drawings and Specifications, noted on the submittals. Failure to comply will automatically void any implied approval for use of the equipment on this project.
- C. Installation Drawings:
1. Submit prior to starting installation.
 2. Show all devices, terminal cabinets, conduits, wiring, and connections required for the complete system described.
- D. Submittals Procedures:
1. Review and recommendations by the Architect or Engineer are not to be construed as change authorizations.

- E. If discrepancies are discovered between the materials or equipment submitted, and the Contract Documents, either prior to or after the data is processed, the Contract Documents govern.

1.6 RECORD DRAWINGS:

- A. Comply with Division 1, Section 01 78 00, "Project Record Documents".
- B. Keep record drawings up to date as the work progresses.
- C. Show all changes, deviations, addendum items, change orders, corrections, and other variations from the Contract Drawings.
- D. Keep record drawings at the jobsite and available for the Architect's review.
- E. At the completion of the work, incorporate all deviations from the installation drawings to indicate "as-built" conditions.

1.7 OPERATION AND MAINTENANCE DATA:

- A. Comply with Division 1, Section 01 78 00, "Operation and Maintenance Data".
- B. Provide a separate manual or chapter for each system.
- C. Description of system.
- D. Operating Sequence and Procedures:
 1. Step-by-step procedure for system start-up, including a pre-start checklist.
 - a. Refer to controls and indicators by nomenclature consistent with that used on panels and in control diagrams.
 2. Detailed instruction in proper sequence, for each mode of operation (i.e., day-night, staging of equipment).
 3. Emergency Operation:
 - a. If some functions of the equipment can be operated while other functions are disabled, give instructions for operations under those conditions.
 - b. Include here only those alternate methods of operations (from normal) which the operator can follow when there is a partial failure or malfunctioning of components or other unusual condition.
 4. Shutdown Procedure:
 - a. Include instructions for stopping and securing the equipment after operation.
 - b. If a particular sequence is required, give step-by-step instructions in that order.
- E. Preventive Maintenance:
 1. Schedule for preventive maintenance.
 - a. State the recommended frequency of performance of each preventive maintenance task such as cleaning, inspection, and scheduled overhauls.
 2. Cleaning: Provide instructions and schedules for all routine cleaning and inspection with recommended lubricants.
 3. Inspection: If periodic inspection of equipment is required for operation, cleaning, or other reasons, indicate the items to be inspected and give the inspection criteria.
 4. Provide instructions for lubrication and adjustments required for preventive maintenance routines. Identify test points and given values for each.

- F. Manufacturers' Brochures:
 1. Include manufacturers' descriptive literature covering devices and equipment used in the system, together with illustrations, exploded views, and renewal parts lists.
 2. Edit manufacturers' standard brochures so that the information applying to the actual installed equipment is clearly defined.
- G. Results of performance testing, as specified in Part 3 of This Section.

1.8 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. All products and equipment's shall comply with Oregon Revised Statute (ORS) 453.005(7)(e) prohibiting pentabrominated, octabrominated and decabrominated diphenyl ethers. Where products or equipments within this specification contain these banned substances, provide complying products and equipment from approved manufacturers with equal performance characteristics.
 2. Provide work and materials conforming to:
 - a. Local and State codes
 - b. Federal and State laws and regulations.
 - c. Other applicable laws and regulations.
 3. Obtain and pay for all permits, licenses, and inspection certificates required by authorities having jurisdiction.
 4. Pay any other fees required by governing authorities for work of this Division.
- B. Install only electrical products listed by a recognized testing laboratory, or approved in writing by the local inspection authority as required by governing codes and ordinances.

1.9 SITE VISITATION

- A. The Contractor shall visit the site prior to bidding and become familiar with existing conditions and all other factors which may affect the execution of the work. Coordination of installation of equipment with prior bid packages previously issued shall be completed. Include all related costs in the initial bid proposal.

1.10 COORDINATION

- A. Coordinate Work of This Division with all other trades to ensure proper installation of electrical equipment.
 1. Review Drawings of other trades or crafts to avoid conflicts with cabinets, counters, equipment, structural members, and other possible impediments to electrical work.
 2. Report potential conflicts to Architect prior to rough-in.
 3. Proceed with rough-in following Architect's directives to resolve conflicts.
 4. In general, the Architectural Drawings govern.
- B. Verify the physical dimension of each item of electrical equipment to fit the available space. Contractor's responsibility includes:
 1. Coordination of the equipment to fit into the available space.
 2. Access routes through the construction.
- C. Layout Drawings:
 1. Equipment arrangement shown on Drawings is diagrammatic to indicate general equipment sizing and spatial relationship. Contractor shall include, as part of distribution equipment submittal, a scaled floor plan which includes all equipment shown with their submitted sizes.
 2. Submit layout drawings for approval prior to commencing field installation.

- D. Where electrical connections are required for equipment provided as Work of other Divisions, coordinate rough-in and wiring requirements for that equipment with its supplier and installer prior to commencing work. Notify Architect and Engineer of any discrepancies between the actual rough-in and wiring requirements, and those identified on Drawings for resolution prior to installation.
- E. Arrange raceways, wiring, and equipment to permit ready access to switches, motors, and control components.
 - 1. Doors and access panels shall be kept clear.
- F. Coordinate underground work with other contractors working on the site.
 - 1. Coordinate particularly with contractors installing storm sewer, sanitary sewer, water, and irrigation lines to avoid conflicts.
 - 2. Common trenches may be used with other trades, providing clearances required by codes and ordinances are maintained.

1.11 CHANGEORDERS

- A. All supplemental cost proposals by the Contractor shall be accompanied with a complete itemized breakdown of labor and materials. At the Architect's request, Contractor's estimating sheets for the supplemental cost proposals shall be made available to the Architect. Labor shall be separated and allocated for each item of work.

1.12 WARRANTY

- A. Provide a written warranty covering the work of this Division as required by the General Conditions.
- B. Apparatus:
 - 1. Free of defects of material and workmanship and in accord with the Contract Documents.
 - 2. Built and installed to deliver its full rated capacity at the efficiency for which it was designed.
 - 3. Operate at full capacity without objectionable noise or vibration.
- C. Include in Contractor's warranty for Work of Division 26 system damage caused by failures of any system component.

PART 2 - PRODUCTS**2.1 GENERAL**

- A. Where specified materials or methods conflict with applicable codes, the more stringent requirement applies.
- B. Provide apparatus built and installed to deliver its full rated capacity at the efficiency for which it was designed.
- C. Ensure that entire system operates at full capacity without objectionable noise.
- D. Materials and Equipment:
 - 1. Use materials and equipment that are:
 - a. New.
 - b. Of quality meeting or exceeding specified standards.
 - c. Free of faults and defects.
 - d. Conforming to Contract Documents.
 - e. Of size, make, type, and quality specified.
 - f. Suitable for the installation indicated.
 - g. Manufactured in accordance with NEMA, ANSI, U.L. or other applicable standards.
 - h. Otherwise as specified in Division 1 Section, "Product Requirements".
 - 2. Equipment not meeting all requirements will not be acceptable, even though specified by name.
 - 3. Where two or more units of the same class of equipment are furnished, use products of the same manufacturer.
 - a. Component parts of the entire system need not be products of same manufacturer.
 - 4. Basis of Design:
 - a. Equipment scheduled or specified by performance or model number shall be considered the Basis of Design.
 - b. If other equipment is provided in lieu of the Basis of Design equipment, assume responsibility for all changes and costs which may be necessary to accommodate this equipment, including, but not limited to:
 - 1) Different sizes and locations for connections.
 - 2) Different dimensions.
 - 3) Different access requirements.
 - 4) Any other differences.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. General:
 - 1. Provide a complete properly operating system for each item of equipment specified.
 - 2. Install materials in a neat and professional manner.
 - 3. Comply with equipment manufacturer's written instructions, the best industry practices, and the Contract Documents.
 - 4. Comply with latest published NECA Standard of Installation, and provide competent supervision.
- B. Clarification:
 - 1. Where there is a conflict among manufacturer's instruction, best practice, and the Documents, request clarification from the Architect prior to rough-in.

2. Architect's decision will be final.
3. Work installed without clarification shall be removed and corrected by the Contractor at no cost to the Owner.

3.2 INSTALLATION IN RATED CONSTRUCTION

- A. Install intumescent material around ducts, conduits, and other electrical elements penetrating rated construction.
- B. Comply with firestop materials manufacturer's written instructions to prevent spread of smoke or fire through sleeves or block-outs penetrating rated fire barriers.
- C. Provide firestop materials specified in Division 7 Section, "Through-Penetration Firestop Systems," and as follows:
 1. Capable of passing a 3-hour test per ASTM E-814 (UL 1479).
 2. Consisting of material capable of expanding nominally eight times when exposed to temperatures of 250-350°F.
 3. An alternate method utilizing intumescent materials in caulk or putty complying with Division 7 Section, "Through-Penetration Firestop Systems" may be used.

3.3 EXCAVATION AND BACKFILL

- A. Perform all necessary excavation and backfill for the installation of electrical work in compliance with Division 31.
- B. For direct burial cable or non-metallic conduit, a minimum 3-inch cover of sand or clean earth fill shall be placed all around the cable or conduit on a leveled trench bottom. Lay all steel conduit on a smooth level trench bottom, so that contact is made for its entire length. Water shall be removed from trench while electrical conduit is being laid.
- C. Place backfill in layers not exceeding 8-inches deep and compact to 95% of maximum density at optimum moisture to preclude settlement.
 1. Interior: Bank sand or pea gravel.
 2. Exterior: Excavated material with final 8-inches clean soil.
- D. Following backfilling, grade all trenches to the level of surrounding soil. All excess soil shall be disposed of at the site as directed.
- E. Provide 6-inches wide vinyl tape marked "ELECTRICAL" in backfill, 12-inches below finished grade, above all high voltage cable or conduit runs. Provide trace wire for all non-metallic conduit.
- F. Coordinate patching of all asphalt or concrete surfaces disturbed by this work with General Contractor.

3.4 NOISE CONTROL

- A. Minimize transmission of noise between occupied spaces.
- B. Outlet Boxes:
 1. Do not install outlet boxes on opposite sides of partitions back to back.
 2. Do not use straight through outlet boxes, except where indicated.
- C. Conduit:
 1. Route conduit along corridors or other "noncritical" space to minimize penetrations through sound rated walls, or through non-sound-rated partitions between occupied spaces.
 2. Grout solid and airtight all penetrations through sound rated partitions.
 3. Use flexible connections or attachments between independent wall structures.
 - a. Do not rigidly connect (i.e., bridge) independent wall structures.

- D. Do not install contactors, transformers, starters, and similar noise-producing devices on walls that are common to occupied spaces, unless otherwise indicated.
 - 1. Where such devices are indicated to be mounted on walls common to occupied spaces, use shock mounts, or otherwise isolate them to prevent the transmission of noise to the occupied spaces.

3.5 EQUIPMENT CONNECTIONS

- A. General:
 - 1. Provide complete electrical connections for all items of equipment requiring such connections, including incidental wiring, materials, devices, and labor necessary for a finished working installation.
 - 2. Verify the location and method for connecting to each item of equipment prior to roughing-in.

3.6 EQUIPMENT SUPPORT

- A. Minimum Support Capacity:
 - 1. Provide fastening devices and supports for electrical equipment, luminaires, panels, outlets, and cabinets capable of supporting not less than four times the ultimate weight of the object or objects fastened to or suspended from the building structure.
- B. Camera Supports:
 - 1. Support Cameras from the building structure.
 - 2. Use supports that provide proper alignment and leveling of cameras.
 - 3. Where permitted at exposed cameras, install flexible connections neat and straight, without excess slack, and attached to the support device.
- C. Support all junction boxes, pull boxes, or other conduit terminating housings located above the suspended ceiling from the floor above, roof, or penthouse floor structure to prevent sagging or swaying.
- D. Conduits:
 - 1. Support suspended conduits 1-inch and larger from the overhead structural system with metal ring or trapeze hangers and threaded steel rod having a safety factor of four.
 - 2. Conduits smaller than 1-inch installed in ceiling cavities, may be supported on the mechanical system supports when available space and support capacity has been coordinated with the subcontractor installing the supports.
 - 3. Anchor conduit installed in poured concrete to the steel reinforcing with No. 14 black iron wire.
- E. Powder actuated or similar shot-in fastening devices will not be permitted for any electrical work except by special permission from the Architect.

3.7 ACCESS DOORS

- A. Furnishing and installation of access doors coordinate with owner.

3.8 ALIGNMENT

- A. Install panels, cabinets, and equipment level and plumb, parallel with structural building lines.
- B. Install all electrical enclosures fitted neatly, without gaps, openings, or distortion.
- C. Properly and neatly close all unused openings with approved devices.
- D. Fit surface panels, devices, and outlets with neat, appropriate, trims, plates, or covers without overhanging edges, protruding corners, or raw edges.

3.9 CUTTING AND PATCHING

- A. General:
 1. Comply with Division 1 Section, "Cutting and Patching".
 2. Restore to original condition new or existing work cut or damaged by installation, testing, and removal of electrical Work.
 3. Patch and finish spaces around conduits passing through floors and walls to match the adjacent construction, including painting or other finishes.
 4. Clean up and remove all dirt and debris.
- B. Make additional required openings by drilling or cutting. Use of jackhammer is prohibited.
- C. Fill holes that are cut oversize so that a tight fit is obtained around the objects passing through.
 1. In rated construction, comply with Division 7 Section, "Through-Penetration Firestop Systems".
- D. Obtain Architect's permission and direction prior to piercing beams or columns.
- E. Where alterations disturb lawns, paving, walks, and other permanent site improvements, repair and refinish surfaces to condition existing prior to commencement of work.

3.10 PROTECTION OF WORK

- A. Protect all electrical work and equipment installed under this Division against damage by other trades, weather conditions, or any other causes.
 1. Equipment found damaged or in other than new condition will be rejected as defective.
- B. Provide enclosures and trims in new condition, free of rust, scratches, and other finish defects.
 1. If damaged, properly refinish in a manner acceptable to the Architect.

3.11 COMPLETION AND TESTING

- A. Upon completion, test systems to show that installed equipment operates as designed and specified, free of faults and unintentional grounds.
 1. Schedule system tests so that several occur on the same day.
 2. Coordinate testing schedule with construction phasing.
 3. Conduct tests in the presence of the Architect or its representative.
 4. Notify Architect of tests 48 hours in advance.

- B. Engage a journeyman electrician with required tools to conduct equipment tests. Arrange to have the equipment factory representative present for those test where the manufacturer's warranty could be impacted by the absence of a factory representative.
- C. Provide a written record of performance tests and submit with operation and maintenance data.

3.12 COMMISSIONING

- A. Complete all phases of work so the system, equipment, and components can be checked out, started, calibrated, operationally tested, adjusted, balanced, functionally tested, and otherwise commissioned. Complete systems, including all subsystems, so they are fully functional.
- B. Perform commissioning as specified in Section 01 91 00, General Commissioning Requirements, the technical sections, and Section 26 08 00, Commissioning of Electrical Systems.
 - 1. Unless specified otherwise in the technical sections, provide factory startup services for the equipment.
- C. Participation in Commissioning:
 - 1. Provide skilled technicians to checkout, startup, calibrate, and test systems, equipment, and components.
 - 2. The Engineer reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment or system.
- D. Resolution of Deficiencies:
 - 1. Corrective work shall be completed in a timely fashion to permit timely completion of the commissioning process. Experimentation to render system performance will be permitted.
- E. Verification and Documentation:
 - 1. As each test is performed, the Contractor shall have the commissioning manager observe the physical responses of the system and compare them to the specified requirements to verify the test results.
 - 2. Submit site observation reports for deficiencies in the system.
 - 3. Record the result of individual checks or tests on the pre-approved checklist, test, and report form from the commissioning plan and submit results for review.

END OF SECTION

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.2 SUMMARY

- A. This section describes supporting devices for electrical equipment, associated conduit, and cable.
- B. Related Sections include:
 - 1. Section 26 05 33 Raceways and Boxes for Electrical Systems.
 - 2. Section 26 05 36 Cable Trays for Electrical Systems.

1.3 REFERENCED STANDARDS

- A. International Building Code (IBC)
- B. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Hangers: Kindorf B-905-2A channel, H-119-D washer, C105 strap, minimum 1/2-inch rod with ceiling flange, or equal.
- B. Pipe Straps: Two-hole galvanized or malleable iron.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide all electrical equipment supports.
- B. Install vertical support members for equipment, straight and parallel to building walls.
- C. Provide independent supports to structural member for electrical fixtures, materials, or equipment installed in or on ceiling, walls, or in void spaces and/or over furred or suspended ceilings.
- D. Do not use other trades' fastening devices to support electrical equipment materials or fixtures.
- E. Do not use supports and/or fastening devices to support other than one particular item.
- F. Support conduits within 18 inches of outlets, boxes, panels, cabinets, and deflections.
- G. Provide complete seismic anchorage and bracing for the vertical and lateral restraint of conduit, cable trays, bus ducts, and electrical equipment as required by IBC Chapter 16 and the most recent version of the SMACNA Seismic Restraint Manual for Seismic Hazard Level (SHL) A. Shop drawings of bracing systems shall be submitted to the Architect for review and shall bear the seal of a professional engineer registered in the State of Oregon.

3.2 CAMERAS

- A. Light-Duty Ceiling Systems:
 1. Attach No. 12 hanger wire from each corner of the cameras to the structure above.
 2. Positively and securely attach cameras within 6 inches of each corner to the suspended ceiling framing member by mechanical means.
- B. Intermediate-Duty Ceiling Systems:
 1. Positively and securely attach cameras within 6 inches of each corner to the suspended ceiling framing member by mechanical means.
 2. Attach No. 12 hanger wire within 3 inches of each corner of each cameras.
 3. Connect two 12-gauge slack wires from the cameras housing to the structure above for cameras weighing less than 56 pounds.
 4. Support cameras weighing 56 pounds or more directly from the structure above with approved hangers attached to each corner of the cameras.
- C. Heavy-Duty Ceiling Systems:
 1. Positively and securely attach cameras within 6 inches of each corner to the suspended ceiling framing member by mechanical means.
 2. Connect two 12-gauge slack wires from the luminaire housing to the structure above for cameras weighing less than 56 pounds.
 3. Support luminaires weighing 56 pounds or more directly from the structure above with approved hangers attached to each corner of the cameras.

3.3 PULL AND JUNCTION BOXES

- A. Pull and junction boxes installed within the cavity of a suspended ceiling that is not a fire rated assembly may be attached to the suspended ceiling framing members, provided the following criteria are met:
 1. Installation complies with the ceiling system manufacturer's instructions.
 2. Pull or junction box is not larger than 100 cubic inches.
 3. The pull or junction box is supported to the main runner with two fastening devices that are designed for framing member application and positively attach or lock to the member.
 4. The pull or junction box serves branch circuits and associated equipment in the area.
 5. The pull or junction box is within 6 feet of the luminaires supplied.
 6. The framing members are not rotated more than 2 degrees after installation.
 7. Pull and junction boxes installed within the cavity of a suspended ceiling may be attached to independent support wires, provided the following criteria are met:
 - a. Independent support wires are taut and connected at both ends, one end to the ceiling framing member and the other to the structure above.
 - b. Pull or junction box is not larger than 100 cubic inches.
 - c. The pull or junction box is secured to the independent support wires by two fastening devices that are designed for the application.
 - d. Independent support wires in a fire-rated ceiling are distinguishable by color, tagging or other effective means.

3.4 CABLES AND RACEWAY

- A. Cables and raceway installed within the cavity of a suspended ceiling may be attached to independent support wires provided the following criteria are met:
 1. Independent support wires are taut and connected at both ends, one end to the ceiling framing member and the other to the structure above.
 2. Raceways are not larger than one inch trade size and cables and bundled cables are not larger than one inch diameter including insulation.
 3. Not more than three raceways or cables are supported by any independent support wire and are supported within the top or bottom 12 inches.
 4. Cables for Class 2 power-limited signaling systems and other power limited systems are securely fastened within 2 feet of each termination and at intervals not to exceed 5 feet or per the manufacturer's installation instructions.
 5. Raceways are secured at intervals required for the type of raceway installed.

6. Cables and raceway are secured to independent support wires by fastening devices and clips designed for the purpose.
 7. Independent support wires are distinguishable by color, tagging, or other effective means.
- B. Cables and raceway installed within the cavity of a suspended ceiling may be supported with trapezes constructed of steel rods and channels provided the following criteria are met:
1. The size of the rods, channel, and fastening devices are suitable for the anticipated weight.
 2. The spacing of the trapezes meets that required for the type of raceway installed.
 3. Cables and raceway are secured to a trapeze by straps designed for the purpose.
 4. Cables and raceway do not support other raceway or cables.
 5. An appropriately sized seismic bracing system is installed.

END OF SECTION

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.2 SUMMARY

- A. This Section includes:
 1. Raceways and conduits of specified types for all electrical system wiring, except where clearly indicated otherwise.
 2. All fittings, boxes, hangers, and appurtenances required for the conduits and raceways.
 3. Size raceways and conduits as indicated. Where no size is indicated, conduit may be the minimum code permitted size for the quantity of conductors installed, based upon NEC tables for conductors with type THW insulation.
- B. Related Sections include:
 1. Section 26 05 29 Hangers and Supports for Electrical Systems.
 2. Section 26 05 53 Identification for Electrical Systems.

PART 2 - PRODUCTS

2.1 METALLIC CONDUITS

- A. Rigid Metal Conduit (RMC): Smooth surfaced heavy wall mild steel tube of uniform thickness and temper, reamed and threaded at each end and protected inside and out with galvanizing, sherardizing, or equivalent process. RMC shall comply with NEC Article 344.
- B. Intermediate Metallic Conduit (IMC): Smooth surface, intermediate wall mild steel tube of uniform thickness and temper, reamed and threaded at each end, and protected inside and out with galvanizing, sherardizing, or equivalent process. IMC shall comply with NEC Article 342.
- C. Electrical Metallic Tubing (EMT): Smooth surface, thin wall mild steel tube of uniform thickness and temper, galvanized or sherardized on the outside, and enameled on the interior. EMT shall comply with NEC Article 358.
- D. Flexible Conduits (Flex):
 1. Flexible Metallic Conduit: Interlocking single strip steel construction, galvanized inside and out after fabrication. Flex shall comply with NEC Article 348.
 2. Liquid Tight: Similar to flexible metallic conduit, except encased in a liquid tight polyvinylchloride or equivalent outer jacket over the flexible steel core, and shall comply with NEC Article 350.

2.2 NON-METALLIC CONDUITS

- A. Rigid Non-Metallic Conduit: Type II PVC Schedule 40, suitable for use with 90°C rated wire. Conduit shall conform to UL Standard 651 and carry appropriate UL listing for above and below ground use.

B. Non-metallic tubing (ENT)

1. ENT Raceway shall be blue polyvinyl chloride (PVC) branch wiring.
2. ENT Raceway shall be available in trade sizes 1/2" through 2".
3. ENT Raceway shall be easily cut to length using shear type cutters.
4. ENT Raceway shall be hand bendable, corrugated of circular cross section. No special tools needed for bending.
5. ENT Raceway, Fittings, Boxes and Accessories shall not rust.
6. ENT shall provide protection for power wiring conductors.
7. ENT shall have an ambient temperature range -4° F to 122° F.
8. ENT shall meet requirements of NEC for Electrical Nonmetallic Tubing.
9. Single manufacture shall provide ENT, Fittings, Boxes and Accessories to form a complete integrated raceway system.
10. ENT shall be listed to the requirements of UL Standard UL 1653 in accordance with Article 362 of the NEC and Section 12-1500 of the CEC.
11. ENT Raceway shall be recognized for use with PVC rigid nonmetallic conduit fittings.
12. ENT Raceway shall be rated for 90°C conductors.
13. Conductors shall easily push through the raceway (up to approximately 50 feet).
14. ENT Raceway shall be available in sticks, coils and reels.

B. Fittings

1. Fittings used with ENT shall be listed and/or certified.
2. One piece ENT Coupling, Threaded Terminator and RNC Transition Fittings shall be rated concrete tight without tape.
3. Vertical and 45° Stub Downs shall be made available in 1/2" through 1" trade sizes. (Molded part to retain ENT for concrete pour and provides clearance for attaching fittings to ENT).
4. Vertical and 90° Stub Down Transition Adapter shall be made available in 1/2" through 1" trade sizes (Molded part to retain ENT for concrete pour and provides threaded port for transitioning to other conduit systems).
5. Quick Connect Couplings shall be available in 1/2"-1" trade sizes (Molded part which allows two pieces of ENT to be quickly coupled).
6. Quick Connect Male Threaded Adapter shall be available in 1/2"-1" trade sizes (Molded part which snaps onto a piece of ENT to allow it to have a male threaded end).
7. Quick Connect Male Snap-in Adapters shall be available in 1/2"-1" trade sizes (Molded part which snaps onto a piece of ENT to allow it to connect to an outlet or switch box).
8. Schedule 40 Male Terminal Adapter shall be available (Molded fitting which is solvent cemented to a piece of ENT to provide a male threaded end).
9. Schedule 40 Nonmetallic Couplings shall be available (Molded part which allows two pieces of ENT to be connected together with solvent cement).
10. Non-Metallic ENT Transition Adapters shall be available
 - a. Male ENT to schedule 40 & 80 PVC Conduit
 - b. ENT to EMT
 - c. Reducers, 3/4" to 1/2" ENT and 1" to 3/4" ENT

2.3 WIREWAYS

- A. Troughs: Steel, painted, square in cross section, preformed knock-outs on standard spacing, screw cover.
- B. Fittings: Tees, elbows, couplings as required for configuration shown on the Drawings.

2.4 FITTINGS

- A. RMC and IMC:
 1. Threaded Locknuts: Sealing type where used with NEMA 2, 3, 3R, 4 and 12 enclosures.
 2. Threaded Bushings: 1-1/4-inch and larger, insulated, grounding type as required under Section 26 05 26.
 3. Threaded Couplings: Standard threaded of the same material and as furnished with conduit supplied. Erickson type couplings may be used where required to complete conduit runs larger than 1 inch.
- B. EMT:
 1. Connectors: Steel compression ring or steel set screw type for conduit termination, with insulated throat, suitable for conditions used. Use lay-in grounding type bushings where terminating grounding conductors.
 2. Couplings: Steel compression ring or steel set screw type, concrete tight.
- C. Threadless: RMC and IMC couplings and box connectors may be steel threadless, compression ring or set screw type for use with conduits 1 inch and smaller where installed in poured concrete locations or where limited working space makes threaded fittings impractical.
- D. Weatherproof Connectors: Threaded.
- E. Expansion Couplings: Equivalent to O.Z. type EX with jumper.
- F. Seal-Offs: With filler fiber, compound, and removable cover.

2.5 METALLIC BOXES

- A. Flush and Concealed Outlet Boxes: Galvanized stamped steel with screw ears for device ring mounting, knock-out plugs, mounting holes, fixture studs if required, RACO or equivalent.
- B. Surface Outlet Boxes: Galvanized stamped steel same as above for use on ceilings; cast steel or aluminum with threaded hubs or bosses for use on walls.
- C. Large Boxes: Boxes exceeding 4-11/16 inches square when required shall be welded steel construction with screw cover and painted, steel gauge as required by physical size, Hoffman, Circle AW or equivalent.
- D. Systems: Boxes for systems devices shall be as recommended by the systems manufacturer, suitable for the equipment installed. Equip with grounding lugs, brackets, device rings, etc., as required.

2.6 NON-METALLIC BOXES

- A. Boxes used with ENT shall be listed and/or certified.
- B. Non-metallic Mud Boxes shall be available.
- C. Mud Boxes with two 1", four 1/2" and six 3/4" ports shall be available
- D. Mud Boxes with quick connect ports shall be molded out of Polycarbonate
- E. Mud Boxes with removable back shall be available
- F. Mud Box types shall include;
 1. Ceiling Box listed for fixture support up to 50 lbs. and ceiling fan support up to 35 lbs
 2. One Gang
 3. Two Gang
 4. 4 Square
- G. Non-Metallic Outlet and Switch Box shall be available in Single and Two Gang
 1. Boxes shall have eccentric knockouts
 2. Two gang shall have dual voltage capability
 3. Optional dual voltage divider shall be available

- H. Non-Metallic Box Extenders shall be available.
- I. Non-Metallic Plaster Rings shall be available.
- J. Non-Metallic Blank Covers shall be available.
- K. Non-Metallic 4" Octagon Ceiling Boxes shall be available

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Conceal all conduits in finished spaces. Concealed conduits shall run in a direct line with long sweep bends and offsets. RMC and IMC embedded in concrete below grade or in damp locations shall be made watertight by painting the entire male thread with Rustoleum metal primer or equivalent before assembly.
- B. Route exposed conduit parallel or at right angles to structural building lines and neatly offset into boxes. Conduits attached directly to building surfaces shall closely follow the surfaces. Conduit fittings shall be used to "saddle" under beams. Drilling or notching of existing beams, trusses on structural members shall be coordinated with Architect prior to commencing.
- C. RMC and IMC terminations at boxes, cabinets, and general wiring enclosures shall be rigidly secured with double locknuts and bushings or approved fittings. Conduit shall be screwed in and shall engage at least five threads in hub where conduit boxes with threaded hubs or bosses are used. Insulating bushings shall be used for conduits 1-1/4-inches or larger.
- D. Keep conduit and raceways closed with suitable plugs or caps during construction to prevent entrance of dirt, moisture, concrete, or foreign objects. Raceways shall be clean and dry before installation of wire and at the time of acceptance.
- E. Pack spaces around conduits with polyethylene backing rods and seal with polyurethane caulking to prevent entrance of moisture where conduits are installed in sleeves or block-outs penetrating moisture barriers.
- F. Exposed Ceiling Structure Areas: For spaces/rooms which do not have a finished ceiling to conceal conduit installations, underground conduit shall be provided where practical. Above-ground conduits for such areas shall have routing planned in advance. Contractor shall provide a proposed conduit routing plan in advance for review and approval by the Architect prior to rough-in and installation. Above-ground conduits shall be routed and supported parallel and perpendicular to building lines and structure, and tight to structural elements where practical.
- G. Plenum Installation: Conduit systems routing through plenum spaces shall meet code requirements for plenum installation and be suitable for such areas. Protect cabling in conduit where cabling is not suitable/listed for installation plenum spaces.

3.2 CONDUIT

- A. RMC:
 1. RMC may be used in all areas for all wiring systems.
 2. RMC shall be installed where exposed at exterior locations and where otherwise subject to physical damage.
 3. RMC shall be installed with threaded fittings made up tight.
- B. IMC:
 1. IMC may be used for all circuits rated 600V and less where not in contact with earth or fill.
 2. IMC shall be installed with threaded fittings made up tight.
- C. EMT:
 1. EMT may be used in all other dry protected locations for circuits rated 600V and less.
 2. EMT, whether exposed or concealed, shall be securely supported and fastened at intervals of nominally every 8 feet and within 24 inches of each outlet, ell, fitting, panel, etc.
- D. Flex:
 1. Flex shall be used for connections to vibration producing equipment (such as motors, transformers, and mechanical equipment) and where installation flexibility is required with a minimum 12 inches slack connection.
 2. Limit flex length to 36 inches for exposed equipment connections and 72 inches in concealed ceiling and wall cavities.
 3. PVC jacketed flex shall be used in wet locations, areas subject to washdown, and exterior locations.
 4. Flex shall not be used to circumvent a rigid raceway system as required by this specification.
- E. PVC:
 1. Type II Schedule 40 and 80 PVC may be used underground and in and under interior slabs, poured concrete and CMU walls, and where scheduled or noted on the Drawings.
 2. Make connections with waterproof solvent cement.
 3. Provide RMC at 60 degree and larger bends and where penetrating slabs.
- F. ENT:
 1. ENT may be used in walls and above non-plenum rated ceilings for lighting and power system drops within a room.
 2. ENT shall be securely fastened at proper intervals per NEC Article 362.
 3. ENT shall comply with conduit bending requirements listed in NEC Article 362.
 4. ENT shall not be used to circumvent a rigid raceway system as required by this specification.
 5. ENT shall not be installed where exposed to physical damage. Coordinate with other trades and route ENT clear of equipment and possible routes of service access.

3.3 RACEWAYS

- A. Surface metal wireways may be installed at locations to serve motor starters or other control devices where required by a multitude of wiring interconnections or physical layout.

3.4 FITTINGS

- A. Metallic raceways and conduits shall be assembled continuous and secured to boxes, panels, etc., with appropriate fittings to maintain electrical continuity. All conduit joints shall be cut square and reamed smooth with all fittings drawn up tight.
- B. Crimp-on, tap-on, indenter type, malleable iron or cast set screw fittings shall not be used.

3.5 BOXES

- A. General:
 1. Outlet boxes shall be of code required size to accommodate all wires, fittings, and devices.
 2. Provide multi-gang boxes as required to accept devices installed with no more than one device per gang.

3. Equip all metallic boxes with grounding provisions as described in NEC Article 250. Equipment Grounding Conductors routing through metallic boxes shall be grounded to the box using approved grounding connection means.
- B. Size and Type:
1. Flush wall switch and receptacle outlets used with conduit systems shall be 4 inches square, 1-1/2 inches or more deep, with one or two-gang plaster ring, mounted vertically. Where three or more devices are at one location, use one piece multiple gang tile box or gang box with suitable device ring.
 2. Wall bracket and ceiling surface mounted luminaire outlets shall be 4-inch octagon 1-1/2 inches deep with 3/8-inch fixture stud where required. Wall bracket outlets shall have single gang opening where required to accommodate luminaire canopy. Provide larger boxes or extension rings where quantity of wires installed requires more cubic capacity.
 3. Junction boxes installed in accessible ceiling or wall cavities or exposed in utility areas shall be a minimum of 4 inches square, 1-1/2 inches deep with appropriately marked blank cover.
 4. Boxes for the special systems shall be suitable for the equipment installed. Coordinate size and type with the system supplier.
 5. Junction boxes for all power, lighting, and low-voltage systems at CMU or concrete walls shall be metallic masonry type. Contractor shall closely coordinate masonry rough-ins with masonry wall installer and wall construction method/phasing to provide conduit pathways and junction box installation in coordination with masonry wall installation. Masonry boxes shall be positioned and supported to be flush with the finished wall. For CMU walls, conduit shall route vertically, centered within the CMU block cell. Dimensional locations of all masonry wall rough-ins shall be approved by the Architect prior to installation.
- C. Pull Boxes
1. Provide pull boxes where shown for installation of cable supports or where required to limit the number of bends in any conduit to not more than three 90-degree bends.
 2. Use galvanized boxes of code-required size with removable covers installed so that covers will be accessible after work is completed.
- D. Installation:
1. Boxes and outlets shall be mounted at nominal centerline heights shown on the drawings.
 2. Adjust heights in concrete masonry unit (CMU) walls to prevent devices or finish plates from spanning masonry joints.
 3. Recessed boxes shall be flush with finished surfaces or not more than 1/8-inch back and be level and plumb. Long screws with spacers or shims for mounting devices will not be acceptable. No combustible material shall be exposed to wiring at outlets.
 4. Covers for flush mounted boxes in finished spaces shall extend a minimum of 1/4-inch beyond the box edge to provide a finished appearance. Finish edge of cover to match cover face.
 5. Boxes installed attached to a stud in sheet rock walls shall be equipped with opposite side box supports equivalent to Caddy #760. Install drywall screw prior to finish taping. Methods used to attach boxes to studs shall not cause projections on the face of the stud to prevent full-length contact of sheet rock to the stud face.

3.6 PULL WIRES

- A. Install nylon pull lines in all empty conduits larger than 1 inch where routing includes 25 feet or more in length or includes 180 degrees or more in bends.
- B. Where conduits requiring pull lines are stubbed out and capped, coil a minimum of 36 inches of pull line and tape at termination of conduit for easy future access. Label pull lines as to conduit starting or terminations point and intended future use.

END OF SECTION

CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical apply to this section.

1.2 SUMMARY

- A. This Section includes:
 1. Provide a complete cable tray system as indicated.
- B. Related Sections include:
 1. Section 26 05 29 Hangers and Supports for Electrical Systems.

1.3 SUBMITTALS

- A. Shop Drawings:
 1. Submit shop drawings indicating materials, finish, dimensions, and accessories.
 2. Show layout, support, and installation details.
 3. Shop drawings shall include seismic installation detail, approved by a registered structural engineer.
- B. Product Data: Submit manufacturer's product data, including UL classification.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basket: Cooper B-Line Snake Tray or approved equal.
- B. Coordinate with Section 27 05 28.36

2.2 BASKET TRAYS

- A. Continuous, rigid, welded steel wire mesh cable management system.
 1. Mesh System: Permits continuous ventilation of cables and maximum dissipation of heat.
 2. Safety Edge: Continuous safety edge T-welded wire lip.
 3. Wire Mesh: Welded at all intersections.
- B. Material: Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.
- C. Finish for Carbon Steel Wire: Finish applied after welding and bending of mesh.
 1. Electro-Plated Zinc Galvanizing: ASTM B 633, Type III, SC-1.
 2. Hot-Dip Galvanizing: ASTM A 123.
 3. Flat Black: Powder painted surface treatment using ASA 61 black polyester coating.
- D. Nominal Dimensions:
 1. Mesh: 2 x 4 inches.
 2. Straight Section Lengths: 120 inches.
 3. Width: 12 inches in corridor, 8 inches in Gymnasium/Cafeteria.
 4. Depth: 4 inches in corridor, 2 inches in Gymnasium/Cafeteria.
 5. Wire Diameter: 0.177 inch, minimum.
- E. Fittings: Field fabricated in accordance with manufacturer's instructions from straight sections.

- F. Support System: Standard.
 - 1. Wall Installation: CS Bracket. Maximum tray width of 12 inches.
 - 2. Trapeze Mounting to Ceilings: CS Profile. Maximum tray width of 18 inches.
 - 3. Ceiling Installation: CSC Bracket. Maximum tray width of 12 inches.
 - 4. Fasteners: As required by tray widths. Furnished by manufacturer.
- G. Support System: Cablofil FAS System
 - 1. Floor and Wall Installation: FAS Profile.
 - 2. Wall Installation:
 - a. FAS Universal Bracket. Maximum tray width of 24 inches.
 - b. FAS L Bracket. Maximum tray width of 12 inches.
 - 3. Ceiling Installation: FAS C Bracket. Maximum tray width of 12 inches.
 - 4. Under Floor Support: UFS Under Floor Support Stand.
 - 5. Fasteners: Not required.
- H. Hardware: Hardware, including splice connectors and support components furnished by manufacturer.
- I. ACCESSORIES:
 - 1. Grounding: GTA-2-2 grounding lugs for attachment on tray of continuous ground conductor fixing system.

PART 3 - EXECUTION

3.1 BASKET INSTALLATION

- A. Load Span Criteria: Install and support cable management system in accordance with span load criteria of $L/240$.
- B. Cutting:
 - 1. Cut wires in accordance with manufacturer's instructions.
 - 2. Cut wires with side action bolt cutters to ensure integrity of galvanic protective layer.
 - 3. Cut each wire with 1 clean cut to eliminate grinding or touch-up.
- C. Install cable management system using hardware, splice connectors, support components, and accessories furnished by manufacturer.

END OF SECTION

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. This section describes conduit, ducts, duct accessories, handholes, boxes and manholes constructed and installed to form a complete underground raceway system.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03 30 00 Cast-In-Place Concrete.
- B. Section 31 23 00 Trench, Backfilling and Compacting.
- C. Section 31 23 19 Dewatering.

1.3 REFERENCED STANDARDS

- A. AASHTO: American Association of State Highway and Transportation Officials.
- B. ACI: American Concrete Institute.
- C. ANSI: American National Standards Institute.
- D. ASTM: American Society for Testing and Materials.
- E. NEC: National Electrical Code.
- F. NEMA: National Electrical Manufacturers Association.
- G. UL: Underwriters Laboratories.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit descriptive details of the manufacturers' proposed standard product listings, including:
 - a. Precast manholes and handholes.
 - b. Precast manhole and handhole accessories, including covers and frames.
 - c. Precast concrete 28-day compressive strength data.
 - d. Manhole and handhole cement certification.
 - e. Duct bank cement certification.
 - f. Duct spacers.
 - g. Ducts and raceways.
 - h. Conduit expansion/deflection fittings.
- B. Show drawings for manholes and handholes, including:
 - 1. Design criteria signed by professional structural engineer licensed by the State of Oregon.
 - 2. Reinforcing steel locations and concrete covers.
 - 3. Layout of inserts, attachments, and openings.
 - 4. Locations and types of joints.
 - 5. Accessories, including covers, frames, and diamond plate doors where applicable.
- C. Duct-Bank Coordination Drawings: show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
 - 2. Drawings shall be signed and sealed by a qualified professional engineer licensed by the State of Oregon.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Handholes and boxes shall be precast concrete, 4,000 psi strength at 28 days, with reinforcing and galvanized checker plate traffic covers designed for AASHTO loading of H-20. Wall thickness shall be 3 inches minimum.
- B. Precast units shall conform to ASTM C 478. Pulling irons shall be 7/8-inch diameter hot-dip galvanized steel bar with exposed triangular opening.
- C. Design:
 - 1. Precast structures shall be designed in accordance with AASHTO "Specification for Highway Bridges." Concrete and reinforcing shall be designed in accordance with ACI Code 318.
 - 2. Tops and walls of structures shall be designed for AASHTO H-20 highway loading, with 30 percent loading added for impact.
 - 3. Walls shall be designed to withstand all soil pressures, taking into consideration the soil to be encountered and ground water level present at the site.
 - 4. Assume ground water level is at ground surface unless a lower water table is indicated in the boring logs. Precast handhole pull boxes shall be designed and constructed not to float.
- D. All structures shall be identified with manufacturer's name embedded in, or otherwise permanently attached to, an interior wall face.
- E. Covers for handholes and boxes shall be spring-assisted galvanized diamond plate door with locking latch, and shall have 3-inch high markings in weld bead, inscribed before galvanizing with the word, "ELECTRICAL". Covers shall also have identification such as "MH-PA-1."
- F. Acceptable Manufacturers: Utility Vault Company, Hanson, Renton Concrete Products, or equal.

2.2 PRECAST CONCRETE VAULTS

- A. Vaults shall be precast concrete, minimum 4,000 psi strength at 28 days, with reinforcing and cover designed for AASHTO loading of H-20. Wall thickness shall be 3 inches minimum. Access opening shall have 36]-inch minimum clear opening.
- B. Precast units shall conform to ASTM C 478.
- C. Pulling irons shall be 7/8-inch diameter and shall have hot-dip galvanized steel bar with exposed triangular opening.
- D. Design:
 - 1. Precast structures shall be designed in accordance with AASHTO "Specification for Highway Bridges." Concrete and reinforcing shall be designed in accordance with ACI Code 318.
 - 2. Tops and walls of structures shall be designed for AASHTO H-20 highway loading, with 30 percent loading added for impact.
 - 3. Walls shall be designed to withstand all soil pressures, taking into consideration the soil to be encountered and groundwater level present at the site.
 - 4. Assume ground water level is at ground surface unless a lower water table is indicated in the boring logs. Precast manholes shall be designed and constructed not to float.
- E. All structures shall be identified with manufacturer's name embedded in, or otherwise permanently attached to, an interior wall face.
- F. Transformer Vault -
 - 1. Access cover and frame shall be steel with diamond plate finish.
 - 2. The frame shall be steel with a 36-inch square opening. The cover shall have holes for lifting and shall have minimum 2-inch high factory label "TELEPHONE," "ELECTRIC," or "ELECTRIC HV," as appropriate or as noted on the drawings.
 - 3. Acceptable Manufacturers: Utility Vault Company, Hanson, Renton Concrete Products, or equal.

- G. Sectionalizing Vault -
 1. Access cover and frame shall be steel with diamond plate finish.
 2. The frame shall be steel with a 36-inch by 72-inch opening. The cover shall be two 36-inch by 36-inch pieces and have holes for lifting and shall have minimum 2-inch high factory label "TELEPHONE," "ELECTRIC," or "ELECTRIC HV," as appropriate or as noted on the drawings.
 3. Acceptable Manufacturers: Utility Vault Company, Hanson, Renton Concrete Products, or equal.

2.3 DUCT LINES

- A. Size: Except where otherwise shown on the drawings, ducts and conduits shall not be less than 4-inch trade size.
- B. Ducts (concrete-encased): Type II PVC Schedule 40, suitable for use with 90°C rated wire. Conduit shall conform to UL Standard 651 and carry appropriate UL listing for below-ground use.
- C. Ducts (direct-buried):
 1. Rigid Non-Metallic Conduit: Type II PVC Schedule 40, suitable for use with 90°C rated wire. Conduit shall conform to UL Standard 651 and carry appropriate UL listing for above- and below-ground use.
 2. Rigid Metal Conduit: UL 6 galvanized rigid steel. Where metal conduit is shown on the drawings or specified below, conduit shall have a coating of 20 mil bonded PVC, or shall be coated with bituminous asphaltic compound.
- D. Manufactured bends shall be not less than 36 inches in radius for conduits 4 inches in diameter or larger.

2.4 SPACERS

- A. Factory-fabricated rigid PVC vertical and horizontal interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum of 3 inches separation between ducts while supporting ducts during concreting or backfilling. Acceptable manufacturers: Carlon, Orangeberg, or equal.

2.5 GROUNDRODS

- A. Ground rods shall be copper-clad steel, 3/4-inch diameter and 10-feet long.

2.6 GROUNDWIRE

- A. Ground wire shall be stranded bare copper No. 6 AWG minimum.

2.7 CONDUIT EXPANSION/DEFLECTION FITTINGS

- A. Conduit expansion/deflection fittings in embedded runs shall be rated for indoor use, outdoor use, buried underground, or embedded in concrete in non-hazardous areas.
- B. Fittings shall allow axial expansion or contraction up to 3/4 inch and angular misalignment of the axes of the coupled runs in any direction to 30 degrees. Inner sleeves shall maintain constant inside diameter in any position and provide smooth insulated wireway for protection of wire insulation.
- C. Fittings shall have a watertight flexible neoprene outer jacket and tinned copper flexible braid grounding strap.
- D. Use with galvanized rigid steel conduit or PVC Schedule 40 conduit utilizing rigid metal conduit nipples and rigid metal to PVC adapters.
- E. Acceptable Manufacturers: Crouse-Hinds, O-Z/Gendy, or equal.

PART 3 - EXECUTION**3.1 PRECAST MANHOLES AND HANDHOLE PULL BOXES**

- A. Construction
 - 1. Units may be precast monolithically or may consist of assembled sections.
 - 2. Assembled sections shall have mating edges with tongue-and-groove joints. Joints shall be designed to firmly interlock adjoining components, and provide waterproof junctions. Joints shall be sealed watertight using preformed plastic strips installed in accordance with the manufacturer's instructions.
 - 3. Furnish lifting devices for proper handling of units.
 - 4. Provide ground rod and sleeve in manhole floors.
 - 5. Install sump with grate.
- B. Duct entries shall be a minimum of 14 inches above floor and below ceiling. Cable supports, clamps, or racks shall be provided. Floor shall slope 2 percent in all directions to a sump. Sump shall be a minimum of 8 inches in diameter.
- C. Install pulling irons or inserts for pulling eyes, inserts for cable racks, and openings for conduit entry as required. Steel components other than reinforced steel shall be hot-dip galvanized after fabrication. Manholes and handhole pull boxes shall have concrete bottoms.
- D. Install drains in electrical manholes and handhole pull boxes with a minimum 4-inch pipe set in the bottom and terminated in a minimum of 1 cubic yard of drain rock.

3.2 INSTALLATION

- A. Install on a level bed of well-tamped gravel or crushed stone, well-graded from the 1-inch to 2-inch sieve.
 - 1. The top of frame and covers shall be flush with the finished surface of pavements, and flush with finished grade in unpaved areas.
 - 2. Set manholes and handholes plumb to limit the depth of standing water to a maximum of 2 inches. Unless otherwise specified, manhole covers shall be set at grade.
 - 3. Construct a sufficient number of precast concrete and mortar courses between top of manhole and manhole frame to reach the required level. Grout the manhole frame to the chimney.
- B. Locate underground duct lines and manholes and handholes at the approximate locations shown on the drawings with due consideration given to the location of other utilities, grades, and paving.
- C. Provide windows for duct bank terminations and fill with concrete or non-shrink grout after duct placement.
- D. Provide pulling irons opposite each duct and conduit entrance. Pulling irons shall be cast in the walls opposite all duct windows approximately 6 inches above the top of the window.
- E. Ground Rods and Grounding:
 - 1. Rods shall protrude approximately 4 inches above the manhole floor.
 - 2. In precast manholes, drive a ground rod into the earth through the floor sleeve. After the manhole is set in place, fill the sleeve with sealant to make a watertight seal.
- F. Ground Wires:
 - 1. Install ground wires around the inside perimeter of the manhole and anchor them to the walls.
 - 2. Connect the wires to the ground rods by exothermic welding or approved compression process to form solid metal joints.
 - 3. Bond the ground wires to the exposed non-current-carrying metal parts of racks, etc., in the manholes. Also bond the wires to duct bank bare equipment grounding conductors.

3.3 TRENCHING

- A. Excavate trenches in accordance with Section 31 23 00, Trenching, Backfilling, and Compacting.
- B. Work with extreme care near existing utilities to avoid damaging them. Cut the trenches neatly and uniformly.
- C. For Concrete-Encased Ducts:
 1. After excavation of the trench, drive stakes in the bottom of the trench at 4-foot intervals to establish the grade and route of the duct bank.
 2. Pitch the trenches uniformly toward manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts towards buildings.
 3. The walls of the trench may be used to form the side walls of the duct bank provided that the soil is self-supporting and that the concrete envelope can be poured without soil inclusions. Use forms where the soil is not self-supporting.
 4. After the concrete-encased duct has sufficiently cured, backfill the trench in accordance with Section 31 23 00, Trenching, Backfilling, and Compacting.

3.4 DUCT LINE INSTALLATIONS

- A. General
 1. Duct line shall be in accordance with the NEC, as shown on the drawings, and as specified.
 2. Slope duct to drain toward manholes and away from building and equipment entrances. Pitch shall be not less than 4 inches in 100 feet. Curved sections in duct lines shall consist of long sweep bends with a minimum radius of 5 feet in the horizontal and vertical directions unless noted otherwise. The use of manufactured bends is limited to building entrances and stub-ups to equipment.
 3. Underground conduit stub-ups to equipment inside buildings shall be galvanized rigid steel and shall extend at least 10 feet outside the building foundation. Stub-ups to equipment, mounted on outdoor concrete slabs, shall be galvanized rigid steel and shall extend at least 5 feet from edge of slab. Install insulated grounding bushings on the terminations. Couple the steel conduits to the ducts with suitable adapters, and encase with 3 inches of concrete.
 4. Upon completion of the duct bank installation, pull a standard flexible mandrel through each duct. The mandrel shall be at least 12 inches long, and shall have a diameter 1/2 inch less than the inside diameter of the duct. After mandreling, pull a brush with stiff bristles through each duct to remove the loosened particles. The diameter of the brush shall be equal to or slightly larger than the diameter of the duct.
 5. Seal the ducts and conduits at building entrances and at outdoor equipment terminations with a suitable nonhardening compound.
- B. Direct Burial Duct and Conduits:
 1. Install direct burial ducts and conduits only where shown on the drawings.
 2. Ducts and conduits shall be joined and terminated with fittings recommended by the conduit manufacturer.
 3. Tops of ducts and conduits shall be not less than 24 inches below grade.
 4. Do not kink the ducts or conduits.
 5. Place a continuous strip of utility warning tape approximately 12 inches above ducts or conduits before backfilling trenches. See Section 31 23 00, Trenching, Backfilling, and Compacting, for tape description and installation requirements.

END OF SECTION

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section Common Work Results for Electrical, apply to this section.

1.2 SUMMARY

- A. This Section includes: Clearly and properly identify the complete electrical system to indicate the loads served or the function of each item of equipment connected under this scope of work.

PART 2 - PRODUCTS

2.1 LABELS

- A. Pre-printed: Permanent material pre-printed with black on white, with adhesive backing, Brady, 3M or equivalent.
- B. Engraved Laminated Plastic: 3-ply laminated plastic, colors indicated herein, with beveled edges, engraved letters and stainless steel screw attachment. Nameplate length to suit engraving. Adhesive attachment is not acceptable.
- C. Clear Plastic Tape: Black 12 point Helvetica medium text, clear adhesive backing, field printed with proper equipment for device labeling. Brother P-Touch, Dyno-tape, Kroy, or equal.
- D. Wire Markers: White with black numbers, adhesive backed tape on dispenser roll, Brady, 3M or equivalent.
- E. Marker Pen: Black permanent marker suitable for writing on metallic surfaces.

PART 3 - EXECUTION

3.1 GENERAL

- A. Nameplate and text coloring:
 - 1. Normal: Black nameplate with white lettering.
- B. Provide clear plastic tape label for all relays, contactors, time switches and miscellaneous equipment provided under this Division of work indicating equipment served

3.2 DEVICES

- A. Label each receptacle plate with preprinted clear plastic tape indicating serving panel and circuit number (e.g. PANEL 2PA-5). Clean all oils, dirt and any foreign materials from plate prior to label application. Receptacles connected to a GFCI protected circuit downstream from the protecting device shall be so labeled.

3.3 RACEWAYS AND BOXES

- A. Label all pull boxes and junction boxes for systems with paint or marker pen on box cover identifying system. Where box covers are exposed in finished areas, label inside of cover. Covers shall be color labeled as follows: 480Y/277V wiring - orange; 208Y/120V wiring - black; fire alarm - red; communications - green; security - blue.
- B. Label each end of pull wires left in empty conduits with tags or tape indicating location of other end of wire.

3.4 SYSTEMS

- A. Complex control circuits may utilize any combination of colors with each conductor identified throughout, using wraparound numbers or letters. Use the number or letters shown where the Drawings or operation and maintenance data indicate wiring identification.
- B. Label the fire alarm and communication equipment zones, controls, indicators, etc., with machine printed labels or indicators appropriate for the equipment installed as supplied or recommended by the equipment manufacturer.

END OF SECTION

COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Division 27 – Communications governs the infrastructure for the low-voltage information transport systems, which include voice and data and their pathways.
- B. Description of Work:
 - 1. Furnish and install materials for the communications infrastructure systems as specified herein and as shown on the drawings. Upon completion, the systems shall be functioning in compliance with performance requirements specified.
 - 2. The cabling specified and shown on the drawings is for complete, performance based, workable systems. Deviations from the cabling shown due to a particular manufacturer's requirements shall be made only with the written approval of the Architect and the Owner, and at no additional cost to the Owner.
 - 3. This division also includes telecommunications cabling, connections, and equipment needed for the A/V projection, A/V classroom systems, Distributed Antenna System, sound reinforcement, intercom and IP Video Camera cabling. Refer to "T" series drawings for locations, quantities and additional requirements.

1.2 SECTION INCLUDES

- A. Definitions
- B. Quality Assurance
- C. Submittal Requirements

1.3 RELATED DOCUMENTS

- A. Comply with the referenced codes and standards and with the Contract Documents. Where conflicts occur, the more stringent shall apply.
- B. The following codes, associations, acts and agencies, as required by law:
 - 1. Federal Communications Commission (FCC)
 - 2. National Electric Code® (NEC®)
 - 3. National Electrical Safety Code (NESC)
 - 4. National Fire Protection Association (NFPA)
 - 5. Occupational Safety and Health Administration (OSHA)
- C. The following standards:
 - 1. American National Standards Institute (ANSI)
 - 2. National Electrical manufacturers Association (NEMA)
 - 3. Telecommunications Industries Association (TIA)
 - 4. Electronic Industries Association (EIA)
 - 5. Institute of Electrical and Electronics Engineers (IEEE)
 - 6. Underwriters Laboratories (UL®)
 - 7. American Standards Association (ASA)
- D. The following guidelines:
 - 1. BICSI, Telecommunications Distribution Methods Manual (TDMM)

1.4 RELATED SECTIONS

- A. Section 27 0500 – Common Work Results for Communications
- B. Section 27 0513 – Communications Services
- C. Section 27 0526 – Grounding and Bonding for Communications Systems
- D. Section 27 0528 – Pathways for Communications Systems
- E. Section 27 0528.33 - Conduits and Backboxes for Communications Systems
- F. Section 27 0528.36 - Cable Trays for Communications Systems
- G. Section 27 0528.39 - Surface Raceways for Communications Systems
- H. Section 27 0553 – Identification for Communication Systems
- I. Section 27 0800 – Commissioning of Communications
- J. Section 27 1100 – Communications Equipment Room Fittings
- K. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures
- L. Section 27 1123 – Communications Cable Management and Ladder Rack
- M. Section 27 1126 – Communications Rack Mounted Power Protection and Power Strips
- N. Section 27 1313 – Communications Copper Backbone Cabling
- O. Section 27 1619 – Communications Patch and Station Cords
- P. Section 27 2133 – Wireless Access Points
- Q. Section 27 4100 - Audio-Video Systems
- R. Section 27 4116 – Integrated AV Systems
- S. Section 27 5113 – Paging Systems
- T. Section 27 5319 – Distributed Antenna Systems

1.5 DEFINITIONS

- A. Advanced System Warranty – an extended warranty held either by the connectivity or cabling manufacturer directly with the Owner for this project that guarantees product and performance of the entire cabling system for the warranty period.
- B. Conveniently Accessible - being capable of being reached from floor or use of 8' step ladder without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and duct work.
- C. Entrance Room – A space in which the joining of campus and building telecommunications backbone facilities takes place.
- D. Equipment Room – An environmentally controlled centralized space for telecommunications equipment that usually houses a main or intermediate crossconnect, as well as video surveillance and security equipment.
- E. IDF – Intermediate Distribution Frame, also known as a Telecommunications Room (TR) or Communications Room.

- F. Lead Telecommunications Installer –the project manager for the Telecommunications Subcontractor for all telecommunications work in the construction documents (T-series drawings and specification Section 27), who shall be on-site at all times while Division 27 work is being performed. This individual shall attend all construction project meetings.
- G. Listed Communications Cable – A cable listed by the Underwriters Laboratory (UL[®]) and accepted by the local authority having jurisdiction as having met appropriate designated standards or has been tested and found suitable for installation in specific spaces. Refer to *NEC*[®] Section 800 for listing types and additional requirements.
- H. MDF – Main Distribution Frame, also known as the Main Equipment Room.
- I. Plenum – A compartment or chamber to which one or more air ducts is connected and that forms part of the air distribution system. Assume space above suspended/accessible ceilings is a plenum.
- J. Plenum-rated – listed by the Underwriters Laboratory as being suitable for installation into a plenum space. Communications cabling routed through plenum-rated space shall be plenum-rated and identified as Type CMP.
- K. Point of Entrance (Building Entrance) - The point within a building at which the Outside Plant (OSP) communications wire or cable emerges from an external wall, from a concrete floor slab, or from a rigid metal conduit (Type RMC) or an intermediate metal conduit (Type IMC) connected by a grounding conductor to an electrode in accordance with the *NEC*[®].
- L. Subcontractor, Telecommunications – company responsible for all telecommunications work in the construction documents (T-series drawings and specification sections 27 0000 through 27 5313).
- M. Telecommunications – in general, telecommunications refers to infrastructure/equipment needed for the voice, data, and video communications and transport systems.
- N. Telecommunications Consultant – As defined for sections referring to telecommunications work only, this Consultant shall be the telecommunications design consultant employed by the Owner for the purpose of observing the work of the Communications Subcontractor(s).
- O. Telecommunications Room - An environmentally enclosed architectural space designed to contain telecommunications equipment, cable terminations, or crossconnect cabling. The Main Equipment Room may also be known as the MDF, and may be co-located with the building's Entrance Room and Equipment Room. Telecommunications Rooms will also house equipment for additional systems, such as security, cable television, and audio/video.
- P. UL[®] – Underwriters Laboratory

1.6 QUALITY ASSURANCE

- A. Project Submittal Compliance – The Project Architect shall be responsible for receiving and compiling all submittal information. As such, all such data pertaining to Section 27 shall conform to the following Division 1 Sections:
 - 1. Section 01 7800 – Closeout Submittals
- B. Telecommunications Subcontractor Qualifications
 - 1. Company Requirements
 - a) The Telecommunications Subcontractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications.

- b) Telecommunications Systems specified shall be assembled and installed under the direction of a qualified Telecommunications Subcontractor. Qualification requirements shall include submittal by the Telecommunications Subcontractor to the Architect of the following:
 - 1) List of previous projects of this scope and nature, including names and sizes of projects (to include square footage and construction cost – overall and that of the Telecommunications Subcontractor), description of work, times of completion, and names of contact persons for reference.
 - 2) Installers shall certify that they are manufacturer-authorized or trained for work to be performed.
 - 2. Lead Telecommunications Installer Requirements:
 - a) Lead Communications Installer shall be a current member of BICSI in good standing and have completed (at a minimum) BICSI ITS Installer 2 Training (for both copper and fiber).
 - b) Submit certificate of ITS Installer 2 Training (or higher) with bid and preconstruction submittal package.
 - c) Advanced training from connectivity manufacturer may be submitted in lieu of BICSI ITS Installer 2 Training. Submit manufacturer training certificates for review by Owner as substitution request as part of Pre-Bid questions. This training must be by the same manufacturer that will hold the Advanced System Warranty.
 - 3. General Telecommunications Installer Requirements:
 - a) For all work associated with Specification Sections 27 all installers are to have a minimum of BICSI ITS Installer 1 Training or equivalent training from the connectivity manufacturer.
 - b) Submit a list with bid of names of all installers and appropriate copies of certificates verifying training with pre-construction submittal package.
- C. Warranty Requirements
 - 1. Project Warranty
 - a) Equipment and materials required for installation under these specifications shall be the current model and new (less than one year from date of manufacture), unused and without blemish or defect, and are to be guaranteed to be free from defect.
 - b) When a defect or problem is observed within the first year after substantial completion, the Owner will notify the governing subcontractor through the proper channels. The appropriate Subcontractor then has 48 hours to fix the defect or furnish and install a replacement part/system, all at no cost to the project or Owner.
 - 2. Advanced System Warranty for Telecommunications (Copper and Fiber Systems)
 - a) Beyond the initial one year project warranty, the Telecommunications Systems shall be warranted for a minimum of 20 years by a national and reputable connectivity or cabling manufacturer.
 - 1) This warranty shall cover any material defect, as well as the performance of the cabling system. (Example: A Category 6A cabling system is to deliver 10,000BASE-T speed, or 10 “Gig” performance for the entire length of the warranty period.)
 - 2) This warranty shall cover both material and labor for the full length of the warranty period.

- b) The Telecommunications Subcontract shall be certified by this manufacturer.
- c) The following manufacturers are conditionally approved to provide the system warranties (subject to specific project requirements):
 - 1) Copper Connectivity Manufacturers
 - i. CommScope
 - ii. Panduit
 - 2) Fiber Connectivity Manufacturers
 - i. CommScope
 - ii. Panduit
 - 3) Cabling Manufacturers
 - I. CommScope
- II. General (for Panduit product Set)
- D. When articles, materials, operations or methods related to execution of communications work are noted, specified, or described in the specifications or are indicated or reasonably implied on drawings and schedules, execute work as required or appropriate to provide complete and proper function, operation and installation.
- E. The drawings utilize symbols and schematic diagrams to indicate items of work. These symbols and diagrams will not typically identify dimensions nor will they identify inclusion of specific accessories, appurtenances and related items necessary and appropriate for a complete and proper installation and operation. The Telecommunications Subcontractor shall install work complete and ready for proper operation, including related items not specifically identified, shown, indicated or specified. The work shall be installed, in accordance with the intent diagrammatically expressed on the drawings, and in conformity with the dimensions indicated on architectural drawings and on shop drawings approved by the Telecommunications Consultant.
- F. The drawings include details for various items, which are specific with regard to the dimensions and positioning of the work. These details are intended only for the purpose of establishing general feasibility; they do not obviate field coordination for the indicated work. Work shall not proceed until actual field conditions and requirements are verified by the Telecommunications Subcontractor.
- G. The drawings are diagrammatic and indicate the general arrangement of systems and equipment unless indicated otherwise by dimensions.

1.7 SUBMITTALS

- A. General Requirements
 - 1. Provide Submittals
 - 2. Architect shall receive and Telecommunications Consultant is to review all submittals related to Division 27 work. This includes, but is not limited to, relevant:
 - a) Pre-bid questions,
 - b) Contractor and personnel qualifications with bid,
 - c) Voluntary alternates and unit pricings with bid,
 - d) Pre-construction product submittals and shop drawings,
 - e) Change order requests, requests for information (RFIs), design change directives (DCDs), and any other changes as directed by the architect/engineer.
 - 3. Record drawings and warranty certificates/letters shall be in accordance with Section 01 7800.

4. Allow a minimum of one week (five working days) for the Telecommunications Consultant to review.
- B. The following submittals are due with the Bid:
1. Proof of Telecommunications Subcontractor and personnel qualifications
 - a) Provide a typed list with the following information:
 - 1) Company name of Telecommunications Subcontractor
 - 2) List of connectivity or cabling manufacturers that the Telecommunications Subcontractor is certified to install and provide advanced warranty for.
 - 3) List of previous projects (minimum of 3) of this scope and nature, including:
 - I. Project name and date of completion
 - II. Project size (square feet of building, total construction cost, total cost of telecommunications scope)
 - III. Name and contact information for building owner or IT Manager
 - 4) Name and contact information for Lead Telecommunications Installer
 - b) Provide certificates or letter(s) from BICSI and / or manufacturers verifying by name these qualifications have been met.
 - c) Refer to Quality Assurance subsection in this specification section for additional requirements and qualifications.
 2. Voluntary alternatives (that realize substantial cost savings)
 3. Unit pricing for the following items:
 - a) All unit pricing relating to Division 27 as identified in Section 01 2200.

- C. The following submittals are due at the Pre-Construction Phase (to be delivered to the Project Architect with copies to Telecommunications Consultant):
1. General Requirements:
 - a) Follow submission guidelines as outlined in Division 1. At a minimum, provide the requirements as outlined in this section. Where Division 1 requirements are more stringent, follow those in addition to the requirements in this section.
 - 1) Strictly electronic submission to Telecommunications Consultant is acceptable. General contractor, architect, and engineering requirements may differ.
 - b) Ensure a cover page with Project Title, Telecommunication Subcontractor Company, and point of contact is included for all physical submittals.
 - c) Updated Personnel Qualifications
 - 1) Provide a list of names of all telecommunications installers with appropriate certificates from BICSI or the manufacturer.
 2. Product Information, divided by Specification Section and in order as listed in specification. Identify the start of each specification section.
 - a) Provide manufacturer's product information cutsheet or specifications sheet with the specific product number identified or filled out.
 - 1) Submitted cutsheets without specific product identified will result in the whole submittal being returned without review.
 - 2) No product substitutions will be considered post bid without a significant cost savings to the project to be realized by the owner – a minimum of \$1000, either in material or labor savings. For any product substitution requests post-bid, Telecommunications Subcontractor shall submit an RFI through the proper channels with the requested documentation from the Pre-bid requirements above. Also, include realized cost savings. The project team may issue a change order (or its equivalent) for the product change at their discretion.
 - I. One exception to this is if the specified product goes out of production and is unavailable before submitted shop drawings are approved. Telecommunications or Subcontractor is to submit an RFI explaining the situation and recommending an equivalent product with the same features at no cost change to the project or Owner.
 - II. Other exceptions may be considered. Telecommunications Subcontractor is to submit an RFI explaining the situation.
 3. Shop Drawings
 - a) Conform to all requirements of Section 01 3300. In addition, generate electronic shop drawings in AutoCAD®, dwg file format, version 2004 (or newer), saved to disk (CD-R or DVD+/-R) or USB Flash Drive with project name and number clearly indicated [or uploaded to project website]. Shop drawings shall include Telecommunications or Subcontractor title block and included readily printable Plot/Drawing tabs with mview-window at a scale to not be less than 1/8"=1'-0" unless otherwise noted. The scale shall also be indicated on the drawings.

- 1) Acceptable electronic shop drawing sizes include: 8.5"x11", 11"x17", 22"x34" or 24"x36".
 - b) Stamped seismic calculations for Rack and Cabinet systems to be created by contractor for review by the AHJ.
 - c) Refer to individual sections for additional requirements.
 - d) Communications pathways
 - 1) Hangers and Supports – indicate proposed routing of all cabling supported by J-hooks.
 - 2) Cable Trays - indicate size and proposed routing of all communications cable trays; should any of those locations or sizes differ from the construction drawings due to minor coordination issues, cloud the affected area and note why the change is necessary. (For major coordination issues, please submit an RFI.)
 - 3) Firestopping – indicate manufacturer, product/assembly, and UL system for all firestop penetrations required for communications cabling.
- D. The following submittals are due during Construction (project closeout), in accordance with the requirements in Sections 01 7839 and 27 0000 - Communications:
1. 3 weeks prior to Substantial Completion:
 - a) Record Drawings
 - 1) Modify reviewed and accepted AutoCAD® shop drawings to include revisions based upon completion of work.
 - 2) Provide (1) printed set of record drawings to scale (not less than 1/8" = 1'-0").
 - 3) This set is to include system function diagrams and details not on original construction documents.
 - b) Test Results, in accordance with section 27 0800.
 - c) With the exception of the (1) printed set of record drawings, submit these files electronically either on disk (CD or DVD) or USB Flash Drive, with project name and number clearly indicated.
 2. Within two weeks after Substantial Completion:
 - a) Warranty Certificates for the Advanced Telecommunications System Warranty for the copper and fiber systems with point of contact for any warranty claims.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts are available.
- B. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer and part number.
- C. All products and materials shall be new and unused prior to their installation as part of this project. Refurbished items are not allowed.

PART 3 - EXECUTION**3.1 GENERAL**

- A. Coordinate with all other trades prior to installation.
1. Telecommunications Subcontractor shall meet with Electrical, Mechanical, and General Contractors prior to construction to identify pathway and infrastructure space requirements.
 - a) At a minimum, the following items shall be discussed:
 - 1) Cable tray locations and clearance space above (12" if possible, with proper coordination)
 - 2) Placement for sleeving and wall penetrations
 - 3) In-ceiling projection screens and other audio/video equipment.
 - b) Failure to coordinate sufficient space for telecommunications infrastructure shall result in relocation of various systems by the contractor at no additional cost to owner.
 2. Prior to the start of work, the Telecommunications Subcontractor shall carefully inspect the installed work of other trades and verify that such work is complete to the point where Division 27 work may properly commence. Start of work indicates acceptance of conditions.
 3. Coordinate location of equipment and conduit with other trades to minimize interference.
 - a) Holes through concrete and masonry structures shall be cut with a diamond core drill or concrete saw upon approval of the structural engineer of record for the base building. Pneumatic hammer, impact electric, hand or manual hammer type drills shall not be allowed, except where permitted by the General Contractor as required by limited working space.
 - b) Holes shall be located so as not to affect structural sections such as ribs or beams.
 - c) Holes shall be laid out in advance. The General Contractor shall be advised prior to drilling through structural sections, for determination of proper layout.
 - d) Structural Penetrations: Where conduits, wireways and other raceways pass through fire partitions, fire walls or walls and floors, provide an effective barrier against the spread of fire, smoke and gases.
- B. Follow all manufacturers' instructions and install equipment in accordance with applicable codes and regulations, the original design and the referenced standards.
1. In the event of discrepancy, immediately notify the Telecommunications Consultant through the proper channels. Do not proceed with installation until unsatisfactory conditions and discrepancies have been fully resolved.
- C. Protection of Systems and Equipment
1. Protect materials and equipment from damage during storage at the site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, theft, moisture, extreme temperature and rain.
 2. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering them on sides with securely fastened protective rigid or flexible waterproof coverings.

3. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum-cleaned both inside (as appropriate) and outside before testing, operating or painting.
 4. As determined by the Telecommunications Consultant, damaged equipment shall be fully repaired or shall be removed and replaced with new equipment to fully comply with requirements of the Contract Documents. Decision of the Telecommunications Consultant shall be final.
 5. Painted surfaces shall be protected with removable heavy kraft paper, sheet vinyl or equal, installed at the factory and removed prior to final inspection.
 6. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with same quality of paint and workmanship as used by manufacturer.
- D. Access to Equipment
1. Equipment shall be installed as per the scaled detail on the T-series Drawings. .
 2. Working spaces shall be not less than specified in the National Electrical Code[®] for voltages specified.
 3. Where the Telecommunications Consultant determines that the Telecommunications Subcontractor has installed equipment not “conveniently accessible” for operation and maintenance, equipment shall be removed and reinstalled, one time only, as directed by the Telecommunications Consultant, at no additional cost to the Owner.
- E. Cleaning
1. During construction, and prior to Owner acceptance of the building, remove from the premises and dispose of packing material and debris caused by communications work.
 2. Remove dust and debris from interiors and exteriors of telecommunications equipment (including electrical rough-in). Clean accessible current carrying elements prior to being energized.
- F. Completion
1. General:
 - a) Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.
 2. Results Expected:
 - a) Systems shall be complete and operational.
Cleaning work shall be complete.
 3. Testing and Verification – General Requirements
 - a) Refer to individual sections for additional testing and verification requirements.
 - b) The Telecommunications Subcontractor shall verify that requirements of this specification are met. Verification shall be through a combination of analyses, inspections, demonstrations and tests, as described below.
 - c) Verification by Inspection: Verification by inspection includes examination of items and comparison of pertinent characteristics against the qualitative or quantitative standard set forth in the specifications.

- d) Verification by Test and Demonstration: The Telecommunications Subcontractor shall verify by formal demonstrations or tests that the requirements of this Specification have been met. The Communications Subcontractor shall demonstrate that the communications systems components and subsystems meet specification requirements in the "as-installed" operating environment during the "System Operation Test".
- e) Perform system operation tests after full enclosure of walls.
- f) System Operation Tests Conducted Upon Completion of Work: Upon completion of the Telecommunications Subcontractor's Work, subject the system to functional and operational tests. When required corrections determined by initial test results have been completed, fully retest the system. The Owner shall be notified in writing not less than seven days in advance of date of proposed final testing and inspection. The advance notice shall include certification that the installation is complete and operable and that the Telecommunications Subcontractor has satisfactorily performed the final tests specified herein. The acceptance testing and final inspection shall be accomplished in the presence of the Owner and the Telecommunications Consultant. At least 10 days prior to scheduled system completion, the Telecommunications Subcontractor shall submit, for approval by Owner and Telecommunications Consultant, a test plan to completely test the telecommunications system. The Telecommunications Subcontractor shall include in test plan, for acceptance by the Owner and Telecommunications Consultant, a complete and detailed final acceptance test check-off list ("punch list"). The list shall be a complete representation of specified functions and conditions.

4. Commissioning

- a) There shall be three phases of commissioning:
 - 1) Rough-in inspection
 - 2) Above-ceiling inspection (after cables are placed)
 - 3) Final inspection
- b) At a minimum, the Telecommunications Consultant shall check the following items:
 - 1) Accurate location and height above finished floor for all outlet boxes.
 - 2) Accurate dimensions (particularly depth) of all outlet boxes and diameter of in-wall conduit serving outlet boxes.
 - 3) Cable tray size, location, and clearance.
 - 4) Location and size of all other communications conduits or pathways
 - 5) That power receptacles within the communications rooms meet the design requirements.

- 6) The Telecommunications Consultant is then to issue a written report to the Architect identifying all items which currently do not meet the construction document requirements. This report is to be forwarded to the appropriate subcontractor(s) and all items are to be addressed.

This report is not necessarily all inclusive; should issues be discovered later in the project, the appropriate communications subcontractor is still responsible for corrections/repairs.

- c) Once all communication cabling has been installed and properly supported and walls have been painted, but prior to the installation of ceiling tiles/material, the Telecommunications Consultant shall schedule a time to be on-site to conduct above-ceiling inspection.
- 1) At a minimum, the Telecommunications Consultant shall check the following items:
- i. That all items from the previous inspection have been corrected.
 - ii. That communications cabling is routed correctly and adequately supported.
 - iii. That communications cabling is not painted or over sprayed.
 - iv. That the installed communications cabling matches what was specified / submitted.
 - v. That there are no kinks, splices, or other damage to the installed communications cabling.
- 2) The Telecommunications Consultant is then to issue a written report to the Architect identifying all items which currently do not meet the construction document requirements. This report is to be forwarded to the appropriate subcontractor(s) and all items are to be addressed. This report is not necessarily all inclusive; should issues be discovered later in the project, the appropriate communications subcontractor is still responsible for corrections/repairs.
- d) Once all communications work has been completed, contractor shall request final inspection. This request shall be made 3 weeks before substantial completion. The Telecommunications Consultant shall then schedule a time to be on-site to conduct this inspection; the Telecommunications Consultant shall also invite the Owner to attend this inspection.
- 1) At a minimum, the Telecommunications Consultant shall check the following items:
- I. That all items from the previous inspections have been corrected
 - II. That all faceplates are installed, with the correct modules, quantity of modules, and approved labeling scheme
 - III. That all equipment and cabling within communications rooms is installed per the contract documents, including all patch panels and wall blocks (with specified spare capacity), horizontal and backbone cabling labeling, and telecommunications grounding.

- IV. And all other items necessary to guarantee contract documents are met and complete and functioning communications systems are installed.
- 2) The Telecommunications Consultant is then to issue a written report to the Architect identifying all items which currently do not meet the construction document requirements. This report is to be forwarded to the appropriate subcontractor(s) and all items are to be addressed prior to substantial completion. This report is not necessarily all-inclusive; should issues be discovered within one year after substantial completion, the appropriate communications subcontractor is still responsible for corrections/repairs.

3)

END OF SECTION

COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.

1.2 SECTION INCLUDES

- A. Summary
- B. General Requirements
- C. Environmental Considerations
- D. Site Specific Requirements

1.3 PROJECT SUBMITTAL COMPLIANCE

- A. Project Architect shall be responsible for receiving and compiling all submittal information. As such, all such data pertaining to Section 27 shall conform to the following Division 1 Sections:
 - 1. Section 01 6000 – Substitutions
 - 2. Section 01 3300 – Submittals
 - 3. Section 01 7823 – Operations and Maintenance Data
 - 4. Section 01 7839 – Project Record Drawings

1.4 RELATED SECTIONS

- A. Section 27 0000 – Communications
- B. Section 27 0513 – Communications Services
- C. Section 27 0528 – Pathways for Communications Systems
- D. Section 27 0528.29 - Hangers and Supports for Communications Systems
- E. Section 27 0528.33 - Conduits and Backboxes for Communications Systems
- F. Section 27 0528.36 - Cable Trays for Communications Systems
- G. Section 27 0528.39 - Surface Raceways for Communications Systems
- H. Section 27 0553 – Identification for Communication Systems
- I. Section 27 0800 – Commissioning of Communications
- J. Section 27 1119 – Communications Terminal Blocks and Patch Panels
- K. Section 27 1123 – Communications Cable Management and Ladder Rack
- L. Section 27 1513 – Communications Copper Horizontal Cabling
- M. Section 27 1543 – Communications Faceplates and Connectors

1.5 GENERAL REQUIREMENTS

- A. Eugene School District is a “tobacco free” environment. Tobacco in any form whatsoever is not permitted in this school or on the property owned by the District.
- B. Eugene School District is providing new telecommunications cable and infrastructure to support District-wide deployment of wireless communications and the installation of an IP based video surveillance system. This contract will be responsible for all aspects of telecommunications cabling and supporting infrastructure required for functional systems, specifically:
 - 1. Pathways as per Section 27 0528 and as called out on Drawings.
 - 2. Installation of fiber backbone between the main Equipment Room (MDF) and Telecommunication Rooms (TR) or Telecommunications Cabinets as identified on Drawings. Fiber shall be 50/125 μ m Laser Optimized (OM3) as per Section 27 1323.
 - 3. Installation of horizontal cabling system and related components as per Sections 27 1513 and 27 1543.
 - 4. Installation of Wireless Access Points as identified on the Drawings and as per Sections 27 1543.
 - 5. Testing of fiber and copper cabling systems in accordance with ANSI/TIA-568 and as outlined in Section 27 0800.
 - 6. Creation of as-built documentation, both electronically and printed, as specified in these documents.
- C. All work outlined in these documents and on the accompanying Drawings must be prior to the substantial completion date called out in Division 00 of this bid package, specifically:
 - 1. All construction in telecommunications spaces, i.e., MDF/IDF and mounting of telecommunications racks and cabinets.
 - 2. All raceway (including requisite surface mounted raceway), conduits, and junction boxes required for telecommunications pathways.
 - 3. Installation and testing of all telecommunications cabling (fiber and copper) to allow District to install active electronics and bring complete systems live.
 - 4. Test results and as-build documentation as per Section 27 0513.

1.6 SUMMARY

- A. The intent of the Division 27 Specifications and the accompanying Drawings is to provide a complete and workable system as shown, specified and required by applicable codes and the Authority Having Jurisdiction (AHJ). Include all work as specified in Division 27 and shown on the accompanying Drawings, including appurtenances, to provide a complete and functional system.
- B. The Division 27 Specifications and accompanying Drawings are complementary and what is called for in one shall be as binding as if called for in both. Items shown on the Drawings are not necessarily included in or called out in the Specifications and vice versa. Specifications shall supersede Drawings in the case of a conflict.
- C. Imperative language is frequently used in the Division 27 Specifications. Except as otherwise noted, such requirements are to be performed by the Contractor or a Sub-contractor directly responsible to the Prime Contractor performing the Division 27 work.
- D. The Drawings accompanying Division 27 (T series) are diagrammatic. They do not show every component of a complete telecommunications premises distribution system which may be required to accommodate unique building construction features or materials installed by other trades. The Drawings are to be followed as closely as practical while making necessary adjustments in the placement of cable to facilitate the overall construction of the building without additional cost to the Owner. The right is reserved to make any reasonable changes in Telecommunications Outlet locations prior to roughing-in.

1.7 ENVIRONMENTAL CONSIDERATION

- A. When at all possible, equipment and materials are to be assembled at Distributors or Contractors location and delivered to construction site without packaging or shipping material. Exceptions are granted for protection of delicate components in transit.
- B. Except as noted for purposes of recycling, all construction related debris; packaging and waste materials will be removed from the job site each day and disposed of by the Contractor.

1.8 SITE SPECIFIC REQUIREMENTS

- A. Site details are shown on the accompanying drawings.

1.9 DEVICE LOCATIONS

- A. Telecommunications Room locations as per the accompanying Drawings.

END OF SECTION

COMMUNICATIONS SERVICES**PART 1 - GENERAL REQUIREMENT****1.01 SECTION INCLUDES**

- A. Basic Communication Requirements
- B. Administrative Requirements
 - 1. Contract Documents, Quality Assurance, and Manufacturer's Warranty
 - 2. Technical Qualifications
 - 3. Certificates and Reference Standards
 - 4. Laws and Regulations, Permits
 - 5. Submittal and Substitution Information
 - 6. Environmental Requirements
 - 7. Progress Drawings and Schedules

1.02 PROJECT SUBMITTAL COMPLIANCE

- A. Project Architect shall be responsible for receiving and compiling all submittal information. As such, all such data pertaining to Section 27 shall conform to the following Division 1 Sections:
 - 1. Section 01 6000 – Substitutions
 - 2. Section 01 3300 – Submittals
 - 3. Section 01 7823 – Operations and Maintenance Data
 - 4. Section 01 7839 – Project Record Drawings

1.03 RELATED SECTIONS

- A. Section 27 0000 – Communications
- B. Section 27 0500 – Common Results for Communications Services
- C. Section 27 0528 – Pathways for Communications Systems
- D. Section 27 0528.29 - Hangers and Supports for Communications Systems
- E. Section 27 0528.33 - Conduits and Backboxes for Communications Systems
- F. Section 27 0528.36 - Cable Trays for Communications Systems
- G. Section 27 0528.39 - Surface Raceways for Communications Systems
- H. Section 27 0553 – Identification for Communication Systems
- I. Section 27 0800 – Commissioning of Communications
- J. Section 27 1119 – Communications Terminal Blocks and Patch Panels
- K. Section 27 1123 – Communications Cable Management and Ladder Rack
- L. Section 27 1126 – Communications Rack Mounted Power Protection and Power Strips
- M. Section 27 1313 – Communications Copper Backbone Cabling
- N. Section 27 1323 – Communications Optical Fiber Backbone Cabling
- O. Section 27 1513 – Communications Copper Horizontal Cabling

1.04 BASIC COMMUNICATION REQUIREMENTS

- A. All materials and equipment installed under this contract shall be new, unused, free of defects, and of current manufacture.

- B. The Contractor shall field-investigate this facility to ascertain the exact physical and electrical conditions in the main Equipment Room (MDF), and the Telecommunications Room (IDF) locations to become familiar with the physical environment of the building.
- C. The Contractor shall provide, install, and test the entire cable infrastructure as described under this contract.
- D. The Contractor shall call attention to the Owner any error, conflict, or discrepancy in Plans and/or Specifications. Do not proceed with any questionable items of work until a resolution or clarification has been made. Supplemental Plans and Specifications may be supplied as required and shall become part of the Contract Documents.

1.05 CONTRACT DOCUMENTS

- A. The contract documents, such as drawings, schedules and specifications are used to describe the required work.
- B. The work to be performed under the contract documents includes furnishing all labor, materials, equipment and services necessary, whether listed in the specifications or not, to construct and install the complete communications infrastructure as shown on contract drawings and specifications.
- C. The drawings and schedules depict, in general, application-dependent data while the narrative/specifications, in general, define broader requirements, such as overall quality.
- D. The Contractor shall follow all specifications herein. In case of conflict between drawings and specifications, the latter shall prevail unless authorized in writing by the Owner.
- F. Supplementary Details and Plans may be supplied as required. They shall be issued as addendum and shall become a part of the Contract Documents.

1.06 QUALITY ASSURANCE

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner.
- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated or a substitution is requested, equipment shall be equivalent in every way to that of the equipment specified. All substitutions are subject to the control and approval of the owner or the owner representative.
- C. Strictly adhere to all Telecommunications Industry Association (TIA) and BICSI recommended installation practices and manufacturer's guidelines when installing communications components.

1.07 MANUFACTURER'S WARRANTY CERTIFICATION

- A. The manufacturer's certification must be supported by Contractor's successful completion of an installation class recognized by an independent organization (such as BICSI or an accredited school). A written test is strongly preferred.

1.08 TECHNICAL QUALIFICATIONS

- A. Contractor must be certified by manufacturer as able to provide a 20 year (minimum) manufacturer's warranty certificate.
- B. A minimum of three references demonstrating Contractor's past installation experience in Certified Category 6A systems in similar facilities with a minimum of 500 nodes shall be submitted. The Contractor must supply a one year warranty upon completion of the job.
- C. At least 50% of the technicians, to include all on-site Journeymen Electricians, must have successfully completed the manufacturer's warranty certification class.
- D. All Journeymen are to possess a current Oregon License.
- E. All Apprentices are to be actively enrolled in an Oregon State approved electrical apprenticeship program.

- B. The Contractor shall field-investigate this facility to ascertain the exact physical and electrical conditions in the main Equipment Room (MDF), and the Telecommunications Room (IDF) locations to become familiar with the physical environment of the building.
- C. The Contractor shall provide, install, and test the entire cable infrastructure as described under this contract.
- D. The Contractor shall call attention to the Owner any error, conflict, or discrepancy in Plans and/or Specifications. Do not proceed with any questionable items of work until a resolution or clarification has been made. Supplemental Plans and Specifications may be supplied as required and shall become part of the Contract Documents.

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- C. The drawings and schedules depict, in general, application-dependent data while the narrative/specifications, in general, define broader requirements, such as overall quality.
- D. The Contractor shall follow all specifications herein. In case of conflict between drawings and specifications, the latter shall prevail unless authorized in writing by the Owner.
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- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated or a substitution is requested, equipment shall be equivalent in every way to that of the equipment specified. All substitutions are subject to the control and approval of the owner or the owner representative.
- C. Strictly adhere to all Telecommunications Industry Association (TIA) and BICSI recommended installation practices and manufacturer's guidelines when installing communications components.

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- A. Contractor must be certified by manufacturer as able to provide a 20 year (minimum) manufacturer's warranty certificate.
- B. A minimum of three references demonstrating Contractor's past installation experience in Certified Category 6A systems in similar facilities with a minimum of 500 nodes shall be submitted. The Contractor must supply a one year warranty upon completion of the job.
- C. At least 50% of the technicians, to include all on-site Journeymen Electricians, must have successfully completed the manufacturer's warranty certification class.
- D. All Journeymen are to possess a current Oregon License.
- E. All Apprentices are to be actively enrolled in an Oregon State approved electrical apprenticeship program.

- F. All Equipment/Telecommunication Room and Telecommunications Outlet equipment shall be installed and tested on-site by a technician(s) who, by virtue of an acceptable training course or documented experience, is qualified to perform these procedures. Acceptable training may include successful completion of the manufacturer's training course, documented on-the-job experience or successful completion of applicable technical courses in a recognized trade school.
- G. Verification of the above requirements must be submitted in writing with bid.

1.09 CERTIFICATES

- A. Contractor must provide evidence of ability to provide a Manufacturer's Certificate of Warranty for the system bid.
- B. Contractor must provide Technician Certificate(s) for the 50% mentioned above.

1.10 REFERENCE STANDARDS

- A. This section references the latest revisions of the following documents. In case of conflict between the requirements of this section and those of the listed documents, the more stringent shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI/IEEE 802.3i-x	Physical Layer Specifications for 10/100/1,000/10,000Mbps Transmission over Twisted Pair Cable
ANSI/TIA-568-C.0-3	Building Telecommunications Wiring Standards
ANSI/TIA-569-C	Commercial Building Standard for Telecommunications Pathways and Spaces
EIA RS-310-C	Racks, Panels, and Associated Equipment
UL 94	Tests for Flammability of Plastic Materials and Parts in Devices and Appliances
ANSI/ICEA S-80-576-1988	Communications Wire and Cable for Wiring of Premises
ANSI-TIA-607-B	Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
TIATSB-162-A	Telecommunications Cabling Guidelines for Wireless Access Points
UL1863	Standard for Communication Circuit

1.11 LAWS AND REGULATIONS

- A. This section references the latest revisions of the following documents. In case of conflict between the requirements of this section and those listed documents, the requirements of the listed documents shall prevail.

<u>Reference</u>	<u>Title</u>
NFPA-70	National Electric Code® (NEC®) plus all Oregon State Electrical Code plus local County and City Amendments
IBC	International Building Code
UL®	Underwriters Laboratories Inc.
Oregon Fire Code	

1.12 UNDERWRITERS LABORATORIES LISTING

- A. Unless otherwise specified, electrical equipment and material shall be listed and labeled by Underwriters Laboratories (UL®) for the purpose for which it is used. This requirement may be waived only if a UL® listing is not available for this type of product. Telecommunications cables are acceptable if UL® recognized.

1.13 PERMITS, LICENSES AND TAXES

- A. Contractor shall obtain and pay for permits, inspections, licenses and taxes applicable to this work. Copies of all permits and inspections are to be prominently displayed at each site. Copies of all inspection reports are to be presented to Owner upon closeout of project.

1.14 SUBMITTALS**A. GENERAL**

- 1. Owner must approve all submittals before the start of fabrication (or shipment, for stock items) of any equipment requiring submittals.

B. DRAWINGS

- 1. The Contractor shall submit shop drawings for any modification or new product installation not previously identified in bid documents.
- 2. The drawing must be submitted not less than five (5) days (weekends and national holidays excluded) before the scheduled work begins.
- 3. The Contractor shall proceed with the installation only after approval from the Owner.

C. MATERIALS LIST

- 1. The Contractor shall submit a list of all materials for the proposed work.

D. FIRESTOPPING

- 1. The Contractor shall comply with all requirements of Section 07 8400 – Fire Stopping

E. SOUND DEADENING MATERIALS

- 1. The Contractor shall submit a list of acoustic separation products and procedures. The submittal shall include the manufacturer's technical data for each product including product description, specifications (including labeling or listing by an agency acceptable to the Owner), and storage requirements.

F. MATERIAL SAFETY DATA SHEETS

- 1. Supply Material Safety Data Sheets (MSDS) to Owner for all material accompanied by such.

G. TEST PLANS

- 1. The Contractor shall submit a plan for the testing the installed network.
- 2. The test plan shall include test equipment to be used, procedure and report structure.

H. CERTIFICATES

- 1. Low Voltage Electrical Permit
- 2. The Contractor shall post a copy of the permit and email or fax a copy to the Owner.
- 3. The Contractor shall provide copy of approved permit to the Owner certifying that the work has been inspected and that the work conforms to the requirements of the Authority Having Jurisdiction.

I. PRODUCT WARRANTY

- 1. A manufacturer's warranty is required for this work in addition; Contractor shall provide no-cost warranty on the installed work for a period of one year.

1.15 PROGRESS DRAWINGS AND SCHEDULES

- A. All drawings shall be revised as necessary during the course of the work.
- B. The Contractor shall maintain on-site, one neatly and legibly marked (redlined) set of full-size Drawings accurately depicting as-built locations, changes, and repairs made during the work.
 - 1. Marking of the Drawings shall be kept current.
 - 2. Drawings shall be delivered to the Owner prior to final progress payments.

PART 2 - PRODUCTS**2.1 GENERAL**

- A. The use of a manufacturer's name and model or catalog number herein is for the purpose of establishing the product set, which the Contractor is to supply and install.
- B. Quantities are to be determined by Contractor unless specified.
- C. Products shall be UL[®] listed for the purpose they are to be used.
- D. Cable passing through Plenum spaces shall be rated for such use.

2.2 PRE-APPROVED PRODUCT SETS

- A. The following product sets are pre-approved for this project. Except as noted, all others will require a substitution request to be completed and approved as per these documents. The District will not consider product sets that have not been pre-approved or accepted as per the substitution request process.
 - 1. Structured Cable Systems:
 - a. CommScope - all category 5e, 6 and category 6A components, i.e., jacks, patch panels, patch cords and fiber optic components.
 - b. Panduit - all category 5e, 6 and category 6A components, i.e., jacks, patch panels, patch cords and fiber optic components. Partner cable, i.e., General is acceptable for the Panduit solution.
 - 2. Racks, cabinets, frames and associated fastening devices
 - a. Chatsworth Products Incorporated (CPI)

2.3 FIRESTOPPING

- A. Comply with the requirements of Section 07 8400
- B. Products may be in the form of caulk, putty, strip, sheet, or devices that shall be specifically designed to fill holes, spaces, and voids at communications penetrations.
- B. Firestopping materials shall also provide adhesion to substrates and maintain fire and smoke seal under normal expected movements of substrates, conduits and cables.

2.4 ACOUSTIC SEPARATION

- A. Acceptable products for 2" through 4" penetrations are as follows
 - 1. STI EasyPath™
 - 2. Resilient latex caulk and re-enterable putty manufactured by 3M™, Specified Technologies or Hilti.
 - 3. Or approved substitution
- B. Acceptable products for less than 2" penetrations are as follows
 - 1. Resilient latex caulk and re-enterable putty manufactured by 3M™, Specified Technologies or Hilti.
 - 2. Or approved substitution

PART 3 - EXECUTION**3.1 GENERAL**

- A. Manufacturer's installation instructions and requirements shall be strictly adhered to in the telecommunications equipment installation, fabrication and testing process.
- B. Where conflicts arise between the requirements of this Specification and the manufacturer's installation instructions, the Owner shall be consulted for resolution.
- C. All twisted pair wiring systems shall be installed according to manufacturers' installation guidelines, and according to related ANSI/TIA-568-C standards.
- D. All installed cables shall be kept free from nicking, abrading, or cutting during storage and during the installation process.
- E. Cable shall be installed into conduits after conduit installation is complete and appropriate bushings or couplers have been installed. Manufacturers' recommendations for maximum pulling tensions and minimum bend radii for all cables must not be exceeded.
- F. Care shall be exercised in wiring to avoid damage to wiring and equipment.
- G. Connections shall be made with approved mechanical connectors.
- H. All wiring and connectors shall be installed in strict adherence to standard communications installation practices and to federal, state or local applicable codes.
- I. Equipment shall be firmly held in place. Fastenings, supports, and hangers shall be adequate to support their loads.
- J. Open areas requiring suspension for cables will employ properly rated support mechanisms and devices to accommodate future addition of cable.
- K. Cable ties will be used in concealed areas only as mandated by code or ANSI/TIA-568-C. Cable ties shall bear the same rating as the cable when installed in plenum areas.
- L. Cable running in exposed areas will be bundled using Velcro® or similar hook and loop material. Such material will be used exclusively in the ER and TRs. Cable ties are permitted for temporary cable dressing only and shall be removed prior to substantial completion.
- M. The installation must conform to OSHA standards and comply with state and local safety codes.

- N. Applicable fire codes will be strictly adhered to in regards to plenum ratings for cable and associated cable ties. Fire stopping will be the responsibility of this contract in areas penetrated as a part of this project.
- O. Installation shall be neat, well organized, and professional.
- P. Installation shall be conducted as to maintain consistency between color-coding, labeling and documentation.
- Q. Splicing of any unshielded twisted pair or fiber optic is not acceptable, unless directed to by specifications, addendum, drawings or other written communication with owner or authorized representative.
- R. Any discrepancies, conflicts or issues must be brought to the attention of the Owner before installation or as soon as possible thereafter.
- S. The Contractor shall clean up the work area at the end of each day. At the end of the project all material removed or left over, and/or not being used shall be removed from the project site unless other arrangements have been made. A final clean up shall be made before final payment is made.
- T. The Contractor shall coordinate with the General Contractor for final cleaning of the Equipment and all Telecommunications Rooms. Final cleaning shall include necessary steps to remove all debris from the rooms and provide completely dust-free surfaces on all installed components.
- U. All wall and floor penetrations shall be fire stopped at or before substantial completion.

3.2 PREPARATION

- A. Before installation of cabling and/or equipment in telecommunications spaces, the Contractor shall field-investigate the facility and ascertain if the physical and electrical conditions within the facility shall permit commencement of the Contractor's work.
- B. Any discrepancies, questions, or concerns noted at that time should be brought to the immediate attention of the Owner.

3.3 DOCUMENTATION

A. TEST REPORTS

- 1. The Contractor shall compile test results into the forms that contain all applicable test data. Hard copy output indicating successful testing of every location is not required.
- 2. A solid state USB memory device containing all test data and the appropriate application to display such in a Windows-based environment shall be provided.

3.4 AS BUILTS

- A. Owner will be provided the drawings electronically. These drawings shall be the base drawings for the as built documentation with the following being provided by the Contractor as a separate AutoCAD® layer:
 - 1. Outlet location,
 - 2. Cable ID.

3.5 TELECOMMUNICATION OUTLETS

- A. All locations shall be annotated with information that duplicates the labeling on the jack. In the case of a field terminated plug, such as WAPs or IP based, single cable applications the location shall be so noted.

END OF SECTION

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL REQUIREMENT

1.1 GENERAL

- A. Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.
- B. This section and all related sections shall be performed by a qualified Contractor as outlined in the specifications.

1.2 DESCRIPTION OF WORK

- A. This contract shall be responsible for all hangers and support mechanisms required to properly support all telecommunications cables to satisfy the local Authority Having Jurisdiction.
- B. This contract shall be responsible for all pathways as called out on Drawings, specifically:
 - 1. Various conduits and "J-Boxes" to accommodate Telecommunications Outlets (TO). Any necessary penetrations shall accommodate a minimum of a Trade Size 1 EMT conduit.
- C. The Contractor shall coordinate with the General Contractor and all other trades in regard to final placement of telecommunications pathways. Placement shall be such that pathway will be accessible for future additions requiring placement of telecommunications cable.
- D. The Contractor shall provide all labor, equipment and supplies to furnish and install the communications pathway, hangers and supports.
- E. Installation shall include the actual physical installation of the hardware and/or support structure, firestopping, testing and documentation.

1.3 RELATED SECTIONS

- A. Section 26 0533 - Raceways and Boxes for Electrical Systems
- B. Section 27 0528.29 - Hangers and Supports for Communications Systems
- C. Section 27 0528.33 - Conduits and Backboxes for Communications Systems
- D. Section 27 0528.36 - Cable Trays for Communications Systems
- E. Section 27 0528.39 - Surface Raceways for Communications Systems

1.4 SUBMITTALS

- A. The following information shall be provided:
 - 1. Manufacturer's literature and catalog cuts indicating:
 - 2. Physical dimensions, including dimensions (if appropriate)
 - 3. Materials of construction

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials and equipment installed under this contract shall be new, unused, free of defects, and of current manufacture. Equipment and material shall carry Underwriters Laboratory certification if required by local, state or national codes. Products are to be from the acceptable manufacturer listed below or an approved alternate. In no case will field fabrication or "shop built" cable support products be acceptable.

2.2 J-HOOKS

- A. J-hooks shall be constructed of galvanized steel or hot dipped zinc.
- B. Fastener is to be installed using dedicated wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments. Product is to be UL[®] Listed for the application.
- C. Acceptable products: CADDY[®] CABLECAT – Wide Base Cable Support.

2.3 ADJUSTABLE CABLE SUPPORT SYSTEM

- A. Cable support system shall be a factory produced assembly and sized to accommodate 100 percent expansion, i.e., rated to hold double the number of initially installed cables.
- B. Acceptable product is: CADDY[®] CABLECAT Adjustable Cable Support

2.4 ROD MOUNTED CABLE SUPPORT SYSTEMS

- A. Acceptable product is: CADDY[®] CAT-CM Cable Support System

2.5 FIRESTOPPING SYSTEMS TELECOM RACEWAYS

- A. Comply with the requirements of Section 07 8400
- B. Acceptable products for 2” through 4” penetrations are as follows
 - 1. STI EasyPath™
 - 2. Resilient elastomeric caulk and re-enterable putty manufactured by 3M™, Specified Technologies or Hilti.
- C. Acceptable products for less than 2” penetrations are as follows
 - 1. Resilient elastomeric caulk and re-enterable putty manufactured by 3M, Specified Technologies or Hilti.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install per manufacturer’s instruction per weight loading.
- B. Install in accordance with directions given in Section 27 0528.39
- C. SMR shall be securely supported using mechanical fasteners at intervals not exceeding 10 feet or in accordance with manufacturer’s installation instructions.
- D. Telecommunication Outlets shall be surface mount outlet boxes compatible with the raceway specified.
- E. The path of the SMR shall minimize impact on molding, tack boards and other architectural elements. Vertical runs of raceway from the ceiling to outlets shall be installed on walls near corners wherever possible. Raceway may be installed horizontally at the same height as the outlets or near to the ceiling. Entrance end fittings will be supplied at the ends of raceway runs to transition to conduit sleeves through walls, ceilings or floors. SMR shall be installed parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.
- F. Metal components shall be bonded and grounded in accordance with applicable code and ANSI/TIA-607-B.

- G. J-hooks are to be supported by dedicated wires or rods installed by this contract. In no case will ceiling grid wires be used to support J-hooks. J-hooks will be attached to ceiling grid wires (where applicable) to satisfy seismic bracing requirements and to prevent swinging.
- H. Adjustable cable support systems are to be securely attached to building structure and loaded as per manufacturer's instruction.
- I. Fire Rated wall and floor penetrations shall be fire-stopped in accordance with the manufacturer's instructions using the product set referenced in 2.06 above.

END OF SECTION

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL REQUIREMENT

1.1 SUMMARY

- A. Section includes discrete J-Hooks, slings and related accessories for supporting low voltage cable bundles above accessible.

1.2 REFERENCES

- A. American National Standards Institute (ANSI) / Telecommunications Industry Association (TIA)
 - 1. ANSI/TIA-568-C.1 Commercial Building Telecommunications Cabling Standard
 - 2. TIA -569-C Standard for Telecommunications Pathways and Spaces for Commercial Building
 - 3. ANSI/NFPA 70 National Electrical Code
- B. Underwriters Laboratories, Inc. (UL[®])
 - 1. UL[®] 2043 Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces
 - 2. UL[®] 2239 Conduit, Tubing and Cable Support Hardware

1.3 SUBMITTALS

- A. Provide submittal information in accordance with Section 27 0500 - Common Work Results for Communications and supplementary requirements described in this specification.
- B. Product Data: Submit product data on all cable support devices and accessories. Indicate materials, finishes, load ratings, dimensions, listings, approvals and attachment methods.
- C. Closeout Submittals
 - 1. As-built Drawings: Provide as-built drawings of main pathways

1.4 QUALITY ASSURANCE

- A. Low voltage system cable supports and accessories shall be listed to Underwriters Laboratories, Inc. Standard 2239.
- B. Low voltage system cable supports and accessories shall have the manufacturers name and part number stamped on the part for identification.
- C. Pre-Installation Meetings: Contractor shall set up a pre-installation meeting to discuss low voltage cable support layout work and installation guidelines. Attendees shall include Owner contractor, and appropriate subcontractors. Purpose of meeting shall be to coordinate work between the parties to have a consistent layout for all low voltage system cables, minimize interferences and to make cable system accessibility for future Owner modifications and maintenance high priority issue for all installers.

1.5 COORDINATION

- A. Coordinate layout and installation of low voltage cable bundle supports with other construction elements to ensure adequate headroom, working clearance and access. Revise locations and elevations for those indicated as required to suit field conditions and as approved by Owner.
- B. Particular attention is called to clearances as related to HVAC ducting and sheet metal work.

PART 2 - PRODUCTS

2.1 WIDE BASE CABLE SUPPORTS

- A. J hooks - minimum size is 1-⁵/₁₆ inch diameter loop for (24) 4-pair balanced twisted pair cables or equivalent strand fiber optic cable in inner duct. Provide larger size or multiple hooks where required. A minimum of 1" wide with flared edges where cables enter and leave support. A 2 inch diameter loop shall be required for (48) 4-pair balanced twisted pair cables or equivalent strand fiber optic cable or inner duct.
- B. Accessories: Provide applicable accessories to independently support "J" hooks from structure. This includes extender bracket for mounting multiple J hooks on a single support, fasteners and clamps for connecting to wall, beams, rods, dedicated support wires and "C" and "Z" Purlins as required for specific construction.
- C. Cable Retainers: Provide cable retainers at each "J" hook
- D. Finish
 - 1. Dry Locations, Above Lay-in Ceiling, Below Raised Floor - galvanized
 - 2. Wet and Damp Locations: stainless steel
- E. Manufacturer
 - 1. ERICO Caddy CableCat™ series
 - 2. Chatsworth RapidTrak™ series

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate installation with General Contractor and other trades
- B. All low voltage systems cables shall be supported. Provide supports along entire Pathway.
- C. Space supports a maximum of 48 inches apart and at each change of direction of the cables. In areas covered by dropped ceiling, tiles shall be left open to allow inspection by Owner.
- D. Hang cable supports from ³/₈" all thread rods, dedicated #8 galvanized ceiling drop wire or wall brackets connected directly to structure. Do not support from the ceiling grid or ceiling wire system.
- E. Where main pathways are indicated on the Drawings, contractor shall follow the indicated pathways as closely as possible according to field conditions. Pathways for smaller cable counts shall be designed and documented on the as-built drawings by the contractor.
- F. Install support wires, brackets or rods to route cables parallel and perpendicular to building lines.
- G. Provide multiple hooks or slings at each hanger location as required by cable count and cable segregation requirements.
- H. Fill supports with cabling to 50% or less of the manufacturer's recommended fill. Provide multiple supports where required cable count exceeds 50% fill.
- I. Install low voltage cable support system above accessible ceilings only.
- J. Elevation of Cable Supports: Contractor shall coordinate the allocation of ceiling space and the mounting elevations to allow maintenance and accessibility for future modifications. Telecommunications cable supports shall be as close to the ceiling as possible while allowing ceiling tiles to be removed. Supports shall be located to avoid interference with maintenance access to other equipment.
- K. Cable installation and supports shall comply with applicable provisions of ANSI/TIA-569-C and NFPA 70.

END OF SECTION

CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes boxes and conduits related to the installation of telecommunications cable supporting voice, data, and video (A/V and Video Surveillance) systems.

1.2 RELATED DOCUMENTS

- A. Related Sections
 - 1. Section 26 0533 - Raceways and Boxes for Electrical Systems
 - 2. Section 27 0528.29 - Hangers and Supports for Communications Systems
 - 3. Section 27 0528.36 - Cable Trays for Communications Systems
 - 4. Section 27 0528.39 - Surface Raceways for Communications Systems
- B. Other References

1.3

- 1. ANSI/TIA-569-C - Commercial Building Standard for Telecommunications Pathways and Spaces
- 2. ANSI/TIA-607-B – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

1.4 DESCRIPTION

- A. Provide raceway systems for the installation of the telecommunications cables.
- B. This Section shall include all raceways, outlet boxes; plaster rings and all appurtenances required for the conduits and raceways.
- C. Size conduits and raceways as indicated. Where no size is indicated, conduit will be a minimum of Trade Size 1.

PART 2 - PRODUCTS

2.1 RACEWAYS

- A. Except as noted below and on Drawings, components shall be as per Section 26 0533, Raceways and Boxes
- B. Minimum conduit size for telecommunications outlets shall be Trade Size 1 EMT

2.2 TELECOMMUNICATIONS OUTLET BOXES

- A. Comply with Section 26 0533, Raceways and Boxes
- B. Wall outlets shall be 4" square, 2-³/₄" deep (minimum).

2.2 OUTLET DEVICE RING

- A. Provide ⁵/₈" deep single gang device (mud) ring.

2.3 DEVICE PLATES

- A. Provide as per 27 1543 – Communications Faceplates and Connectors

2.4 PULL STRING

- A. Shall be nylon having not less than 200-pound tensile strength.

PART 3 - EXECUTION

3.1 RACEWAYS

- A. Comply with Section 26 0533, Raceways and Boxes
- B. No length of run shall exceed 100 feet and shall not contain more than two 90-degree bends or the equivalent without a code size pull box. Provide pull boxes where necessary to comply with these requirements. Locate pull boxes in straight runs only, not as a replacement for an elbow.
- C. Conduits with an internal diameter of two inches or less shall have a bend radius at least 6 times the internal conduit diameter. Conduits greater than two inches shall have a bend radius at least 10 times the internal conduit diameter.
- D. Provide an insulated bushing on all conduits terminated in a cabinet and/ or pull boxes.
- E. Terminate conduits stubbed out above accessible ceiling space so that the conduit is parallel with the ceiling and provide an insulating bushing.

3.2 PULL BOXES

- A. Pull boxes shall be sized per the following table:

Conduit Trade	PULL BOX SIZING (inches)			
	Width	Length	Depth	Width increase for additional conduit
1	4	16	3	2
1- ¹ / ₄	6	20	3	3
1- ¹ / ₂	8	27	4	4
2	8	36	4	5
2- ¹ / ₂	10	42	5	6
3	12	48	5	6
3- ¹ / ₂	12	54	6	6
4	15	60	8	8

3.03 PULL STRINGS

- A. Nylon type pull strings shall be included in all raceways over 10 feet long. Leave not less than 12 inches of slack at each end of the pull string.

END OF SECTION

CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to completely execute a complete wire basket cable tray system as described in this specification and as shown on the Drawings.
- B. Wire basket cable tray systems are defined to include, but are not limited to straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports and accessories.
- C. Material listed in this section is for use non-telecommunications room spaces. See section 27 1123 for cable tray in telecommunications room spaces.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM) International:
 1. ASTM A1011 / A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
 2. ASTM A123 / A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 3. ASTM A510 - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
 4. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
 5. ASTM A580 – Standard Specification for Stainless Steel Wire
 6. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 7. ASTM A641 / A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 8. ASTM A653 / A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 9. ASTM D769 - Standard Specification for Black Synthetic Iron Oxide
- B. National Electrical Manufacturers Association:
 1. NEMA FG 1 - Fiberglass Cable Tray Systems.
 2. NEMA VE 1 - Metal Cable Tray Systems.
 3. NEMA VE 2 - Cable Tray Installation Guidelines.
- C. NFPA 70: National Electrical Code (2008)
- D. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
- E. ANSI/TIA-569-C – Commercial Building Standard for Telecommunications Pathways and Spaces

1.3 DRAWINGS

- A. The Drawings, which constitute a part of these specifications, indicate the general route of the wire basket cable tray systems. Data presented on Drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

- B. Specifications and Drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Contractor is directed to make field surveys as part of his work prior to submitting system layout drawings.

1.4 QUALITY ASSURANCE

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the owner or owner's representative.
- B. Supply all equipment and accessories new and free from defects.
- C. Supply all equipment and accessories in compliance with the applicable standards listed in Part 1.02 of this section and with all applicable national, state and local codes.
- D. All items of a given type shall be the products of the same manufacturer.
- E. Zinc plated wire basket cable tray shall be classified by Underwriters Laboratories (UL).
- F. Wire basket cable tray shall be of uniform quality and appearance.
- G. Comply with the National Electrical Code (*NEC*[®]), as applicable, relating to construction and installation of cable tray and cable channel systems (Article 392, *NEC*[®]).
- H. Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.

1.5 SUBMITTALS

- A. Submittal Drawings: Submit drawings of wire basket cable tray and accessories including connector assemblies, clamp assemblies, brackets, splice plates, splice bars, grounding clamps and hold-down plates showing accurately scaled components. Indicate wire basket cable tray dimensions, support points, and finishes.
- B. Product Data: Submit manufacturer's data on wire basket cable tray system including, but not limited to, types, materials, finishes and inside depths.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under references. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.7 PRE-INSTALLATION MEETINGS

- A. Convene a minimum of two week(s) prior to commencing work of this section. Meeting shall include General Contractor and all sub-contractors involved with the installation of duct work, plumbing or other such fixtures that will be placed in shared space above the dropped ceiling.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Ship and store wire basket cable tray system equipment in its original packages and in a clean, dry space to prevent damaging from weather, construction traffic or foreign matter. All handling performed in accordance with manufacturer's recommendations. Provide protective coverings during construction.
- B. Deliver wire basket cable tray systems and components carefully to avoid breakage, bending and scoring finishes. Do not install damaged equipment.
- C. Replace at no expense to Owner, equipment or material damaged during storage or installation as directed by the Architect.

PART - PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS**

- A. Coordinate selected product with Section 26 0536.
- B. Subject to compliance with these specifications, wire basket cable tray systems to be installed shall be as manufactured by the following:
 - 1. Cablofil® - Legrand, 60 Woodlawn Street .West Hartford, CT 06110
 - 2. Chatsworth Products Incorporated, Chatsworth California
 - 3. Approved equivalent

2.2 WIRE BASKET CABLE TRAY SECTIONS AND COMPONENTS

- A. Provide wire basket cable tray of types and sizes indicated with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the additional construction highlighted in Section 2.02.
- B. All straight section longitudinal wires shall be constructed with a continuous top wire safety edge. Safety edge must be kinked and T-welded on all tray sizes.
- C. Wire basket cable tray shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All mesh sections must have at least one bottom longitudinal wire along entire length of straight section.
- D. Wire basket cable tray sizes shall conform to the following nominal criteria:
 - 1. Straight sections shall be furnished in standard 118.3 inch lengths.
 - 2. Wire diameter shall be 0.196" (5mm) minimum on all mesh sections (minimum size of 4.5mm on stainless steel).
 - 3. Wire basket cable tray shall have a 4 inch usable loading depth by 12 or 18 inches wide as called out on Drawings.
- E. In order for a system to be approved as an equipment ground conductor (EGC), all splicing assemblies shall be UL® Classified or CSA approved as an EGC. When using powder coated wire mesh cable tray as an EGC, the paint must be completely removed at all contact points of splice/ground bolt attachments.
- F. Material and Finishes: Material and finish specifications for are as follows.
 - 1. Non-exposed cable tray shall be bright zinc plated, as manufactured.
 - 2. In exposed areas the cable tray shall be white powder coat. Straight sections shall be powder coated with an average paint thickness of 1.2mils (30microns) to 3.0mils (75microns).
- G. All fittings shall be field formed from straight sections in accordance with manufacturer's instructions. Where exposed, white touch-up matching powder coat shall be applied to conceal bright edges.
- H. Wire basket cable tray supports shall be center support hangers, trapeze hangers or wall brackets from the manufacture of the tray.
- I. Trapeze hangers or center support hangers shall be supported by ¼" inch or ⅜" inch diameter rods.
- J. Special accessories shall be furnished as required to protect, support and install a wire basket cable tray system.

PART - EXECUTION

3.1 INSTALLATION

- A. Install wire basket cable tray in accordance with NEMA VE 2 to ensure that the cable tray equipment complies with the requirements of the *NEC*[®], applicable portions of NFPA 70B, and the National Electrical Contractors Association's (NECA) 'Guide to Quality Electrical Installations' pertaining to general electrical installations practices.
- B. All trays should be supported using a minimum of 1/4" All Threaded Rod (ATR).
- C. Special accessories shall be furnished as required to protect, support and install a wire basket cable tray system.
- D. Coordinate wire basket cable tray with other electrical work as necessary to properly interface installation of wire basket cable tray with other work.
- E. Support trays and fasten to structure. Install supports at each connection point, at end of each run, and at other points to maintain spacing between supports of 5 feet maximum.
- F. Install firestopping in accordance with local and NFPA regulations to sustain ratings when passing wire basket cable tray through fire-rated elements.
- G. Ground and bond metal cable tray in accordance with NFPA 70, National Electrical Code Article 392: Cable Trays. Additionally;
 - 1. Bond cable tray system to a known source of building ground.
 - 2. Provide continuity between wire basket cable tray components. Powder coating must be thoroughly removed at grounding device connection point.
 - 3. Make connections to tray using mechanical, compression or exothermic connectors.
 - 4. If required, ground cable trays by mounting up to two #6 AWG bare copper wires to each wire basket cable tray section, bonded with a grounding clamp
- H. Provide sufficient space encompassing wire basket cable tray to permit access for installing and maintaining cables.

3.2 TESTING

- A. Test wire basket cable tray support systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. See NFPA 70B, Chapter 20, for testing and test methods.
- B. Manufacturer shall provide test reports witnessed by an independent testing laboratory of the "worst case" loading conditions outlined in this specification and performed in accordance with the latest revision of NEMA VE-1.

END OF SECTION

SURFACE RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL REQUIREMENT

1.1 SECTION INCLUDES

- A. Surface mounted raceway (SMR).

1.2 RELATED SECTIONS

- A. Section 26 0533 - Raceways and Boxes for Electrical Systems
- B. Section 27 0528 – Pathways for Communications Systems
- C. Section 27 0528.29 - Hangers and Supports for Communications Systems
- D. Section 27 0528.33 - Conduits and Backboxes for Communications Systems
- E. Section 27 0528.36 - Cable Trays for Communications Systems

1.3 SUBMITTALS

- A. Submit under provisions of Section 27 0513
- B. Samples: If other than specified product is bid, Contractor must submit a 24-inch length of proposed product. Show finished detail with boxes, faceplate, connectors, angles and transitions.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms regularly engaged in manufacturer of raceway systems, boxes and fittings of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years. Provide fittings and boxes produced by a manufacturer listed in this section.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver raceways and distribution systems in factory labeled packages.
- B. Store and handle in strict compliance with manufacturer's written instructions and recommendations
- C. Protect from damage due to weather, excessive temperature, and construction operations.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Provide surface mount raceway distribution components as manufactured by Panduit (TG70 Series), or approved alternate.
- B. Panduit LD series is approved for runs of six or fewer cables

2.2 SURFACE MOUNTED RACEWAYS AND FITTINGS

- A. General:
 - 1. System: Surface raceway systems shall consist of bases, covers, appropriate fittings, mounting brackets, workstation boxes / enclosures and device mounting brackets and fasteners necessary for a complete installation.
 - 2. Surface mounted raceways shall be a rectangular design with removable covers or solid construction, constructed of shatter-proof thermoplastic (or similar) raceway, utilizing elbows, couplings, and connectors of the same material.
 - 3. Mounting Brackets: Surface mounted raceway shall be secured to wall using properly rated anchors or mounting brackets. Brackets shall provide un-obscured inspection of fastening bolts at point of wall penetration. In no case whatsoever will surface mounted raceways be attached with drywall screws.

4. Fittings: Fittings shall include flat, internal and external elbows, tees, couplings for joining raceway sections, wire clips, blank end fittings, and device mounting brackets and plates as applicable. Provide full capacity corner elbows and fittings to maintain a controlled 2-inch cable bend radius, meeting the specification for Fiber Optic and UTP cabling and exceeding the ANSI-TIA-569-C requirements for communications pathways.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions under which raceways, boxes, distribution systems, accessories, and fittings are to be installed and substrate that will support raceways. Notify the Owner's Representative in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Strictly comply with manufacturer's installation instructions and recommendations and approved installation practices. Care should be taken to prevent "over tightening" of fastening devices.
- B. The SMR shall be surface mounted on the wall using properly rated anchors or brackets. The top edge of the SMR shall be horizontally level below the suspended ceiling line or the true ceiling line, whichever is lower, shall be installed to permit visually inspection to verify the physical integrity of the raceway for its entire run, shall not block doorways or access to emergency exits, shall not inhibit the operation of windows, and shall not run across windows.
 1. Support: SMR shall be supported by properly rated anchors or mounting brackets at intervals not to exceed 5 feet or in accordance with manufacturer's installation sheets.
 2. Accessories: Provide accessories as required for a complete installation.

3.3 FINAL FINISH

- A. All surfaces are to be left completely smooth and finished. No cut edges are to be exposed. In the event a metallic product is used, all rough edges are to be dressed and covered with appropriate fittings that prevent any access whatsoever with sharp edges.
- B. The Contractor shall coordinate with General Contractor to schedule paint of metallic product to match wall. Non-metallic product shall not be painted.

3.4 CLEANING AND PROTECTION

- A. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.
- B. Protect raceways and boxes until acceptance.

END OF SECTION

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL REQUIREMENT

1.1 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment required for the complete labeling of the telecommunications infrastructure.

1.2 SCOPE

- A. This section includes all telecommunications cables and the associated infrastructure in the telecommunications rooms.

1.3 QUALITY ASSURANCE

- A. All cable identification tags and labels shall be installed in a neat and workmanlike manner.

PART 2 - PRODUCTS

2.1 LABEL TAGS – CABLE AND FACEPLATES

- A. The labels shall be machine generated.
- B. The label background shall be white with either black or blue ink.
- C. Lettering on sleeves shall be 1/8 inch high

2.2 ENGRAVED SIGNAGE

- A. Engraved signage shall be laminate (color as specified) with engraved white letters.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordination
 - Before beginning any work, coordinate labeling protocol with owner
- B. General
 - 1. All horizontal (station) cables and outlets in which they terminate shall be identified by the Contractor at both ends of the wiring run. The standard nomenclature for the labeling is Classroom Number.Telecommunications Room Number, hereafter known as TR, at the top of the plate and the patch panel number and port number below or beside the jack insert.
 - 2. All tie cables shall be labeled at each end. The standard nomenclature for labeling is "From <Room-1> to <Room-2>", where "Room-1" is the originating location and "Room-2" is the destination.
- C. Horizontal (Station) Cables
 - 1. All cables will be labeled the same at both ends. The tag shall be secured to the sheath no more than 4 inches from the end of the cable. Each end of the UTP horizontal cables shall be labeled with the nomenclature "CN.P.NN". Where CN indicates the Classroom Number, P indicates the relative position within the room, and NN indicates the port number.
 - 2. Relative position identification shall commence to the immediate left of the entrance door with the position identifier starting at "A" and increasing through the alphabet in a clockwise direction.
 - 3. Port numbers shall be "1" – "x", where x is the total number of ports on a plate.
- D. Copper Tie Cables
 - 1. Cables shall be labeled "From" – "To", specifically:
From ER to TR-x, where "x" = TR Number

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS 27 0553

- E. Fiber Tie Cables
 - 1. Cables shall be labeled "From" – "To", specifically:
From ER to TR-x, where "x" = TR Number
- F. Telecommunication Outlets (TO)
 - 1. Each TO shall be labeled at the top of the modular jack enclosure with the "CN.TR" nomenclature and the jacks with the patch panel and port number
- G. beside or below.
 - Telecommunications Racks and Frames
 - 1. Labeling in the Main Equipment Room and Telecommunications Rooms shall be as per the Drawings. Labels shall be 1" blue laminate with ½ inch white letters. Labels shall be placed left-to-right identifying "FRAME-1" through "FRAME-x", where "x" = number of racks/cabinets present.
 - Patch Panels
- H.
 - 1. Patch panels shall be labeled identical to the cables and telecommunications outlets.
- I. Door Signage
 - 1. The exterior door of the Main Equipment Room (ER) and Telecommunications Rooms (TRs) shall have signage as per the drawings.

END OF SECTION

COMMISSIONING OF COMMUNICATIONS

PART 1 - GENERAL REQUIREMENT

1.1 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.2 TESTING, IDENTIFICATION AND ADMINISTRATION

- A. All cables and termination points will be tested and labeled per specifications.
- B. Testing is required for this project for all copper telecommunications cables. Fiber optic testing will be as detailed below.
- C. All test results shall be forwarded to the Owner's Representative for certification. Any results observed to be outside stated performance parameters shall be used by the Contractor for immediate correction.

1.3 POST INSTALLATION SERVICES

- A. The Contractor shall provide on-site service as part of the warranty in the event of the failure of any installed components.
- B. The contractor will provide support and warranty for installed cabling.
 - 1. The Contractor will be the first contact point and will interface between manufacture and Owner for warranty issues.
 - 2. The Contractor will provide the owner with contact information of the manufacture for warranty coverage prior to cable acceptance.

1.4 QUALITY ASSURANCE

- A. See Section 27 0513

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. The Contractor shall provide all tools and instruments used to test the installed telecommunications signal cabling.
- B. Test instruments used by the Contractor shall be suitable for the purpose at hand, and shall be of industry-recognized manufacture. Note that copper testing parameters are written for Fluke DTX-1800 or newer tester.
- C. Tools leased by the Contractor are acceptable, provided the operator of the test instrument(s) has a sufficient degree of operational awareness to use the rented instrument(s) correctly and obtain test data that is both, accurate and relevant.

2.2 WARRANTY

- A. All telecommunications cable installed as part of a manufacturer's certified system shall carry the manufacturer's warranty for a minimum of 20 years.
- B. The manufacturer shall provide certification attesting to on-site service as part of the warranty in the event of the failure of any installed balanced twisted pair cables, fiber-optic cables, telecommunications room terminations, telecommunications outlet terminations, or cross-connect cables.
- C. Such service shall be free of charge to the Owner and shall commence from the date of project acceptance and terminate not earlier than the twenty year anniversary of that date as a minimum.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS - COPPER

- A. The basic link shall be tested.
- B. All test results observed shall be used by the Contractor to determine any polarity and noise anomalies for immediate correction.
- C. Test results shall be used jointly by the Contractor and the Owner's Representative to determine the viability of each cable for transmission in accordance with the specifications of the cable manufacturer, and the requirements imposed by the transmission system. This shall form part of the acceptance procedure for the cable plant.
- D. All results obtained by use of pair-scanner testing shall be collated by TO number and presented to the Owner's Representative at the conclusion of the testing. Test compilation shall be initialed and dated by the Contractor's technician performing the test.
- E. Hard copy output indicating successful testing of every location is not required; rather a diskette containing test data and the appropriate application to display such in a Windows base environment is preferred.

3.2 GENERAL TESTING PARAMETERS - COPPER

- A. Categories of balanced twisted pair cable:
 - 1. Unless otherwise designated, all station cable shall be category 6.
 - 2. If so noted on drawings, selected cables shall be category 6.
- B. Balanced twisted pair testing shall provide certification and summary for all locations.
- C. All "category" cable paths shall be tested at each jack for the following parameters and meet the requirements imposed by the ANSI/TIA-568-C.2 and the manufacture's written specification.

Category
Wire Map
Cable Length
Pair-to-pair NEXT
Power Sum NEXT
Attenuation
Pair-to-Pair ELFEXT
Power Sum ELFEXT
Return Loss
Propagation Delay
Delay Skew

3.3 PERFORMANCE TEST PARAMETERS FOR BALANCED TWISTED PAIR

A. Wire Map

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

The field tester shall be capable of measuring length of all pairs of a basic link or channel based on the propagation delay measurement and the average value for Nominal Velocity of Propagation (NVP)¹ 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 feet) plus 10% to allow for the variation and uncertainty of NVP.

C. Insertion Loss (Attenuation)

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 250MHz for category 6 and 1 through 500 MHz for category 6A in maximum step size of 1 MHz. It is preferred to measure insertion loss 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 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 1 through 250MHz for category 6 and 1 through 500 MHz for category 6A. 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 standard as shown in Table 1. . Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin² **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 should include the frequency at which it occurs as well as the test limit value at this frequency.

¹ Nominal Velocity of Propagation (NVP) expresses the speed of the electrical signals along the cabling link in relation to the speed of light in vacuum (3×10^8 m/second). Insulation characteristics and twist rate of the wire pair influence NVP in minor ways. Typically, an ‘average’ value for NVP is published for all four wire-pairs in a data cable.

² ‘Margin’ designates the difference between the measured value and the corresponding test limit value. For passing links, ‘worst case margin’ identifies the **smallest** margin over the entire frequency range; the point at which the measured performance is “closest” to the test limit.

Frequency Range (MHz)	Maximum Step Size (MHz)
1 - 31.25	0.15
31.26 – 100	0.25
100 – 250	0.50
250 - 500	1.00

Table 1 -- Maximum frequency step size as defined in ANSI/TIA-1152

E. PS NEXT Loss

Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link under-test (a total of eight results). PS NEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when all other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 through 250MHz for category 6 and 1 through 500 MHz for category 6A and the step size may not exceed the maximum step size defined in the standard as shown in Table 1. 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 PS NEXT. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

F. ACR-F, pair-to-pair

Attenuation Crosstalk Ratio Far-end is calculated from the pair-to-pair FEXT Loss. It shall be measured for each wire-pair combination from both ends of the link under-test. FEXT Loss measures the 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 ACR-F Loss that must be evaluated and reported in the test results. ACR-F 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. ACR-F is to be measured from 1 through 250MHz for category 6 and 1 through 500 MHz for category 6A and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the standard as in Table 1. 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-F. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

G. PS ACR-F Loss

Power Sum Attenuation Crosstalk Ratio Far-end is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields eight wire-pair combinations. Each wire-pair is evaluated from 1 through 500 MHz in frequency increments that do not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results):

Identify the wire pair that exhibits the worst pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

H. Return Loss

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 250 MHz for category 6 and 1 through 500 MHz for category 6A in frequency increments that do not exceed the maximum step size defined in the standard as shown in Table 1. 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 should include the frequency at which it occurs as well as the test limit value at this frequency.

I. Propagation Delay

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 the ANSI/TIA-568-C.2; Section 6.2.19)

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.

K. PS ANEXT

Pair-to-pair Alien NEXT (ANEXT) contributions is measured by applying the stimulus signal at the near end to one wire pair of a disturbing link and measuring the coupled signal at the near end of a wire pair in a disturbed link. This process is repeated for every wire pair in a disturbing link. The PS ANEXT for each wire pair in a disturbed link is obtained by the power sum addition of all the pair-to-pair ANEXT results to that wire pair from all wire pairs in disturbing links. All the links that are bundles with the disturbed link need to be included as disturbing links. In addition, links that are terminated in adjacent positions in a patch panel or interconnect panel should also be included as disturbing links in this test.

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 PS ANEXT. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

L. PS AACR-F

The pair-to-pair Alien Far End crosstalk (AFEXT) contributions is measured by applying the signal at the near end to one wire pair of a disturbing channel or permanent link and measuring the coupled signal at the far end of a wire pair in a disturbed channel or permanent link. This process is repeated for every wire pair in a disturbing link and for all links in close proximity. A normalization, which is dependent on the relative length of disturbing and disturbed link, is applied to each pair-to-pair alien FEXT measurement. Then the PS Alien Attenuation-to-Crosstalk Ratio from the Far end (PS AACR-F) for each wire pair in a disturbed channel or permanent link is obtained by the power sum addition of all the normalized pair-to-pair far end alien crosstalk results to that wire pair from all wire pairs in disturbing links in close proximity.

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 PS AACR-F. If the link or channel connects two patch panels (data center), these wire pairs must be identified for the tests performed from both ends. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

3.4 TEST RESULT DOCUMENTATION

- A. The test results/measurements 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.
- B. The database for the completed job shall be stored and delivered on magnetic media including the software tools required to view, inspect, and print any selection of test reports.

- C. Test results shall be provided that lists all the links that have been tested with the following summary information
1. The identification of the link in accordance with the naming convention defined in the overall system documentation
 2. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number
 3. The date and time the test results were saved in the memory of the tester.
- D. General Information to be provided in the electronic data base with the test results information for each link:
1. The identification of the customer site as specified by the end-user
 2. The identification of the link in accordance with the naming convention defined in the overall system documentation
 3. The overall Pass/Fail evaluation of the link-under-test
 4. The name of the standard selected to execute the stored test results
 5. The cable type and the value of NVP used for length calculations
 6. The date and time the test results were saved in the memory of the tester
 7. The brand name, model and serial number of the tester
 8. The identification of the tester interface
 9. The revision of the tester software and the revision of the test standards database in the tester
 10. The test results information must contain information on each of the required test parameters that are listed in Section 3.04 and as further detailed below under paragraph E & F.
- E. In-link (In-Channel) detailed test results. The detailed test results data to be provided in the electronic database for must contain the following information:
- For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. The PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
- **Length:** Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m and the test limit value
 - **Propagation delay:** Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value
 - **Delay Skew:** Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value
 - **Insertion Loss (Attenuation):** Minimum test results documentation as explained in Section B for the worst pair
 - **Return Loss:** Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link
 - **NEXT, ACR-F:** Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link
 - **PS NEXT and PS ACR-F:** Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link

F. Between-Link (Between-Channel) Test Results Data

A test report shall be provided for each disturbed link included in the Alien Crosstalk sample test. This test report must contain

1. PS ANEXT results at each frequency (See Table 1 above) for each wire pair in a victim link as well as the PS ANEXT results for the average of these four wire pairs. The worst case margin and the worst values shall be provided for each wire pair and the average of the four wire pairs. PS ANEXT shall be measured and tested from the end of the link or channel where all cables are terminated at a distribution panel. In case the cabling runs from panel to panel (data center) where the worst case PS ANEXT margin is less than 2 dB, the PS ANEXT test results for each disturbed link shall be collected and saved from both ends (both panels) of the disturbed link.
2. PS AACR-F results at each frequency tested (See Table 1) for each wire pair in a disturbed link as well as the PS AACR-F results for the average of the four wire pairs. The worst case margin and the worst values shall be provided for each wire pair and the average of the four wire pairs. PS AACR-F only needs to be measured and tested from one end of the link or channel. Connect the main DTX-1800 unit (measurement of PS AACR-F disturbance) to the disturbed link or channel at the end where all cabling links are terminated at a distribution panel. Select End 1 in the AxTalk Analyzer Software.

3.5 GENERAL TESTING REQUIREMENTS – FIBER OPTIC BACKBONE CABLES

- A. Test reference cords (TRC) shall be used when testing all fiber. Loss for TRCs shall be:
 1. ≤ 0.1 dB for multimode
 2. ≤ 0.2 dB for multimode
- B. All fiber cable paths shall be tested utilizing a power meter to determine the following:
 1. Loss at 850 and 1310 nanometers (multimode) and 1550 nanometers (single mode)
 2. Cable length
- C. Single mode fiber shall be tested in accordance with ANSI/TIA-568-C Method A.1
- D. Test shall be conducted end-to-end, including connectors.
- E. Contractor shall provide results from power meter testing of fiber optic cable to attest to proper polarity and end-to-end performance of the installed fiber.
- F. Contractor shall provide for the Owner's Representative as part of the as-built documentation all factory test results shipped with the fiber.

END OF SECTION

COMMUNICATIONS TERMINAL BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.1 GENERAL

- A. Drawings and general provision of the Contract, including General and other Conditions and other Division 1 – General Requirements sections, apply to the work specified in this section

1.2 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment, including all support structure whether called out for or not, required for the complete installation of work called for in the Contract Documents
- B. Install utility supply and special circuit's cables, riser blocks, patch panels, and all support structure in the Equipment and Telecommunication Rooms as outlined on drawings and specifications.

1.3 SECTION INCLUDES

- A. This Section addresses the termination of copper backbone and station cables which are to be placed between the Main Equipment Room (ER) and the Telecommunications Rooms (TRs) located throughout the building. Included is all equipment and materials required to allow the Telecommunications Rooms to support all associated serving zones and connect it to the main Equipment Room backbone.

1.4 QUALITY ASSURANCE

- A. All equipment shall be installed in a neat and workmanlike manner.
- B. All materials shall be installed per standard installation practices and manufacturer's specifications.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All products must be new and UL Listed for their use.

2.2 PUNCHDOWN BLOCKS

- A. 100 pair 110 type punch down blocks with legs.
- B. 5 pair connecting clips

2.3 PATCH PANELS

- A. 8-pin modular Category 5e 24 or 48 port for access control applications.
- B. 8-pin modular Category 6 (Copper Risers) 24 or 48 port for voice and utility applications.
- C. 8-pin modular Category 6A (Station Cables) 24 or 48 port for data cabling.

PART 3 - EXECUTION

3.1 GENERAL

- A. All 110 blocks shall be installed as per the detail provided on the Drawings.
- B. All patch panels supporting the copper backbone cabling shall be installed in 7' x 19" equipment racks in the ER and TRs.

3.2 INSTALLATION

- A. 110 blocks shall be labeled as per criteria provided on Drawings and Section 27 0553
- B. A one RMU horizontal wire management panel shall be installed at the top of each rack used for copper backbone cables. Additional horizontal wire management shall be installed at a rate of one RMU per each 24 port panel installed.

3.3 PATCH PANELS

- A. Patch Panels shall be installed in equipment racks.
- B. Patch panels shall be installed per manufacturer's instruction and as indicated in drawings and specifications.

END OF SECTION 27 1119

COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents
- B. Install ladder racks, cable trays, and all support structure in the Equipment and Telecommunication Rooms as outlined on drawings and specifications.
- C. Equipment installed shall include:
 - 1. ladder trays,
 - 2. vertical cable management,
 - 3. brackets and support pieces, and
 - 4. All related materials required to provide cable management and transition pathways within the Equipment and Telecommunications Rooms of this project.
- D. Material listed in this section is for use within the telecommunications rooms. See section 27 0528.36 for cable tray in non-telecommunications room spaces.

1.2 RELATED SECTIONS

- A. Section 27 1100 – Communications Equipment Room Fittings
- B. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures

1.3 QUALITY ASSURANCE

- A. All equipment shall be installed in a neat and workmanlike manner.

1.4 SEISMIC CONSIDERATIONS

- A. All equipment must meet or exceed the requirements of Seismic Zone 3 and satisfy the AHJ for suitable components.
- B. Contractor shall submit stamped shop drawings as deferred submittals to AHJ.
- C. Contractor shall provide evidence of submittals and satisfactory compliance from AHJ.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Chatsworth Products Incorporated (CPI) are the only approved products for this Section.
- B. Attachment hardware not supplied in kits from manufacturer shall be Grade 5 or greater.

2.2 CHANNEL RACK-TO-RUNWAY

- A. Use a Channel Rack-to-Runway Mounting Plate Kit to securely attach 12" wide cable tray to equipment rack. A kit from Chatsworth includes all necessary bolts, washers, and nuts to make the attachments. CPI Part 12730-712

2.3 HORIZONTAL WIRE MANAGEMENT

- A. Horizontal cabling managers shall be used to organize and contain patch cord runs from patch port to vertical cable wire management. Manufacturer to be same as structured cabling system.
- B. Double (3.5') RMU units only are acceptable and are to be supplied at the rate of 1 RMU per each 24 ports of patch panel.

2.4 CABLE TRAYS WITHIN TELECOM ROOMS

- A. The telecommunications cable tray shall be 12" wide universal cable runway. CPI 10250-712
- B. End caps, CPI Part Number 10642-001 as required
- C. Cable runway radius drop, CPI 12100-712
- D. Butt splices, as required, will be accomplished using CPI 11299-701
- E. Ninety degree junctions will be accomplished using CPI 11298-701
- F. Wall Angle Support Kit shall be 12" wide for attaching cable tray perpendicular to the wall. CPI 11421-712
- G. Grounding straps shall be CPI 40164-001 (available in lots of 25 each as CPI 40164-025)

2.5 VERTICAL WIRE MANAGEMENT

- A. Two post racks shall be equipped with a double sided 7 foot vertical cable manager on each side of the rack. Chatsworth part number 11729-709.
- B. Four-post racks shall have single sided 7 foot vertical cable managers as shown on drawings, Chatsworth part number 11730-703.

2.6 EQUIPMENT SHELF

- A. Provide one equipment shelf for each rack (two and four post). Chatsworth part number 40074-700

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment Racks
 - 1. Equipment racks shall be equipped with a mounting plate suitable for securing a 12-inch width cable tray from the rack to the backboard.
 - 2. A two RMU horizontal wire management panel shall be installed at the top of the rack. Additional horizontal wire management shall be installed as described above.
 - 3. Bolts used to attach the rack to the floor shall be stainless steel or zinc coated steel. Fasteners shall be Grade 5 or higher
- B. Cable Tray
 - 1. The cable tray shall be installed as per Drawings to support cable runs from equipment rack to wall connections.
 - 2. Appropriate vertical wall brackets, support brackets, and splice kits are to be used when securing the runway.
- C. All racks and associated components shall be grounded in accordance with ANSI/TIA-607-B, National Electric Code[®], and the Authority Having Jurisdiction.
- D. This contract is responsible for satisfying all requirements pertaining to seismic compliance. All inspections or engineering associated with seismic compliance shall be included in this contract at no additional cost to the Owner.

END OF SECTION 27 1123

COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL REQUIREMENT

1.1 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.
- B. Install horizontal cable as outlined on drawings and specifications. Also included is sleeves for any ceiling or wall penetrations not provided by the General or Electrical Contractor; fire stopping as directed by the most stringent of these specifications or code; and all support structure needed to install the above components.
- C. Verify actual counts on prints and drop detail.

1.2 SCOPE OF WORK

- A. It is the intent of this section for the Contractor to provide a complete workable cabling system ready for the Owner's use in accordance with the latest current version of ANSI/TIA-568 standards to support high speed data applications up to 10Gbs including IEEE 802.3x system standards.

1.3 QUALITY ASSURANCE

- A. All cable shall be installed in a neat and workmanlike manner.
- B. Strictly adhere to all category 6A installation practices when installing horizontal cabling.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Refer to Section 27 0513 for General Requirements.
- B. The horizontal UTP cabling system shall be a Category 6A warranted link system, including the patch cords, patch panels, cables, and telecommunications outlets.

2.2 COPPER CABLE

- A. The horizontal copper cable supporting all locations except as noted on Drawings, shall be 4-Pair balanced twisted pair rated for category 6. Color to be Green.
- B. Cable called out as category 5e shall be shall be 4-Pair balanced twisted pair. Jacket shall be white in color.
- C. Backbone cable shall be 4-Pair balanced twisted pair rated for category 6. Jacket shall be rated for wet locations and black in color. Refer to Section 27 1313.

PART 3 - EXECUTION

3.1 GENERAL

- A. Cable termination shall be as per Sections 27 1119 and 27 1543.
- B. Cable ties must be finger tight. The cable tie must not distort the outer jacket.
- C. The bend radius shall be no less than 4 times the outside cable jacket diameter for the horizontal UTP cable and 10 times the outside cable jacket diameter for both the fiber and multi-pair copper riser cable.
- D. Only Velcro[®] (hook and loop) type cable wraps shall be used to bundle cables on the back of the equipment racks and in the cable trays located in the Telecommunication and Rooms.

3.2 PREPARATION

A. Conduits

1. All conduits and sleeves shall be inspected for bushings prior to cable installation.
2. Missing bushings shall be brought to the attention of the owner or authorized representative.

3.3 INSTALLATION

A. Copper Horizontal Cables

1. Installation shall be in a manner to meet the specifications as outlined by the cable manufacturer for the product set being installed.
2. Copper horizontal cables shall be pulled from the TR to the workstation.
3. Service loops of
 - a. 10 feet minimum shall be left coiled high as high as possible in the MDF or IDF.
 - b. 10 feet of slack shall be neatly coiled and secured with Velcro® at the telecommunications outlet (typically in the ceiling) used for Wireless Access points
 - c. Placement of service loops subject to verification by Owner.
4. Location and label shall be annotated on the as built drawings.
5. Locations coiled for wireless shall have ½" black on white labels placed below the outlet on the ceiling grid.

END OF SECTION 27 1513