

SECTION 27 00 00

COMMUNICATIONS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Applicable requirements of General Requirements/Provisions shall be considered a part of this section and shall have the same force as if printed herein full. In addition, all information related to communications infrastructure that is documented in the architectural, structural, mechanical, and electrical drawings/documents shall be included as part of the Communications documents.

1.02 QUALITY ASSURANCE

- A. Specifications, Standards and Codes: All work shall be in accordance with the following:
 - 1. The 2015 edition of the National Electrical Code (NFPA 70)
 - 2. American National Standards Institute (ANSI)
 - 3. National Electrical Manufacturers Association (NEMA)
 - 4. Telecommunications Industries Association (TIA)
 - 5. Electronic Industries Association (EIA)
 - 6. Institute of Electrical & Electronics Engineers (IEEE)
 - 7. Underwriters Laboratories (UL)
 - 8. American Standards Association (ASA)
 - 9. Federal Communications Commission (FCC)
 - 10. Occupational Safety and Health Administration (OSHA)
 - 11. American Society of Testing Material (ASTM)
 - 12. Americans with Disabilities Act (ADA)
 - 13. Local city and county ordinances governing electrical work
 - 14. In the event of conflicts, the more stringent provisions shall apply.

1.03 SCOPE

- A. The work to be done under this section of the Specifications shall include furnishing labor, material, equipment and tools required for the complete installation of the work indicated on the Drawings or as specified herein.
- B. All materials, obviously a part of the Communications Infrastructure and necessary to its proper operation, but not specifically mentioned or shown on the Drawings, shall be furnished and installed without additional charge.

- C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the engineer shall be notified of the discrepancy.

1.04 WORK INCLUDED

The Communications Infrastructure installed and work performed under this Division of the Specifications shall include but not necessarily be limited to the following:

- A. Voice/Data/Video Cabling Infrastructure
- B. Overhead Paging System and Intercom
- C. Communications conduits, raceways, cable tray, racks, cabinets and equipment mounting boards
- D. Grounding and Bonding
- E. Underground raceway excavation, backfill, and compaction
- F. Concrete work for duct banks, maintenance holes, handholes, vaults and restoration (where applicable)

1.05 DEFINITIONS

- A. Terms: The following definitions of terms supplement those of the General Requirements and are applicable to Division 27 - Communications:
- B. Provide: As used herein shall mean “furnish, install and test (if applicable) complete.”
- C. Infrastructure: As used herein shall mean cable, conduit, raceway, cable tray or j-hooks with all required boxes, fittings, connectors, and accessories; completely installed.
- D. Work: As used herein shall be understood to mean the materials completely installed, including the labor involved.
- E. Owner: _____
- F. Project Manager: _____
- G. Architect: _____
- H. Engineer: _____

1.06 DRAWINGS

- A. Drawings are generally diagrammatic and show the arrangement and location of pathways, outlets, support structures and equipment. The Contractor shall carefully investigate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to make adjustments to pathways or materials, the Contractor shall so advise the Engineer and secure approval before proceeding with such work.
- B. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Contractor shall request shop drawings, equipment location drawings, foundation drawings, and any other data required by him to locate the concealed conduit before the floor slab is poured.
- C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.
- D. The right is reserved to make reasonable changes in locations of equipment indicated on Drawings prior to rough-in without increase in contract cost.
- E. The Contractor shall not reduce the size or number of conduit runs indicated on the Drawings without the written approval of the Engineer.
- F. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.
- G. The location of equipment, support structures, outlets, and similar devices shown on the Drawings are approximate only. Do not scale Drawings. Obtain layout dimensions for equipment from Architectural plans unless indicated on Communications plans.
- H. Schematic diagrams shown on the Drawings indicate the required functions only. The technology of a particular manufacturer may be used to accomplish the functions indicated without exact adherence to the schematic Drawings shown. Additional labor and materials required for such deviations shall be furnished at the Contractor's expense.
- I. Verify the ceiling type, ceiling suspension systems, and clearance above hung ceilings prior to ordering cabling and associated hardware. Notify the Engineer of any discrepancies.
- J. Review all architectural drawings for modular furniture.

- K. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Omissions of words or phrases such as “the Contractor shall,” “shall be,” “as indicated on the Drawings,” “In accordance with,” “a,” “the” and “all are intended” shall be supplied by inference.

1.07 SUBMITTALS

- A. Submit for approval, details of all materials, equipment and systems to be furnished. Work shall not proceed without the Owner and/or the Project Manager's approval of the submitted items. Three (3) copies of the following shall be submitted:
 - 1. Submittals for individual systems and equipment assemblies that consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered, reviewed or stored, and such submittals will not be returned except at the request and expense of the Contractor.
 - 2. Contractor shall generate shop drawings. Modify reviewed and accepted shop drawings to include revisions based upon completion of work. Submit shop drawings with record drawings on hard copy.
 - 3. Shop drawings shall include equipment racks, patch panels, termination blocks, connection details, rack mounting details and any other details not included in the construction drawings.
- B. Any materials and equipment listed that are not in accordance with Specification requirements may be rejected.
- C. The approval of material, equipment, systems and shop drawings is a general approval subject to the Drawings, Specifications and verification of all measurements at the job. Approval does not relieve the Contractor from the responsibility of shop drawing errors. The Contractor shall carefully check and correct all shop drawings prior to submission for approval.

1.08 QUALITY ASSURANCE

- A. Equipment and materials required for installation under these Specifications shall be the current model and new (less than one [1] year from the date of manufacture), unused and without blemish or defect.
- B. Equipment shall bear labels attesting to Underwriters Laboratories, where subject to label service. Manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacture of said equipment a minimum of three (3) years and, if so directed by the Owner, be able to furnish proof of their ability by submitting affidavits and descriptive data about their product including size and magnitude comparable to requirements specified herein.

1.09 APPROVED CONTRACTORS

- A. The Contractor shall be approved by the School Board of Sarasota County Information Technology Department.

1.10 CONTRACTOR QUALIFICATIONS

- A. The Contractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications. The Contractor shall be a company specializing in the design, fabrication and installation of integrated communications systems.
- B. Communications Systems specified shall be installed under the direction of a qualified Contractor. Qualification requirements shall include submittal by the Contractor to the Owner of the following:
 - 1. List of previous projects of this scope, size and nature; including names and sizes of projects, description of work, time of completion and names of contact persons for reference.
 - 2. Shall certify that they are manufacturer-authorized for work to be performed.
- C. Contractor must employ at least one (1) full-time Registered Communications Distribution Designer (RCDD). The RCDD shall be a W2 employee and not a subcontractor.

1.11 COORDINATION WITH OTHER TRADES

- A. The Contractor shall coordinate communications work with that of other sections as required to ensure that the entire communications work will be carried out in an orderly, complete and coordinated fashion.

1.12 SITE INVESTIGATION

- A. Prior to submitting bids of the project, visit the site of the work to become aware of existing conditions that may affect the cost of the project. Where work under this project requires extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment or systems, shall be restored to their original condition before the completion of this project.

1.13 PERMITS

- A. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.

1.14 RENOVATIONS AND ADDITIONS

- A. All work that would adversely affect the normal operation of the other portions of the Owner's property shall be done at a time other than normal working hours. Normal working hours shall be considered 7 a.m. to 4 p.m. Monday through Friday.
- B. Prior to submitting bids on the project, visit the site of the work to become aware of existing conditions that may affect the cost of the project.
- C. Where work under this project requires extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment or systems shall be restored to their original and operating condition. Remove all equipment indicated to be demolished, including outlets, devices, raceways and support structures.
- D. Care shall be exercised in the removal and storage of equipment indicated to be relocated or removed and reused. Prior to placing back into service, equipment shall be cleaned, and marred or chipped paint surfaces touched-up.
- E. Provide all coring, cutting and patching to existing walls, floors, etc., required for the removal of existing work or the installation of new work.

PART 2 - PRODUCTS

2.01 SUBSTITUTIONS

- A. Product substitutions are not allowed unless noted as, "Or Approved Equal (by the Information Technology Department)." The Engineer's decision as to whether the submitted equipment is acceptable shall be final and binding.
- B. All changes necessary to accommodate the substituted equipment shall be made at the Contractor's expense, and shall be as approved by the Engineer. Detailed drawings indicating the required changes shall be submitted for approval at the time the substitution is requested.
- C. If substitutions are made in lieu of device specified; form, dimension, design and profile shall be submitted to the Engineer for approval.
- D. Submit request for approval of substitute materials in writing to the Owner at least ten days prior to bid opening.

2.02 MATERIALS

- A. All materials used in this work shall be new and shall bear the inspection label of Underwriters' Laboratories Inc. or certification by other recognized laboratory.
- B. The published standards and requirements of the Telecommunications Industries Association (TIA), National Electrical Manufacturers Association (NEMA), the American National Standard Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), and the American Society of Testing Materials (ASTM), are made a part of these Specifications and shall apply wherever applicable.
- C. 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.
- D. 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 or partner manufacturers that offer a certified solution.
- E. Components of an assembled unit need not be products of the same manufacturer, but must offer a certified end-to-end solution.
- F. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
- G. Components shall be compatible with each other and with the total assembly for the intended service.

PART 3 - EXECUTION

3.01 EXAMINATION OF CONDITIONS

- A. Prior to the start of work, the Contractor shall carefully inspect the installed work of other trades and verify that such work is complete to the point where installation may properly commence. Start of work indicates acceptance of conditions.
- B. Install equipment in accordance with applicable codes and regulations, the original design and the referenced standards.
- C. In the event of a discrepancy, immediately notify the Project Manager.
- D. Do not proceed with installation until unsatisfactory conditions and discrepancies have been fully resolved.

3.02 PROTECTION OF SYSTEMS AND EQUIPMENT

- A. 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.
- B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering the sides with securely fastened protective rigid or flexible waterproof coverings.
- C. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum cleaned both inside and outside before testing, operating or painting.
- D. As determined by the Project Manager, 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 Project Manager shall be final.
- E. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with the same quality of paint and workmanship as used by the manufacturer.

3.03 ACCESS TO EQUIPMENT

- A. Equipment shall be installed in location and manner that will allow convenient access for maintenance and inspection.
- B. Working spaces shall be not less than specified in the National Electrical Code (NEC) for voltages specified.
- C. Where the Project Manager determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled, one time only, as directed by the Project Manager, at no additional cost to the Owner. "Conveniently accessible" is defined as being capable of being reached without the use of ladders or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and duct work.

3.04 CLEANING

- A. 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.

- B. Remove dust and debris from interiors and exteriors of electrical equipment. Clean accessible current carrying elements prior to being energized.

3.05 COMPLETION

- A. General: Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.
- B. Results Expected: Systems shall be complete and operational and controls shall be set and calibrated. Testing, start-up and cleaning work shall be complete.
- C. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the Owner.

3.06 TESTING AND VERIFICATION

- A. See specific Division 27 sections for testing parameters of sub-systems.
- B. The Contractor 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 includes examination of items and comparison of pertinent characteristics against the qualitative or quantitative standard set forth in the Specifications. Inspection may require moving or partially disassembling the item to accomplish the verification, included as part of the work at no additional cost to the Owner.
- D. The Contractor shall verify by formal demonstrations or tests that the requirements of this Specification have been met. The Contractor shall demonstrate that the communications systems, components and subsystems meet Specification requirements in the “as-installed” operating environment during the “System Operation Test.” Even though no formal environmental testing is required, the Contractor shall measure and record temperature, humidity and other environmental parameters and the environmental conditions, which were encountered during the “System Operation Test.”
- E. The Contractor shall carefully plan and coordinate the final acceptance tests so that tests can be satisfactorily completed. The Contractor shall provide necessary instruments, labor and materials required for tests, including the equipment manufacturer's technical representative and qualified technicians in sufficient numbers to perform the tests within a reasonable time period.
- F. The Contractor shall satisfy all items detailed in the final acceptance check-off list (punch list). The list shall be a complete representation of specified installation

requirements. At the time of final acceptance punch list items shall be corrected until the system is found to be acceptable to the Owner and the Project Manager.

- G. After the Contractor systems have been installed and tested, the completed test plan shall be signed by the Communications Contractor Project Manager and submitted for approval.

END OF SECTION

SECTION 27 05 10

FIRESTOPPING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.15 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Firestopping for Communications Systems.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.16 SUBMITTALS

- A. Provide product data from manufacturer's specifications.

1.17 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.03 APPROVED PRODUCTS

- A. Approved Firestopping Manufacturer(s)
 - 1. Flamestopper Thru-Wall Fitting - Wiremold Company (Firestop Devices)
 - 2. Unique Firestop Products (Firestop Devices)
 - 3. STI Firestop Products (Firestop Devices, Putties, Caulks, Sealants, etc.)
 - 4. Hilti (Putties, Caulks, Sealants, etc.)
 - 5. Approved Equal by SCSB Information Technology Department

2.04 TYPES OF PRODUCTS

- A. Sealants

1. Intumescent Firestop Sealants and Caulks
2. Latex Firestop Sealant
3. Acrylic Water-Based Sealant
4. Silicone Firestop Sealants and Caulks
5. Firestop Putty
6. Firestop Collars
7. Wrap Strips
8. 2-Part Silicone Firestop Foam
9. Firestop Mortar
10. Firestop Pillows
11. Elastomeric Spray
12. Accessories:
13. Forming/Damming Materials: Mineral fiberboard or other type as per manufacturer recommendation

B. Firestop Devices

1. Thru-Wall Fitting (Flamestopper by Wiremold)
 - a. The firestop device box shall be constructed of 16 gage G90 steel.
 - b. The firestop device intumescent block shall be constructed of a graphite base material with expansion starting at 375°F and an unrestrained expansion between 6 to 12 times. The intumescent block shall be held securely by the box in order to prevent tampering and damage during installation.
 - c. The firestop device shall have doors which can be adjusted to prevent materials from penetrating the device if the device is empty or completely full. The doors shall be constructed of 16 gage G90 steel with No. 10-32 screws use to adjust opening size.
 - d. The firestop device shall be available for 2" and 4" trade size EMT conduit.
 - e. The firestop device shall be available in safety yellow powder coat, custom colors and an unpainted galvanized finish.
2. Threaded Firestop Device (Unique Firestop Products)
 - a. Threaded steel sleeve device incorporating flat washers secured by threaded device shall be installed around cables. The device shall be available in 1, 2 and 4-inch sizes. Maximum diameter of the wall penetration for 1, 2 and 4-inch sizes shall be 1-1/4, 2-7/16 and 4-1/2 inches respectively.
3. Smooth Firestop Device (Unique Firestop Products)
 - a. Smooth steel sleeve device incorporating flat washers secured by sliding compression couplers. The device shall be available in 1, 2 and 4-inch sizes. Maximum diameter of the wall penetration for 1, 2 and 4-inch sizes shall be 1-1/4, 2-7/16 and 4-1/2 inches respectively.
4. Split-Sleeve Firestop Device (Unique Firestop Products)

- a. Threaded steel sleeve halves incorporating split couplings and slotted washers to fit the specific diameter of the opening. The device shall be available in 1, 2 and 4-inch sizes. Maximum diameter of the wall penetration for 1, 2 and 4-inch sizes shall be 1-1/4, 2-7/16 and 4-1/2 inches respectively.
5. Fire Rated Cable Pathway (STI EZ-PATH)
 - a. Fire rated cable pathway device modules shall be comprised of steel raceway with intumescent foam pads allowing 0-100 percent cable fill.

2.05 UL CLASSIFICATION

- A. Thru-Wall Fitting - The firestop device for use in through-penetration firestop systems shall have been examined and tested by Underwriters Laboratories Inc. to UL1479 (ASTM E 814) and bear the U.S. and Canadian UL Classification Mark.
- B. Threaded, Smooth and Split-Sleeve Firestop Devices - Firestopping sealants and devices shall be used together as a firestop system. All firestop systems shall bear a UL Classification system number. UL Classification system numbers are as follows:
 1. Threaded Firestop System
 - a. Block Wall - W-J-3049
 - b. Dry Wall - W-L-3138
 2. Threaded Firestop System (Vertical)
 - a. Slab - F-A-3010
 3. Smooth Firestop System
 - a. Block Wall - W-J-3048
 - b. Dry Wall - W-L-3137
 4. Split-Sleeve Firestop System
 - a. Block Wall - W-J-3047
 - b. Dry Wall - W-L-3136

2.06 FIRESTOPPING SYSTEMS

- A. Thru-Wall Fitting Firestop System:
 1. The device shall be classified for use in one-, two-, three, and four-hour rated gypsum, concrete and block walls and provide a maximum L rating of six cfm. The devices shall also been tested by Underwriters Laboratories Inc. to UL2043 and determined to be suitable for use in air handling spaces.
- B. Threaded, Smooth and Split-Sleeve Firestop Systems:

1. Shall conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests in a configuration that is representative of field conditions.
 2. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. T rating when required by code authority shall be based on measurement of the temperature rise on penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.
 3. For joints, must be tested to UL 2079 with movement capabilities equal to those of the anticipated conditions.
- C. Firestopping materials and systems must be capable of closing or filling through-openings created by 1) the burning or melting of combustible pipes, cable jacketing, or pipe insulation materials, or 2) deflection of sheet metal due to thermal expansion (electrical & mechanical duct work).
- D. Firestopping material shall be asbestos and lead free and shall not incorporate nor require the use of hazardous solvents.
- E. Firestopping sealants must be flexible, allowing for normal pipe movement.
- F. Firestopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surfaces.
- G. Firestopping materials shall be moisture resistant, and may not dissolve in water after curing.

PART 3 - EXECUTION

3.07 CONDITIONS REQUIRING FIRESTOPPING

- A. General
1. Provide firestopping for conditions specified whether or not firestopping is indicated, and if indicated, whether such material is designed as insulation, safing, or otherwise.
- B. Through-Penetrations
1. Firestopping shall be installed in all open penetrations and in the annular space in all penetrations in any bearing or non-bearing fire-rated barrier.
- C. Membrane-Penetrations

1. Where required by code, all membrane-penetrations in rated walls shall be protected with firestopping products that meet the requirements of third party time/temperature testing.

D. Construction Joints/Gaps

1. Firestopping shall be provided between the edges of floor slabs and exterior walls, between the tops of walls and the underside of floors, in the control joint in masonry walls and floors and in expansion joints.

E. Smoke-Stopping

1. As required by the other sections, smoke-stops shall be provided for through-penetrations, membrane-penetrations, and construction gaps with a material approved and tested for such application.

3.08 EXAMINATION

- A. Examine the areas and conditions where firestops are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Verify that environmental conditions are safe and suitable for installation of firestop products.
- C. Verify that all pipes, conduit, cable, and other items that penetrate fire-rated construction have been permanently installed prior to installation of firestops.

3.09 INSTALLATION

A. General

1. Installation of firestops shall be performed by an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
2. Apply firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
3. Unless specified and approved, all insulation used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.
4. Seal holes and penetrations to ensure an effective smoke seal.
5. In areas of high traffic, protect firestopping materials from damage. If the opening is large, install firestopping materials capable of supporting the weight of a human.

6. Insulation types specified in other sections shall not be installed in lieu of firestopping material specified herein.
7. All combustible penetrants (e.g. non-metallic pipes or insulated metallic pipes) shall be firestopped using products and systems tested in a configuration representative of the field condition.

B. Dam Construction

1. When required to properly contain firestopping materials within openings, damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Noncombustible damming materials may be left as a permanent component of the firestop system.

3.10 FIELD QUALITY CONTROL

- A. Prepare and install firestopping systems in accordance with manufacturer's printed instructions and recommendations.
- B. Follow safety procedures recommended in the Material Safety Data Sheets.
- C. Finish surfaces of firestopping that are to remain exposed in the completed work to a uniform and level condition.
- D. All areas of work must be accessible until inspection by the applicable Code Authorities.
- E. Correct unacceptable firestops and provide additional inspection to verify compliance with this Specification.

3.11 CLEANING

- A. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.
- B. Leave finished work in a neat and clean condition with no evidence of spill-overs or damage to adjacent surfaces.

3.12 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.18 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Grounding and Bonding for Communications Systems.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.19 SUBMITTALS

- A. Provide product data from manufacturer's specifications.

1.20 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.07 APPROVED PRODUCTS

- A. Approved Equipment Grounding Conductor Manufacturer(s)
 - 1. Southwire
 - 2. Or Approved Equal (by SCSB)
- B. Approved Grounding Lug Manufacturer(s)
 - 1. Burndy
 - 2. Thomas & Betts
 - 3. Or Approved Equal (by SCSB)
- C. Approved Grounding Busbar Manufacturer(s)

1. Chatsworth Products, Inc.
2. B-Line
3. Harger
4. Or Approved Equal (by SCSB)

2.08 GROUNDING CONDUCTORS

A. Grounding Conductor

1. Construction shall be Type THHN copper conductors, insulated with heat and moisture resistant PVC over which a UL listed jacket is applied.
2. Jacket color shall be green or black. Black jacketed cable shall be identified at each termination point with a wrap of green tape.

2.09 GROUNDING LUGS

A. Grounding Lugs and Hardware

1. Grounding lugs shall be 2-hole and installed with a crimper that when properly executed the die of the crimper impresses the die # on the lug base. All lugs shall be sleeved with clear heat-shrink to allow for inspection of the crimp. Silicon bronze or stainless steel bolts and washers shall be used to install lugs to equipment. Exothermic welding is also allowed.

2.10 GROUNDING BUSBARS

A. Grounding Busbar

1. The grounding busbar shall be made of 1/4" thick solid copper.
2. The grounding busbar shall be installed with minimum clearance, 1" offsets and 1-1/2" insulators.
3. The grounding busbar shall accommodate 2-hole compression lugs.
4. The grounding busbar shall meet or exceed ANSI/TIA-607-B requirements.

PART 3 - EXECUTION

3.13 GROUNDING

- A. The facility shall be equipped with a Communications Bonding Backbone (TBB). This backbone shall be used to ground all communications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed

in accordance with the recommendations contained in the ANSI/TIA-607-B Telecommunications Bonding and Ground Standard.

- B. The main entrance facility/equipment room in each building shall be equipped with a telecommunications main grounding busbar (TMGB). Each telecommunications room (TR) shall be provided with a telecommunications ground busbar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility.
- C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the MC/IC/TC shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression lugs.
- D. All wires used for communications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap or green tape. All cables and busbars shall be identified and labeled in accordance with the ANSI/TIA-606-A.
- E. See Section 27 05 43 - Underground Ducts and Raceways for Communications Systems for underground duct and raceway systems ground requirements.

3.14 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.21 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Pathways for Communications Systems.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.22 SUBMITTALS

- A. Provide product data from manufacturer's specifications.

1.23 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.11 APPROVED PRODUCTS

- A. Rigid/Intermediate Conduit Manufacturer(s)
 - 1. Approved by Owner
- B. Non-Metallic (PVC) Manufacturer(s)
 - 1. Approved by Owner
- C. Electrical Metallic Tubing (EMT) Manufacturer(s)
 - 1. Approved by Owner

- D. EMT Fittings Manufacturer(s)
 - 1. Approved by Owner
- E. Innerduct/Inner-Conduit Channel Manufacturer(s)
 - 1. Approved by Owner
- F. Metallic Communications Outlet Box Manufacturer(s)
 - 1. Approved by Owner
- G. Pull Box Manufacturer(s)
 - 1. Approved by Owner
- H. Approved Cable Tray System Manufacturer(s)
 - 1. Approved by Owner
- I. Approved Cable Hanger Manufacturer(s)
 - 1. Approved by Owner
- J. Approved Velcro Strap Manufacturer(s)
 - 1. Approved by Owner
- K. Approved Surface Mounted Raceway Manufacturer(s)
 - 1. Coordinate with Division 26 (Electrical Contractor). Refer to Drawings.

2.12 CONDUIT

- A. Rigid and Intermediate Conduit
 - 1. Rigid conduit, intermediate conduit, couplings, locknuts, bushings, elbows and connectors shall be standard thread. All materials shall be steel. Set screw or non-threaded fittings are not permitted.
- B. Non-Metallic (PVC) Conduit
 - 1. Non-metallic conduit shall be heavy wall, Schedule 40 PVC.

2. Couplings and connectors for non-metallic conduit shall be of the same material and be the product of the same manufacturer of the conduit furnished.

C. Electrical Metallic Tubing (EMT)

1. Electrical metallic tubing (EMT), couplings and connectors shall be steel. Malleable iron, pressure-cast or die-cast fittings are not permitted.
2. Fittings for 2" EMT and smaller shall be steel set screw type, except where otherwise noted. Fittings for 2.5" and larger shall be steel set screw type with two (2) screws for connectors and four (4) screws for couplings. All connectors shall be insulated throat type.

D. Conduit Support

1. Individual conduit hangers shall be galvanized spring steel specifically designed for the purpose and sized appropriately for the conduit type and diameter. Support individual conduits 1-1/2 inch and smaller with 1/4 inch threaded steel rods and use 3/8 inch rods for 2 inch and larger.
2. Conduit support channels shall be 14 gauge galvanized (or equivalent treatment) channel sized for the amount of conduit to be supported. Channel suspension shall be 3/8" threaded steel rods. Attach suspension rods to structure with swivel type connectors. Conduit straps shall be spring steel type compatible with channel.
3. Conduit straps shall be single hole cast metal type or two hole galvanized metal type. Conduit clamps shall be spring steel type for use with exposed structural steel.

E. Innerduct/Inner-Conduit Channel

1. Innerduct shall be corrugated plastic equipped with pull-string or mule tape.
2. Inner-conduit channel shall be 3-channel with each channel equipped with mule tape.
3. See Drawings for innerduct / inner-conduit channel details.

2.13 METALLIC COMMUNICATIONS OUTLET BOXES

- A. Metallic outlet boxes and device covers shall be galvanized steel not less than 1/16" thick.
- B. The dimensions of the metallic outlet box shall be 4" x 4" square with a minimum depth of 2-1/8".

- C. Metallic outlet boxes shall be equipped with single device covers (or two-device covers where needed). Where installed in plaster, gypsum board, etc., covers shall be raised to compensate for the thickness of the wall finish.
- D. Where metallic outlet boxes are to be empty for future use, blank coverplates shall be used.

2.14 PULL BOXES

- A. Pull boxes shall be constructed of galvanized steel with flat, removable covers fastened with plated steel screws.
- B. Pull boxes shall be equipped with keyhole screw slots in the cover to permit removal of the cover without extracting the screws.
- C. Pull boxes shall have provisions for grounding.

2.15 CABLE TRAY

- A. Cable Tray System
 - 1. Cable tray shall be steel or aluminum construction.
 - 2. Cable tray cross members shall be factory welded at 12" intervals maximum.
 - 3. Cable tray shall be equipped with one (1) or two (2) support rails that run the length of each segment.
 - 4. End caps shall be installed on the exposed ends of the cable tray, channel supports and bolts. Protective covers shall be installed on threaded rods that come in contact with cabling plant.
 - 5. Wall mount cable tray used in limited clearance areas shall be hook style and constructed of aluminum.
 - 6. See Drawings for cable tray dimensions.
 - a. Cable Tray color shall be black or clear.

2.16 CABLE HANGERS

- A. J-Hooks
 - 1. J-hooks shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables. J-hook shall be cULus Listed.
 - 2. J-hooks shall have flared edges to prevent damage while installing cables.
 - 3. J-hooks sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.

B. Adjustable Non-Continuous Cable Support Sling

1. Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair balanced twisted pair cables; rated for indoor use in non-corrosive environments. Rated to support Category 5 and higher cable, or optical fiber cable. Cable support sling shall be cULus Listed.
2. Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.
3. Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.

2.17 VELCRO STRAPS

A. Velcro Straps

1. Velcro straps installed in air handling spaces must be plenum rated.
 - a. Non-plenum Velcro strap color shall be black.
 - b. Plenum Velcro strap color shall be red.
 - c. Tie Wraps are not approved

2.18 SURFACE MOUNTED RACEWAY

A. Surface Mounted Raceway

1. Coordinate with Division 26 (Electrical Contractor). Refer to Drawings.

PART 3 - EXECUTION

3.15 PENETRATIONS

- A. Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw upon approval of the structural engineer of record for the base of building. Pneumatic hammer, impact electric, hand or manual hammer type drills shall not be allowed, except where permitted by the Project Manager as required by limited working space. X-ray all floor penetrations accordingly.
- 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 Project Manager 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 a code compliant effective barrier against the spread of fire, smoke and gases.
- E. All penetrations where conduit is not used shall be sleeved.
- F. No gaps or rough edges shall be allowed between wall and conduit/sleeve.

3.16 CONDUIT SYSTEM

- A. Conceal all conduits, except in unfinished spaces such as equipment rooms or as indicated by symbol on the Drawings.
- B. Leave all empty conduits with a 200 pound test nylon cord pull line.
- C. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.
- D. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on steel.
- E. Install conduit with wiring, including homeruns as indicated on the Drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.
- F. Conduit shall be run parallel or at right angles to existing walls, ceilings, and structural members.
- G. Attach backbone conduits larger than one-inch trade diameter to or from structure on intervals not exceeding twelve feet with conduit beam clamps, one-hole conduit straps or trapeze type support.
- H. Where conduits must pass through structural members obtain approval of Architect or Engineer.
- I. Install all conduits or sleeves penetrating or routed within rated firewalls or fire floors to maintain fire rating of wall or floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.
- J. Provide expansion and deflection coupling where conduit passes over a building expansion joint.

- K. Service entrance conduits and feeder conduits in direct contact with earth shall be schedule 40, heavy wall PVC. All service entrance conduit elbows shall be galvanized rigid steel. Service entrance conduits installed exposed or concealed in walls or above ceilings shall be galvanized rigid steel (G.R.S.) or intermediate metal conduit (IMC). Provide concrete encasement where required or as indicated on Drawings.
- L. All other conduit, unless specified herein, shall be electrical metallic tubing (EMT). PVC conduit is not allowed in exposed or concealed areas, but only within concrete.
- M. Conduit Installations Within Slab/Floor
1. Conduit shall be run following the most direct route between points.
 2. Conduit shall not be installed in concrete where the outside diameter is larger than 1/3 of the slab thickness.
 3. Conduits shall not be installed within shear walls unless specifically indicated on the Drawings. Conduit shall not be run directly below and parallel with load bearing walls.
 4. Protect each metallic conduit installed in concrete slab or conduits 1-1/2 inch and smaller passing through a concrete slab against corrosion where conduit enters and leaves concrete by wrapping conduit with vinyl all-weather electrical tape.
 5. Protect all conduits entering and leaving concrete floor slabs from physical damage during construction.
 6. Provide expansion fittings in all conduits where length or run exceeds 200 feet or where conduits pass through building expansion joints.
 7. Install all conduits penetrating or routed within rated fire floors to maintain the fire rating of the floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.
 8. Conduits installed within concrete floor slabs which are in direct contact with grade or which penetrate the building roof shall be galvanized rigid steel (G.R.S.), intermediate metal conduit (I.M.C.) or Schedule 40, heavy wall PVC.
- N. Communications cables shall not occupy conduits with power cables.
- O. Metallic conduits shall be grounded in accordance with ANSI/TIA-607-B.
- P. Conduit runs shall not have more than two (2) 90-degree bends between pull points.
- Q. Communications conduit system shall contain no condulets (also know as an LB).

- A. Rigid metal conduit (RMC) or intermediate metal conduit (IMC) shall be used for entrance conduits that exceed 50 feet into the building.
- B. Horizontal Conduits
 - 1. Support horizontal conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, backboard, enclosure or cabinet. Support conduits from structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one-hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hanger rod and conduit clamp assembly, and multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.
 - 2. For runs that total more than 100 feet in length, insert pull boxes so that no segment between boxes exceeds the 100 feet limit.
 - 3. Each horizontal home-run conduit can serve from one (1) to three (3) outlet boxes. For one (1) outlet box, a 3/4" conduit shall be used, minimum. For two (2) outlet boxes, a 1" conduit shall be used, minimum. For three (3) outlet boxes, a 1-1/4" conduit shall be used, minimum.

3.17 COMMUNICATIONS OUTLET BOXES

- A. Exact locations of the outlet boxes shall be coordinated with the electrical contractor and other trades.
- B. Non-metallic communications outlet boxes may only be used for wood frame construction and/or where code allows.
- C. The approximate locations of the outlets are indicated on the Drawings. The exact locations of outlets shall be determined at the building. The right is reserved to change, without additional cost, the exact location of any outlet, a maximum of 10' before it is permanently installed.
- D. Orientation of outlet boxes (horizontal or vertical) shall be as indicated on the architectural elevations.
- E. Install all outlet boxes in finished areas flush with the wall. Maintain 1/4" or less space between outlet box front and finished wall surface.
- F. Outlet boxes shall be firmly anchored in place and shall not depend on the coverplate to hold it secure to the wall.
- G. Outlet boxes installed back-to-back in fire-rated walls shall be separated horizontally by a minimum of 24".

3.18 PULL BOXES

- A. Pull boxes shall be secured, independent of the conduit entries into the box. Pull boxes shall be secured to the building structure. In ceiling applications, pull boxes shall not be supported with ceiling wires.
- B. Conduits entering pull boxes shall connect to pull boxes using die-cast zinc connectors.
- C. Pull boxes shall be free from burrs, dirt and debris.
- D. Pull boxes shall be installed in accordance with ANSI/TIA-569-B.
- E. Pull boxes shall be grounded in accordance with ANSI/TIA-607-B.

3.19 CABLE TRAY SYSTEM

- A. Install trays in accordance with recognized industry practices, to ensure that the cable tray equipment complies with requirements of the NEC.
- B. All open trays shall be installed a minimum of six (6) inches away from any light fixture.
- C. Provide external grounding strap at expansion joints, sleeves, crossover and other locations where tray continuity is interrupted.
- D. Support all pathways from building construction. Do not support pathways from ductwork, piping or equipment hangers.
- E. Install cable tray level and straight.
- F. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete cable tray system.
- G. Cable trays shall not be used to house both low voltage and power cables unless cables are separated by a grounded physical barrier.
- H. Cable tray system shall be grounded in accordance with ANSI/TIA-607-B.

3.20 CABLE HANGERS

- A. Use J-hooks to support cable bundles according to BICSI Specifications

- B. Installation and configuration shall conform to the requirements of ANSI/TIA-568-C.0, ANSI/TIA-568-C.1 & ANSI/TIA-569-B, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.
- C. Install cables using techniques, practices, and methods that are consistent with Category 6 or higher requirements and that supports Category 6 or higher performance of completed and linked signal paths, end to end.
- D. Install cables without damaging conductors, shield, or jacket.
- E. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.
- F. Pull cables without exceeding cable manufacturer's recommended pulling tensions. Use pulling means that will not damage media.
- G. Do not exceed load ratings specified by manufacturer.
- H. Adjustable non-continuous support sling shall have a static load limit of 100 lbs.
- I. To avoid electromagnetic interference (EMI), pathways shall provide minimum clearances of four feet from motors or transformers, one foot from conduit and cables used for electrical power distribution, and five inches from fluorescent lighting. Pathways shall cross perpendicular to fluorescent lighting and electrical power cables or conduits.

3.21 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.24 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Underground Ducts and Raceways for Communications Systems.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.25 SUBMITTALS

- A. Provide product data from manufacturer's specifications.

1.26 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.19 APPROVED PRODUCTS

- A. Rigid/Intermediate Conduit Manufacturer(s)
 - 1. Approved by Owner
- B. PVC/HDPE Conduit Manufacturer(s)
 - 1. Approved by Owner
- C. Innerduct/Inner-Conduit Channel Manufacturer(s)
 - 1. Approved by Owner

- D. Marker Tape Manufacturer(s)
 - 1. Approved by Owner
- E. Approved Maintenance Hole/Handhole Manufacturer(s)
 - 1. Approved by Owner
- F. Approved Conduit Plug/Cap Manufacturer(s)
 - 1. Approved by Owner

2.20 CONDUIT SYSTEM

- A. PVC conduit for concrete encasement shall be Type DB, UL Labeled for 90 degrees C cables. Fittings shall be Type DB, solvent type, and from the same manufacturer as the conduit.
- B. Concrete shall have a minimum strength of 2,500 psi at 28 days.
- C. PVC conduit for direct burial shall be Schedule 40, UL Labeled for 90 degrees C cables. Fittings shall be Schedule 40, solvent type, and from the same manufacturer as the conduit.
- D. Rigid and Intermediate Conduit
 - 1. Rigid conduit, intermediate conduit, couplings, locknuts, bushings, elbows and connectors shall be standard thread. All materials shall be steel. Set screw or non-threaded fittings are not permitted.
 - 2. Galvanized rigid steel conduit shall be hot dipped galvanized inside and outside, in 10 foot lengths and threaded on both ends. Fittings and bushings shall be threaded, cast or malleable iron, and hot dipped galvanized inside and outside.
- E. Non-Metallic Conduit
 - 1. Non-metallic conduit shall be heavy wall, Schedule 40 PVC / HDPE.
 - 2. Couplings and connectors for non-metallic conduit shall be of the same material and be the product of the same manufacturer of the conduit furnished.
- F. Conduit Support
 - 1. Conduit straps shall be single-hole cast metal type or two hole galvanized metal type. Conduit clamps shall be spring steel type for use with exposed structural steel.

G. Innerduct/Inner-Conduit Channel

1. Innerduct shall be non-corrugated PVC equipped with mule tape.
2. Inner-conduit channel shall be 3-channel with each channel equipped with mule tape.
3. See Drawings for innerduct/inner-conduit channel details.

H. Marker Tape

1. Marker tape shall be detectable, orange for communications, and labeled to indicate the type of circuit buried below.

2.21 MAINTENANCE HOLES/HANDHOLES

A. Maintenance Holes

1. Maintenance holes shall be pre-cast or cast in place concrete with a strength of 3,500 psi at 28 days, and steel reinforced.
2. Maintenance holes shall include a cast iron frame with cover, a hot dipped galvanized steel ladder, and hot dipped galvanized pulling eyes embedded in the concrete opposite each duct entrance and in the floor beneath the cover.
3. Maintenance holes shall be equipped with grounding busbar.
4. Maintenance holes shall be equipped with racking for cable storage.
5. Ground splices and connections at maintenance holes shall be exothermic welds, copper or bronze compression ground fittings, or bolted compression ring lugs.
6. The cover for maintenance holes shall have the lettering, "COMMUNICATIONS."

B. Handholes

1. Handholes shall be non-conductive and shall not require grounding for safety. Handholes shall be unaffected by freeze/thaw and resistant to sunlight and chemicals. Handholes shall be pre-cast polymer concrete, heavy duty rated and bottomless.
2. Handholes shall be equipped with racking for cable storage.
3. Handholes shall have the word "COMMUNICATIONS" molded in the cover by the manufacturer. The cover shall be attached with penta-head stainless steel bolts.
4. Handholes shall be able to withstand 10,000 lbs minimum.
5. See Drawings for handhole dimensions and locations.

2.22 CONDUIT PLUGS/CAPS

A. Conduit Plugs/Caps

1. Conduit plugs shall provide a watertight seal at expose ends of conduits.
2. Conduit plugs shall be conduit size specific.
3. Triplex and Quadplex duct plugs shall provide a watertight seal between the conduit and innerduct(s).
4. Simplex duct plugs shall provide a watertight seal between the innerduct and the cable that occupies it.
5. TDUX inflatable bladders shall be used to seal conduits equipped with MaxCell.

PART 3 - EXECUTION

3.22 CONDUIT SYSTEM

A. Excavation and Backfill

1. Contractor shall call underground utilities locator company before digging.
2. Barricades shall be provided around open holes and trenches. Temporary bridges shall be provided over trenches cut through major sidewalk routes. Major sidewalk routes shall not be closed to pedestrian traffic.
3. Barriers shall be provided to protect landscaping adjacent to the excavation area.
4. When rocks, concrete or other debris are encountered during excavation, remove completely.
5. Where sidewalk sections must be removed for installation of underground ducts, remove the sidewalk sections completely from joint to joint.
6. Where asphalt must be removed for installation of underground ducts, saw cut the asphalt in two, straight, parallel lines.
7. Backfill excavations in 6-inch layers and mechanically compact to 98 percent compaction.
8. Excavated materials may be used as backfill only if the backfill is sand or clean dirt that is free of rocks and debris over 3/4" in diameter.
9. In landscaped areas, backfill and mechanically compact to a depth of 6 inches below grade.
10. Backfill the last 6 inches with clean topsoil. Reseed lawn areas.
11. Restore concrete sidewalks and asphalt.
12. The Contractor shall perform all excavation to install the electrical work herein specified and as indicated on Drawings. During excavation, material for backfilling shall be piled back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and others excavation and any water accumulating

therein shall be removed by pumping. All excavation shall be made by open cut.

13. The bottom of the trenches shall be graded to provide uniform bearing and support for conduits, cables, or duct bank on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth, tamped. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.
14. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and rammed until the installation has a cover of not less than the adjacent ground but not greater than 2" above existing ground. The backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to 95% of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water will not be permitted. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore the surface to the grade and compaction indicated, mounded over and smoothed off

B. Duct Banks

1. Duct banks shall be sloped downward toward maintenance holes/handholes and away from buildings a minimum of 6 inches per 100 feet. Duct banks shall not route water from maintenance holes handholes into buildings. Duct banks shall not contain traps between maintenance holes/handholes where water may accumulate.
2. Directional changes in duct banks shall be made with 20' minimum radius bends. Duct banks and direct buried ducts shall be supported on undisturbed soil or on piers extending down to undisturbed soil.
3. Where power and communications duct banks run in parallel, they shall be separated by a minimum of 12 inches.
4. Prior to concrete encasement, ducts, reinforcing steel and ground wires shall be secured with nonmetallic straps or cable ties to nonmetallic duct spacers at intervals not exceeding 8 feet. Duct spacers shall be sized for the ducts being held, and shall provide the minimum spacing between ducts required for concrete flow and by the NEC. Duct spacers shall be anchored to the ground using nonmetallic bands and stakes.
5. Duct banks shall have a minimum of 3 inches of concrete cover on all sides.
6. Where duct banks enter maintenance holes or buildings, they shall be constructed as integral to the wall.
7. Duct bank shall extend to the inside surfaces of the walls, and the duct bank reinforcing shall be integrated with the wall reinforcing.

8. Bell ends shall be provided on ducts where the ducts enter maintenance holes or buildings.
9. Direct buried ducts and fittings shall have bend radii greater than the minimum bend radii of the cables enclosed, and shall not be smaller than the radii of standard manufactured elbows.
10. Direct buried ducts shall be installed parallel to or at right angles to building lines and site features, and as close to curbs and sidewalks as possible to avoid interferences with future landscaping.
11. Where direct buried PVC ducts cannot be buried deep enough to meet the NEC minimum cover requirements, rigid steel conduits shall be installed instead, or a concrete cover shall be poured over the ducts.
12. An orange detectable marker tape (for communications) shall be buried in the backfill approximately 12 inches above duct banks or direct buried cables for the entire length of the duct run.
13. A flexible mandrel and a stiff bristled brush shall be pulled through the ducts to clean them prior to cable pulling.
14. Ducts shall be identified in the maintenance holes and at both ends.

C. Additional OSP Conduit Requirements

1. Leave all empty conduits with a 200-pound test nylon cord pull line.
2. Install a #14 AWG tracer wire in one conduit for the entire length of each duct run.
3. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.
4. Install conduit, including homeruns as indicated on the Drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.
5. Where conduits must pass through structural members obtain approval of Architect or Engineer.
6. Install all conduits or sleeves penetrating or routed within rated firewalls or fire floors to maintain fire rating of wall or floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.
7. Provide expansion and deflection coupling where conduit passes over a building expansion joint.
8. Service entrance conduits and feeder conduits in direct contact with earth shall be schedule 40, heavy wall PVC/HDPE. All service entrance conduit elbows shall be galvanized rigid steel. Service entrance conduits installed exposed or concealed in walls or above ceilings shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Provide concrete encasement where required or as indicated on Drawings.
9. Seal all conduits entering building to prevent entrance of moisture.

10. Conduit fittings shall be gland and ring compression type for all conduit exposed to outdoor environments.
11. Below Grade Conduit Installations
 - a. Install top of conduits 24 inches minimum below finished grade or as indicated on Drawings.
 - b. Install top of conduits 6 inches minimum below bottom of building slabs.
 - c. Where transition is made from below grade PVC installation to a metallic conduit system above grade or slab.
12. Communications cables shall not occupy conduits with power cables.
13. All metallic conduits shall be grounded in accordance with ANSI/TIA-607-B.
14. For runs that total more than 400 feet in length, insert handholes/maintenance holes so that no segment exceeds the 400 feet limit.
15. Conduit runs shall not have more than two (2) 90-degree bends between pull points.
16. Communication conduit system shall contain no condulets (also known as an LB).

3.23 MAINTENANCE HOLES/HANDHOLES

- A. Maintenance holes/handholes shall be installed on a base of pea gravel at least 12 inches deep.
- B. Tops of maintenance holes/handholes shall be level with the existing grade.
- C. Ducts should enter as perpendicular to the wall surface as possible.
- D. Maintenance holes shall be grounded with four 3/4 inch diameter by 8 foot long ground rods, one driven inside of the maintenance hole at each corner. Connect the ground rods and any duct bank ground conductors together with a No. 4/0 AWG bare, stranded copper ground wire loop. A No. 2 AWG bare stranded copper pigtail from the ground wire loop shall be used to ground the maintenance hole cover frame, ladder support bracket, any metallic concrete inserts and metallic cable racks, and the shields of any cables that are spliced in the maintenance hole.

3.24 CONDUIT PLUGS/CAPS

- A. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until ready for use.
- B. Simplex, triplex or quadplex duct plugs shall be installed in conduits to house and seal cables.

- C. TDUX inflatable bladders shall be used to seal conduits equipped with MaxCell.

3.25 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 05 53

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.27 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the equipment and execution requirements relating to Identification for Communications Systems.
- C. Equipment specifications, general considerations, and guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.28 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete installation. The Contractor will provide and install all of the required materials whether specifically addressed in the Specification or not.

PART 2 - LABELING

2.23 LABELING REQUIREMENTS

- A. Labeling shall be done in accordance with the recommendations made in the ANSI/TIA-606-A document, manufacturer's recommendations and best industry practices.
- B. All spaces, pathways, outlets, cables, termination hardware, grounding system and equipment shall be labeled with machine-generated labels.
- C. All labels shall be clear white with black text.
- D. All cables shall be labeled with machine generated, wrap around labels.
- E. A total of two (2) labels per horizontal cable are required at the following intervals: 6" from outlet and 12" from termination block/patch panel.
- F. Labeling scheme shall be alphanumeric. See Appendix 1

END OF SECTION

SECTION 27 08 00

COMMISSIONING OF COMMUNICATIONS

PART 1 - GENERAL

1.29 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the equipment and execution requirements relating to Commissioning of Communications.
- C. Equipment specifications, general considerations, and guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.30 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - TESTING

2.24 TESTING REQUIREMENTS

- A. General
 - 1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA-568-C.0, ANSI/TIA-568-C.1, and/or ANSI/TIA-1152. All conductors/strands of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors/strands in all cables installed.
- B. Copper Testing
 - 1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional

testing is required to verify Category 5e and/or 6 performance. Horizontal balanced twisted pair cabling shall be tested using a level IIe and/or III test unit for category 5e and/or 6 performance compliance.

2. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. The test shall be recorded as pass/fail as indicated by the test unit and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
3. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA-568-C.2 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.
4. Approved tester is as follows:
Fluke DTX

C. Fiber Testing

1. All fiber testing shall be performed on all fibers in the completed end-to-end system. There shall be no splices unless clearly defined in the RFP and/or Drawings. These tests also include continuity checking of each fiber.
2. Singlemode
 - a. Test the optical fiber cable bi-directionally with an OTDR and uni-directionally with a power meter/light source. Fiber must be tested at both 1310nm and 1550nm. Maximum attenuation dB/Km @ 1310nm/1550nm shall be 0.5/0.5 for outside plant and 1.0/1.0 for inside plant. Maximum attenuation per connector pair shall be .75 dB. Attenuation testing shall be performed with a stable launch condition using one-meter or two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements. Test set-up and performance shall be conducted in accordance with ANSI/TIA-568-C.3, and to the manufacturer's application guides.
3. Approved optical fiber test equipment manufacturers are as follows:
 - a. Power Meters & Light Sources
Optical Wavelength Laboratories (OWL)
Noyes
Photonix
Fluke
Agilent

- b. Optical Time Domain Reflectometers (OTDR)
 - GN Nettest
 - Agilent
 - Fluke
 - Anritsu
 - Tektronix

D. Test Results

1. Test documentation shall be provided on disk as part of the as-built package. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation," the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair (or strand) and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
2. The field test equipment shall meet the requirements of ANSI/TIA-568-C.2, ANSI/TIA-568-C.3, and/or ANSI/TIA-1152.
3. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. Alternately, the Contractor shall furnish this information in electronic form. Electronic records shall contain the equivalent of the test results as defined by the Specification and be of a format readable from Microsoft Word.
4. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

PART 3 - DOCUMENTATION, AS-BUILTS, TRAINING AND RECORDS

3.26 DOCUMENTATION & AS-BUILTS

A. As-Built record documentation for communications work shall include:

1. Cable routing and identification
2. System function diagrams
3. Manufacturers' description literature for equipment
4. Connection and programming schedules as appropriate
5. Equipment material list including quantities
6. Spare parts list with quantities
7. Details not on original Contract Documents

8. Test results
 9. Warranties
 10. Release of liens
- B. The Contractor shall provide and maintain at the site a set of prints on which shall be accurately shown the actual installation of all work under this section, indicating any variation from contract drawings, including changes in pathways, sizes, locations and dimensions. All changes shall be clearly and completely indicated as the work progresses.
 - C. Progress prints shall be available for inspection by the Owner or any of his representatives and may be used to determine the progress of communications infrastructure work.
 - D. At the completion of the work, prepare a new set of as-built drawings, of the work as actually noted on the marked-up prints, including the dimensioned location of all pathways.
 - E. Furnish as-built drawings and documentation to the Project Manager. As-built drawings shall be generated in AutoCad 2012 or later. Submit as-built drawings electronically and hard copy.

3.27 OPERATIONS AND MAINTENANCE MANUAL

- A. After completion of the work, the Contractor shall furnish and deliver to the Engineer three (3) copies of a complete Operations & Maintenance Manual. A system wiring diagram shall be furnished for each separate system.
- B. The manual shall be subdivided into separate sections with tab dividers to identify subsystems of the integrated system. Reference appropriate Specification sections.
- C. Provide the following additional information for each electronic system. Information shall be edited for this project where applicable.
 1. Operations manuals for components and for systems as a whole
 2. Maintenance manuals for components and for system as a whole
 3. Point-to-point diagrams, cabling diagrams, construction details and cabling labeling details
 4. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
 5. Emergency instructions for operational and maintenance requirements
 6. Delivery time frame for replacement of component parts from suppliers
 7. Recommended inspection schedule and procedures for components and for system as a whole

8. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
9. Complete “reviewed” shop drawings and product data for components and system as a whole
10. Troubleshooting procedures for each system and for each major system component

3.28 TRAINING

- A. The Contractor shall be responsible for training of facility personnel. Training shall take place after occupancy and before acceptance and shall include programs for on-site operations and maintenance of technology and communications systems. Training shall be for not more than ten (10) people, shall be held at the Owner's site and shall be of sufficient duration and depth to ensure that the trained personnel can operate the installed systems and can perform usual and customary maintenance actions.

3.29 WARRANTY

A. General

1. All equipment is to be new and warranted free of faulty workmanship and damage.
2. Replacement of defective equipment and materials and repair of faulty workmanship within 24 hours of notification, except emergency conditions (system failures), which must be placed back in service within eight (8) hours of notification, all at no cost to the Owner.
3. The minimum warranty provisions specified shall not diminish the terms of individual equipment manufacturer's warranties.

B. Voice & Data Structured Cabling

1. Manufacturer(s) shall provide a minimum 25-year warranty for components used in the installed Voice & Data Structured Cabling System. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

C. Overhead Paging System

1. Manufacturer(s) shall provide a minimum 1-year warranty for components used in the installed Overhead Paging System. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

D. Pathway & Support Infrastructure

1. Manufacturer(s) shall provide a minimum 1-year warranty for components used in the installed Pathway & Support Infrastructure. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

END OF SECTION

SECTION 27 11 13

COMMUNICATIONS ENTRANCE PROTECTION

PART 1 - GENERAL

1.31 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Entrance Protection.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.32 SUBMITTALS

- A. Provide product data from manufacturer's specifications.

1.33 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.25 APPROVED PRODUCTS

- A. Approved Building Entrance Protector Terminal Manufacturer(s)
 - 1. Circa
 - 2. Marconi
 - 3. Porta Systems
 - 4. Or Approved Equal (by SCSB)
- B. Approved Bonding Shield Connector Manufacturer(s)
 - 1. 3M
 - 2. Or Approved Equal (by SCSB)

2.26 BUILDING ENTRANCE PROTECTOR TERMINALS

A. Indoor Building Entrance Protector Terminal

1. The indoor building entrance protector terminal shall be equipped with 110-connector inputs and outputs and shall accommodate industry standard 5-pin protection modules.
2. The indoor building entrance protector terminal shall protect up to 100-pairs and shall be equipped with an internal fuse link.
3. The indoor building entrance protector terminal shall be wall or frame mountable, and able to be stacked for future expansion.
4. The indoor building entrance protector terminal shall be equipped with external ground connectors that accept 6-14 AWG ground wire.

B. Solid State Surge Protection Modules

1. The solid-state surge protector module shall be 5-pin and shall provide transient and power fault protection for standard telephone line applications.
2. The solid-state surge protector module shall be designed to provide a balanced configuration to protect against line-to-line metallic surges.
3. The solid-state surge protector module shall feature an external failsafe mechanism, which permanently grounds module under sustained high current conditions.
4. The solid-state surge protector module shall feature nanosecond response time and safe mode operation in adverse situations.
5. The solid-state surge protector module shall be UL & cUL Listed.

2.27 BONDING SHIELD CONNECTOR

A. Shield Connector

1. The purpose of the bonding shield connector is to make a stable, low resistant electrical connection between the shield of a communications cable and a ground conductor.
2. The bonding shield connector shall be tin-plated tempered brass.

PART 3 - EXECUTION

3.30 BUILDING ENTRANCE PROTECTOR TERMINALS

- A. All copper circuits shall be provided with protection between each building with an entrance cable protector panel. All building-to-building circuits shall be routed through this protector. The protector shall be connected with a #6 AWG copper bonding conductor between the protector ground lug and the telecommunications room (TR) busbar.

- B. Building entrance protector shall be installed in accordance with the recommendations contained in the ANSI/TIA-607-B Telecommunications Bonding and Ground Standard.
- C. Building entrance protector panels shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.31 BONDING SHIELD CONNECTOR

- A. Bonding shield connector shall be installed in accordance with the recommendations contained in the ANSI/TIA-607-B Standard.
- B. Bonding shield connector shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.32 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 11 19

COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.34 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Termination Blocks and Patch Panels.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.35 SUBMITTALS

- A. Provide product data from manufacturer's specifications.

1.36 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.28 APPROVED PRODUCTS

- A. Approved Patch Panel Manufacturer(s)
 - 1. Leviton
 - a. Patch Panel – 69586-L48, L-24
 - b. Jacks - eXtreme 6+
 - 2. Ortronics
 - a. Patch Panel – OR-PHD66U48/24
 - b. Jacks – SII, CAT6, Clarity OR-S22600
 - c. Jacks – OR-KS6 (Fog White and Green)
 - 3. No Exceptions

B. Approved Optical Fiber Enclosure Manufacturer(s)

1. Leviton
 - a. Rack Mount -
 - b. Wall Mount –
2. Ortronics
 - a. Rack Mount – Q-Series - Designated per project
 - b. Wall Mount – Q-Series - Designated per project
3. No Exceptions

C. Approved Termination Block Manufacturer(s)

1. Leviton
2. Or Approved Equal

2.29 PATCH PANELS

A. Category 6e Patch Panel

1. The Category 6/6e patch panel shall be modular in design and equipped with Cat 6/6e jacks.
2. The Category 6/6e patch panel shall be compatible with 19" equipment racks, cabinets or wall mount brackets.
3. The Category 6/6e patch panel shall be flat.
4. The Category 6/6e patch panel shall be equipped with front labeling space to facilitate port identification.
5. The connector module shall exceed the Category 6 performance criteria per ANSI/TIA-568-C.2.
 - a. Icons shall be used if offered from the manufacturer.
 - b. Jack/Icon colors shall be:
Green for voice
White for data

B. Category 6A Patch Panel

1. The Category 6A patch panel shall be modular in design and equipped with Cat 6A jacks.
2. The Category 6A patch panel shall be compatible with 19" equipment racks, cabinets or wall mount brackets.
3. The Category 6A patch panel shall be flat.
4. The Category 6A patch panel shall be equipped with front labeling space to facilitate port identification.
5. The connector module shall exceed the Category 6A performance criteria per ANSI/TIA-568-C.2.
 - a. Icons shall be used if offered from the manufacturer.
 - b. Jack/Icon colors shall be:

White for Data
Green for Voice

2.30 OPTICAL FIBER PANELS/ENCLOSURES

A. Rack Mount Optical Fiber Panel/Enclosure

1. The rack mount optical fiber panel/enclosure shall be equipped with either a swing out mechanism or a sliding drawer to access fibers.
2. The rack mount optical fiber panel/enclosure shall be capable of terminating tight-buffered or loose tube optical fiber cable.
3. The rack mount optical fiber panel/enclosure shall provide for bend radius control throughout the panel as well as storage space for slack cabling.
4. The panel/enclosure shall meet or exceed the performance criteria per ANSI/TIA-568-C.3.
5. The rack mount optical fiber panel/enclosure shall be equipped with optical fiber adapter panels from same manufacturer.
 - a. The optical fiber adapter panels shall accommodate either multimode or singlemode terminated optical fiber.
 - b. The optical fiber adapter panels shall be compatible with SC connectors.
 - c. OM3 laser optimized adaptors shall be aqua in color and equipped with zirconia ceramic sleeves.
 - d. Singlemode adaptors shall be blue or green in color and equipped with zirconia ceramic sleeves.

B. Wall Mount Optical Fiber Panel/Enclosure

1. The wall mount optical fiber panel/enclosure shall have a hinged door for access, with locking available for security.
2. The wall mount optical fiber panel/enclosure shall be capable of terminating tight-buffered or loose tube optical fiber cables and all popular connector types.
3. The wall mount optical fiber panel/enclosure shall provide for bend radius control throughout the panel as well as storage space for slack cabling.
4. The panel/enclosure shall meet or exceed the performance criteria per ANSI/TIA-568-C.3.
5. The wall mount optical fiber panel/enclosure shall be equipped with optical fiber adapter panels from same manufacturer.
 - a. The optical fiber adapter panels shall accommodate either multimode or singlemode terminated optical fiber.
 - b. The optical fiber adapter panels shall be compatible with SC connectors.
 - c. OM3 laser optimized adaptors shall be aqua in color and equipped with zirconia ceramic sleeves.

- d. Singlemode adaptors shall be blue or green in color and equipped with zirconia ceramic sleeves.

2.31 TERMINATION BLOCKS

A. 110 Type Wiring Blocks/Cross-Connect Kits:

1. The 110-type wiring blocks shall be available in 100- and/or 300-pair configurations.
2. The 110-type wiring block shall be Category 5e for backbone terminations and Category 6 for horizontal terminations.
3. The cross-connect kits shall include all the components required to complete a wall-mounted 110 cross-connect installation and be available in both 100-pair and 300-pair configurations for Cat5e and 96-pair and 288-pair configurations for Cat 6. (Includes 110-blocks, connecting blocks and designation strips).
4. The termination block shall meet or exceed the performance criteria per ANSI/TIA-568-C.2.
5. Backbone blocks shall use 5-pair connecting blocks on each 25-pair row.
6. Horizontal blocks shall use 4-pair connecting blocks on each 25-pair row.

B. 66-Blocks

1. The 66-type wiring block shall be a 50-pair configuration.
2. The 66-type wiring block shall have a split clip system using bridge clips to connect incoming pairs to outgoing pairs.
3. The 66 block's labeling system shall use designation strips or covers to accommodate labels.

PART 3 - EXECUTION

3.33 PATCH PANELS

- A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practice.
- B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
- D. Cables shall be neatly bundled and dressed to their respective patch panel. Each patch panel shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

- E. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.34 OPTICAL FIBER PANELS/ENCLOSURES

- A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practices.
- B. Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.
- C. Bend radius of the optic fiber cable in the panel/enclosure shall not exceed 10 times the outside diameter of the cable.
- D. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.
- E. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.
- F. A maximum of 12 strands of fiber shall be spliced in each fiber splice tray.
- G. All spare strands shall be installed into spare splice trays.
- H. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

3.35 TERMINATION BLOCKS

- A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practice.
- B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
- D. Cables shall be neatly bundled and dressed to their respective termination block. Each termination block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

- E. Each cable shall be clearly labeled on the cable jacket within 12" of the termination block at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.
- F. Wall mounted termination block fields shall be mounted on communications backboard.
- G. Wall mounted termination block fields shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.36 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 11 23

COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

PART 1 - GENERAL

1.37 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Cable Management and Ladder Rack.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.38 SUBMITTALS

- A. Provide product data from manufacturer's specifications.

1.39 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.32 APPROVED PRODUCTS

- A. Approved Horizontal Cable Management Manufacturer(s)
 - 1. Ortronics – OR-60400057
 - 2. No Exceptions
- B. Approved Vertical Cable Management Manufacturer(s)
 - 1. Chatsworth Products, Inc. (CPI) – 11374-501 clear, 11374-703 black
 - 2. No Exceptions
- C. Approved Ladder Rack System Manufacturer(s)

1. Chatsworth Products, Inc. (CPI)
2. No Exceptions

D. Approved C-Ring/D-ring Manufacturer(s)

1. Chatsworth Products, Inc. (CPI)
2. Or Approved Equal (by SCSB)

2.33 CABLE MANAGEMENT - HORIZONTAL

A. Horizontal Cable Management

1. The horizontal wire manager shall be compatible with 19-inch equipment racks, cabinets or wall mount brackets.
2. The horizontal cable manager shall provide support for patch cords at the front of the panel.
3. The horizontal cable manager shall be 2 rack-units in height when matched with a 2 rack-unit patch panel or switch.
4. The horizontal cable manager shall be 1 rack-unit in height when matched with a 1 rack-unit patch panel or switch.

2.34 CABLE MANAGEMENT - VERTICAL

A. Vertical Cable Management

1. The vertical cable manger shall be double-sided.
2. The vertical cable manager shall provide support for patch cords at the front of the rack and wire management at the rear of the rack.
3. The vertical cable manager shall be a minimum width of 5".
4. Vertical cable manager color shall be clear or black.

2.35 LADDER RACKS

A. Ladder Rack System

1. See Drawings for ladder rack system details.
2. The ladder rack system shall be securely mounted with hardware designed for use in ladder rack systems.
3. End caps shall be installed on the exposed ends of the ladder racks, channel supports and bolts. Protective covers shall be installed on threaded rods that come in contact with cabling plant.
4. Ladder Rack System color shall be black.

2.36 VELCRO STRAPS

A. Velcro Straps

1. Backbone cables shall be fastened to support structures with Velcro straps.
2. Horizontal cables shall be fastened to support structures with Velcro straps.
 - a. Velcro Strap color shall be black (or red in plenum spaces).
 - b. Tie wraps are not approved.

2.37 C-RINGS/D-Rings

A. C-Rings/D-rings

1. C-rings/D-rings shall be used on backboards to support cables, patch cords and cross-connect wire.
2. C-rings/D-rings shall be made of high-strength, fire-retardant material with rounded edges to prevent damage to cable and wire insulation.

PART 3 - EXECUTION

3.37 CABLE MANAGEMENT - HORIZONTAL

- A. Horizontal cable managers shall be installed below patch panels in a 1:1 ratio (one horizontal cable manager per patch panel) or as indicated on Drawings.

3.38 CABLE MANAGEMENT - VERTICAL

- A. Vertical cable managers shall be installed on both sides of a single equipment rack. Where two (2) or more racks are positioned in a row, vertical cable managers shall be installed between each rack and each end of the row.

3.39 LADDER RACKS

- A. Ladder rack system shall be installed straight, level and perpendicular to walls and ceiling slabs.
- B. Ladder racks shall be supported at 5' intervals maximum.
- C. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete ladder rack system.
- D. See Drawings for ladder rack system details.

3.40 C-RINGS/D-RINGS

- A. C-ring/D-rings shall be installed on 3/4" backboard, straight and level.

3.41 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 13 13

COMMUNICATIONS COPPER BACKBONE

PART 1 - GENERAL

1.40 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Copper Backbone.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.41 SUBMITTALS

- A. Provide product data from manufacturer's specifications.

1.42 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.38 APPROVED PRODUCTS

- A. Approved Copper Backbone Cable (Inside Plant) Manufacturer(s)
 - 1. Berk-Tek
 - 2. Superior Essex
 - 3. General
 - 4. CommScope
 - 5. No Exceptions
- B. Approved Copper Backbone Cable (Outside Plant) Manufacturer(s)
 - 1. General
 - 2. Superior Essex

3. No Exceptions

2.39 COPPER BACKBONE CABLE (INSIDE PLANT)

A. 100-Ohm Balanced Twisted Pair Building Backbone Cables (Inside Plant)

1. Generic Characteristics

- a. The inside plant, balanced twisted pair building backbone cable shall meet the 100-Ohm balanced twisted pair backbone requirements per the latest issue of ANSI/TIA-568-C.2.
- b. The inside plant, 100-Ohm balanced twisted pair cable shall be CMR or CMP rated (according to the space it occupies).
- c. The inside plant, balanced twisted pair building backbone cable core shall consist of 25-pair sub-units.

2.40 COPPER BACKBONE CABLE (OUTSIDE PLANT)

A. 100-Ohm PE-89 Backbone Cables (Outside Plant)

1. Generic Characteristics

- a. The outside plant backbone cable shall be assigned the RDUP designation of PE-89.
- b. The outside plant backbone cable core shall consist of 25-pair sub-units.
- c. The outside plant backbone cable shall contain water-blocking gel and have a jacket made of polyethylene.

PART 3 - EXECUTION

3.42 BACKBONE CABLES (INSIDE PLANT)

- A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practices.
- B. Backbone cables shall be installed separately from horizontal distribution cables
- C. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.
- D. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits
- E. Exposed cables must be CMP or MMP rated if installed in an air return plenum. CMR rated cables shall be installed in metallic conduit if installed in an air return plenum.

- F. Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.
- G. Leave 10' of slack on each end of copper backbone cable.
- H. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
- I. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.
- J. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.
- K. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.
- L. Copper cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- M. Each copper cable shall be clearly labeled on the cable jacket behind the patch panel or block at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.
- N. Copper backbone cables shall be installed separately from horizontal distribution cables

3.43 BACKBONE CABLES (OUTSIDE PLANT)

- A. All OSP cables brought to the Entrance Facilities shall have 15 ft of slack coiled and secured to the wall in the proximity of the termination field.
- B. All cables shall be tagged and identified within each handhole/maintenance hole.
- C. Place initial cables in bottom conduits to facilitate easy subsequent cable placement.
- D. Place leader guard in the duct before placing cable to prevent damaging the cable sheath on the sharp edge of the duct.

- E. Ventilate maintenance where gas has been detected before entering the maintenance hole.
- F. A 600 lb. break-away swivel, along with a slip clutch capstan winch that shows the dynamometer (pulling tension) reading, shall be used at all times during pulling.
- G. At each splice location the cable ends will be sealed watertight at all times. Reels will be continuously manned during cable installation.
- H. Copper backbone cables shall be bonded and grounded in accordance with the recommendations made in the ANSI/TIA-607-B standard, manufacturer's recommendations and best industry practice.

3.44 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 13 23

COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.43 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Optical Fiber Backbone Cabling.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.44 SUBMITTALS

- A. Provide product data from manufacturer's specifications.

1.45 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.41 APPROVED PRODUCTS

- A. Approved Optical Fiber Backbone Cable (Inside Plant) Manufacturer(s)
 - 1. Berk-Tek
 - 2. Superior Essex
 - 3. Corning
 - 4. CommScope
 - 5. No Exceptions
- B. Approved Optical Fiber Backbone Cable (Outside Plant) Manufacturer(s)
 - 1. Berk-Tek
 - 2. Superior Essex

3. Corning
4. CommScope
5. No Exceptions

C. Approved Optical Fiber Connectivity Manufacturer(s)

1. 3M
2. No Exceptions

2.42 OPTICAL FIBER BACKBONE CABLE (INSIDE PLANT)

A. Indoor/Outdoor Distribution 850nm Laser-Optimized 50/125 Multimode Optical Fiber (OFNR) Tight Buffered Cable (OM3)

1. Generic Characteristics

- a. The indoor optical fiber cable shall be available with up to twelve 900-micron tight-buffered 250-micron fibers placed in a color-coded sub-unit bundle with aramid strength elements.
- b. The indoor optical fiber cable shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
- c. Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.5
- d. Minimum overfilled modal bandwidth: 1500 MHz-km @ 850 nm.
- e. Minimum overfilled modal bandwidth: 500 MHz-km @ 1300 nm.
- f. Minimum effective modal bandwidth: 2000 MHz-km @ 850nm

B. Indoor/Outdoor Distribution 8.3/125-micron Singlemode Optical Fiber (OFNR) Tight Buffered Cable (OS2)

1. Generic Characteristics

- a. The indoor optical fiber cable shall be available with up to twelve 900-micron tight-buffered, 250-micron fibers placed in a color-coded sub-unit bundle with aramid strength elements.
- b. The indoor optical fiber cable shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
- c. The loss of fiber shall not exceed 1.0 dB per kilometer @ 1550 nm and 1.0 dB per kilometer @ 1310 nm.

2.43 OPTICAL FIBER BACKBONE CABLE (OUTSIDE PLANT)

A. Indoor/outdoor 850nm Laser Optimized 50/125 Multimode Optical Fiber Non-Conductive (OFNR) Tight Buffer Cable (OM3)

1. Generic Characteristics

- a. The indoor/outdoor optical fiber cable with up to twelve 250-micron coated fibers placed in a color-coded sub-unit bundle with moisture-blocking gel.
 - b. The indoor/outdoor optical fiber cable shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
 - c. The indoor/outdoor optical fiber cable shall have sequential length markings printed on the cable jacket.
 - d. Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.5
 - e. Minimum overfilled modal bandwidth: 1500 MHz-km @ 850 nm.
 - f. Minimum overfilled modal bandwidth: 500 MHz-km @ 1300 nm.
 - g. Minimum effective modal bandwidth: 2000 MHz-km @ 850nm
- B. Indoor/outdoor 8.3/125-micron, Singlemode Optical Fiber Non-Conductive (OFNR) Tight Buffer cable (OS2)
1. Generic Characteristics
 - a. The indoor/outdoor optical fiber cable with up to twelve 250-micron coated fibers placed in a color-coded sub-unit bundle with moisture-blocking gel.
 - b. The indoor/outdoor optical fiber cable shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
 - c. The indoor/outdoor optical fiber cable shall have sequential length markings printed on the cable jacket.
 - d. The loss of fiber shall not exceed 0.50 dB per kilometer @ 1550 nm and 0.50 dB per kilometer @ 1310 nm.

2.44 OPTICAL FIBER CONNECTORS

A. Laser Optimized Multimode Fiber Connectivity OM3

1. The optical fiber field-installable connector shall be SC for installation onto multimode a laser optimized 50/125-micron fiber.
2. The optical fiber field-installable connector shall be compatible with 900-micron buffered fibers.
3. The optical fiber field-installable connector shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
4. The optical fiber field-installable connector shall have a maximum Loss of 0.5 dB.
5. The optical fiber adapter module that occupies the faceplate shall be equipped with zirconia ceramic sleeve.
6. Laser optimized multimode fiber connector color shall be aqua.

B. Singlemode Fiber Connectivity

1. The optical fiber field-installable connector shall be SC for installation onto singlemode 8.3/125-micron fiber.

2. The optical fiber field-installable connector shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
3. The optical fiber field-installable connector shall be compatible with 900-micron buffered fibers or 250-micron loose-tube fibers.
4. The splice loss through each connector pair shall not exceed 0.50 dB.
5. The optical fiber adapter module that occupies the faceplate shall be equipped with zirconia ceramic sleeve.
6. Singlemode fiber connector color shall be blue.

PART 3 - EXECUTION

3.45 BACKBONE CABLES (INSIDE PLANT)

- A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practices.
- B. Backbone cables shall be installed separately from horizontal distribution cables
- C. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.
- D. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits with conduits labeled to and from.
- E. Exposed cables must be OFCP or OFNP rated if installed in an air return plenum. Riser rated cables shall be installed in metallic conduit if installed in an air return plenum.
- F. Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.
- G. Leave 10' of slack on each end of fiber backbone cable.
- H. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
- I. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.
- J. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

- K. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.
- L. Each optical fiber cable shall be individually attached to the respective enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.
- M. Each optical fiber cable shall be clearly labeled at the entrance to the enclosure. Cables labeled within the bundle shall not be acceptable.
- N. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.
- O. A maximum of 12 strands of fiber shall be spliced in each splice tray
- P. All spare fiber strands shall be installed into spare splice trays.
- Q. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

3.46 BACKBONE CABLES (OUTSIDE PLANT)

- A. All OSP cables brought to the Entrance Facilities shall have 15 ft of slack coiled and secured to the wall in the proximity of the fiber enclosure.
- B. All cables shall be permanently tagged and identified within each handhole/maintenance hole.
- C. Place initial cables in bottom conduits to facilitate easy subsequent cable placement.
- D. Place leader guard in the duct before placing cable to prevent damaging the cable sheath on the sharp edge of the duct.
- E. Ventilate maintenance where gas has been detected before entering the maintenance hole.
- F. To ensure that the optical fiber cable's qualities and characteristics are not degraded during installation, excessive pulling tensions and short bending radii will not be allowed. The maximum pulling tension is 600 lbs. The minimum bending radius for cable under tension is 20 times the outside diameter of the cable and for cable at rest is 10 times the outside diameter of the cable.
- G. A 600 lb. break-away swivel, along with a slip clutch capstan winch that shows the dynamometer (pulling tension) reading, shall be used at all times during pulling.

- H. At each splice location the cable ends will be sealed watertight at all times. Reels will be continuously manned during cable installation.
- I. Contractor shall coil 60 feet of spare optical fiber cable in each handhole/maintenance hole without a splice and 75 feet of each optical fiber cable in each handhole/maintenance hole with a splice. Cable coils shall have at least two points of support on the optical fiber racking system.
- J. When mounting the optical fiber slack coils, the minimum bend radius shall not be exceeded; this radius is equal to 10 times the outside diameter of the cable in a static application and 20 times the outside diameter in a dynamic application. At anytime during the entire handling process of the optical fiber cable, as much care as possible should be maintained and all the manufacturer's recommendations should be followed.

3.47 OPTICAL FIBER CONNECTIVITY / SPLICING

- A. Optical fiber connectors shall be installed as per the requirements specified by the manufacturer's installation guidelines.
- B. All splicing shall be of the fusion type made under Light Injection and Detection Mode, whenever applicable. The Contractor shall provide certified and experienced personnel for splicing.
- C. Contractor's tools and equipment shall be in excellent working order. Any worn or improperly working tools shall be discarded and not used on this project. All fusion splicers shall be calibrated and labeled according to the manufacturer's specifications. Contractor shall submit certification of calibration for the fusion splicers to the Engineer.

3.48 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 15 13

COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.46 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Copper Horizontal Cabling.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.47 SUBMITTALS

- A. Provide product data from manufacturer's specifications.

1.48 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.45 APPROVED PRODUCTS

- A. Approved Horizontal Copper Cable Manufacturer(s)
 - 1. Berk-Tek – LANmark 1000
 - 2. Superior Essex – 66-240-2A
 - 3. No Exceptions

2.46 HORIZONTAL COPPER CABLE

- A. 100 OHM Category 6/6e Balanced Twisted Pair Cable

1. The horizontal balanced twisted pair cable shall exceed the Category 6 transmission characteristics per issue of ANSI/TIA-568-C.2.
2. Cable jacket shall be CMR rated.
3. Jacket color shall be Blue.

PART 3 - EXECUTION

3.49 HORIZONTAL CABLES

- A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.
- B. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.
- C. Cable raceways shall not be filled greater than the ANSI/TIA-569-B maximum fill for the particular raceway type.
- D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
- E. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.
- F. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.
- G. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.
- H. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
- I. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- J. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the Contractor shall install appropriate carriers to support the cabling.

- K. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to final acceptance at no cost to the Owner.
- L. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA-568-C.2 document, manufacturer's recommendations and best industry practices.
- M. Leave a minimum of 12" of slack for twisted pair cables at the outlet. Cables shall be coiled in the in-wall box, surface-mount box or modular furniture raceway if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
- N. Cables shall be neatly bundled and dressed to their respective termination device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- O. Each cable shall be clearly labeled on the cable jacket behind the termination device at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.50 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 15 23

COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

PART 1 - GENERAL

1.49 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Optical Fiber Horizontal Cabling.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.50 SUBMITTALS

- A. Provide product data from manufacturer's specifications.

1.51 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the specification or not.

PART 2 - PRODUCTS

2.47 APPROVED PRODUCTS

- A. Approved Horizontal Optical Fiber Cable Manufacturer(s)
 - 1. Berk-Tek
 - 2. Superior Essex
 - 3. Corning
 - 4. No Exceptions

2.48 HORIZONTAL OPTICAL FIBER CABLE

- A. Laser-Optimized 50/125 Multimode Optical Fiber Non-Conductive, Tight Buffered Cable (OM3)

1. Generic Characteristics
2. The indoor optical fiber cable shall be available with up to twelve 900-micron tight-buffered 250-micron fibers placed in a color-coded sub-unit bundle with aramid strength elements.
3. The indoor optical fiber cable shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
4. The indoor optical fiber cable shall have sequential length marking printed on the cable jacket.
5. Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.5
6. Minimum overfilled modal bandwidth: 1500 MHz-km @ 850 nm.
7. Minimum overfilled modal bandwidth: 500 MHz-km @ 1300 nm.
8. Minimum effective modal bandwidth: 2000 MHz-km @ 850nm
9. Cable jacket shall be OFNR rated.
10. Jacket color shall be: Aqua

PART 3 - EXECUTION

3.51 HORIZONTAL CABLES

- A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.
- B. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.
- C. Cable raceways shall not be filled greater than the ANSI/TIA-569-B maximum fill for the particular raceway type.
- D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
- E. Riser rated cable shall be installed in metallic conduit when installed in a plenum space.
- F. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.
- G. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.
- H. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.

- I. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
- J. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- K. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the Contractor shall install appropriate carriers to support the cabling.
- L. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to final acceptance at no cost to the Owner.
- M. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C-1, manufacturer's recommendations and best industry practices.
- N. Leave a minimum of 36" of slack for optical fiber at the outlet. Cables shall be coiled in the in-wall box, surface-mount box or modular furniture raceway if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. Excess slack shall be loosely coiled and stored in the ceiling above each drop location where there is not enough space present in the outlet box to store slack cable.
- O. Cables shall be neatly bundled and dressed to their respective termination device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- P. Each cable shall be clearly labeled on the cable jacket behind the termination device at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.52 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 15 43

COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 - GENERAL

1.52 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Faceplates and Connectors.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.53 SUBMITTALS

- A. Provide product data from manufacturer's specifications.

1.54 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.49 APPROVED PRODUCTS

- A. Approved Copper Connectivity Manufacturer(s)
 - 1. Leviton – eXtreme Cat 6+
 - 2. Ortronics – SII 6/6e, KS6
 - 3. No Exceptions
- B. Approved Optical Fiber Connectivity Manufacturer(s)
 - 1. 3M
 - 2. No Exceptions

- C. Approved Faceplate Manufacturer(s)
 - 1. Leviton
 - 2. Ortronics
 - 3. No Exceptions

- D. Approved Surface Mount Box manufacturer(s)
 - 1. Wiremold
 - 2. No Exceptions

2.50 COPPER CONNECTIVITY

- 1. Category 6e, 8-Position, 8-Contact (8P8C) Modular Jack
 - a. The connector module shall exceed the Category 6 performance criteria per ANSI/TIA-568-C.2.
 - b. The eight-position connector module shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
 - c. The connector module shall be designed for use at the work area (WA), communications room (TR) and/or equipment room (ER) without modification.
 - d. The connector module shall be available in both the T568A and T568B wiring configurations within the same module.
 - e. The connector module shall have an insulation displacement connection featuring insulation slicing of 22 to 24 AWG plastic-insulated solid copper conductors forming a gas-tight connection.
 - f. Icons shall be used if offered from the manufacturer.
 - g. Jack/Icon colors shall be:
 - Green for voice
 - White for data

2.51 FIBER CONNECTIVITY

- A. Laser Optimized Multimode Fiber Connectivity OM3
 - 1. The optical fiber field-installable connector shall be SC for installation onto multimode a laser optimized 50/125-micron fiber.
 - 2. The optical fiber field-installable connector shall be compatible with 900-micron buffered fibers.
 - 3. The optical fiber field-installable connector shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
 - 4. The optical fiber field-installable connector shall have a maximum Loss of 0.5 dB.

5. The optical fiber adapter module that occupies the faceplate shall be equipped with zirconia sleeve.
6. Laser optimized connector color shall be aqua.

2.52 FACEPLATES

A. Faceplates

1. The faceplate housing the connector modules shall have no visible mounting screws.
2. It shall be possible to install the connector modules in wall-mounted single- and dual-gang electrical boxes, utility poles and modular furniture (cubicle) access points using manufacturer-supplied faceplates and/or adapters.
3. The faceplate housing the connector modules shall have the option of being mounted on adapter boxes for surface mount installation.
4. The faceplate housing the connector modules shall have a labeling capability using built-in labeling windows, to facilitate outlet identification and ease network management.
5. The faceplate housing the connector modules shall provide flexibility in configuring multimedia workstation outlets that respond to present or future network needs such as audio, video, coaxial and optical fiber applications.

2.53 SURFACE MOUNT BOXES

- A. The surface mount box shall accommodate connections of any type, UTP, optical fiber or coax.
- B. The surface mount box shall have internal storage space for slack cabling and a built-in spool for controlling cable bend radius.

PART 3 - EXECUTION

3.53 COPPER CONNECTIVITY

- A. 8-position, 8-contact (8P8C) modular jacks shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.
- B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).
- C. Data jacks, unless otherwise noted in Drawings or fiber adapter modules are present, shall be located in the bottom position(s) of each faceplate. Data jacks in horizontally oriented faceplates shall occupy the right-most position(s).

- D. Voice jacks, unless otherwise noted in Drawings, shall occupy the top position(s) on the faceplate. Voice jacks in horizontally oriented faceplates shall occupy the left-most position(s).

3.54 OPTICAL FIBER CONNECTIVITY

- A. Optical fiber connectors shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.
- B. Fiber adapter modules, unless otherwise noted in Drawings, shall be located in the bottom position(s) of each faceplate. Fiber adapter modules in horizontally oriented faceplates shall occupy the right-most position(s).

3.55 FACEPLATES

- A. Blank inserts shall be installed where ports are not used.
- B. The same orientation and positioning of jacks and connectors shall be utilized through out the installation.
- C. Faceplates shall be installed straight and level.
- D. Faceplates shall be installed at the same heights as electrical faceplates.

3.56 SURFACE MOUNT BOXES

- A. Blank inserts shall be installed where ports are not used.
- B. The same orientation and positioning of jacks and connectors shall be utilized through out the installation.
- C. Surface mount boxes shall be installed straight and level.
- D. Surface mount shall be installed at heights as electrical receptacles.

3.57 IDENTIFICATION

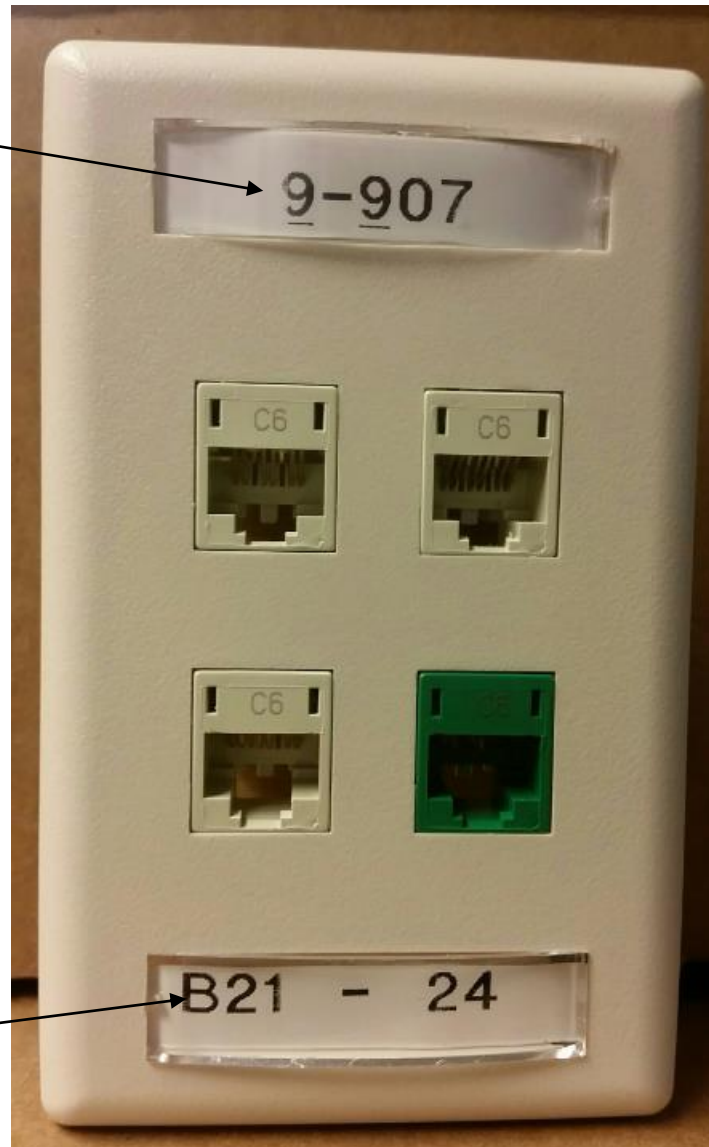
- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

Appendix 1
Wall Plate Labeling and Patch Panel Labeling

Wall Plate

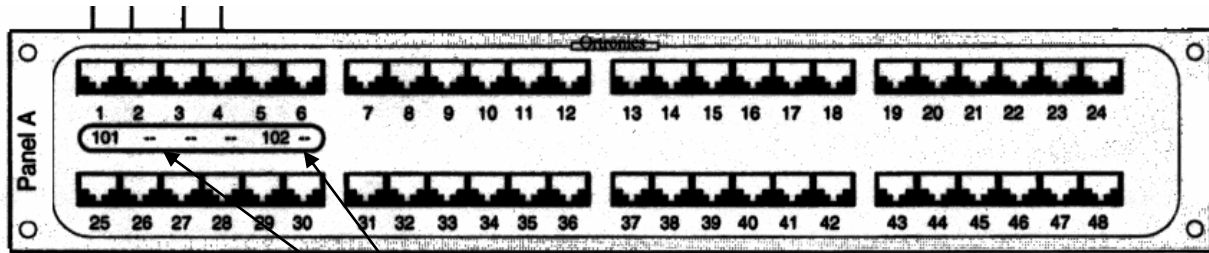
Building Number - Room Number



Patch Panel and Jack Number

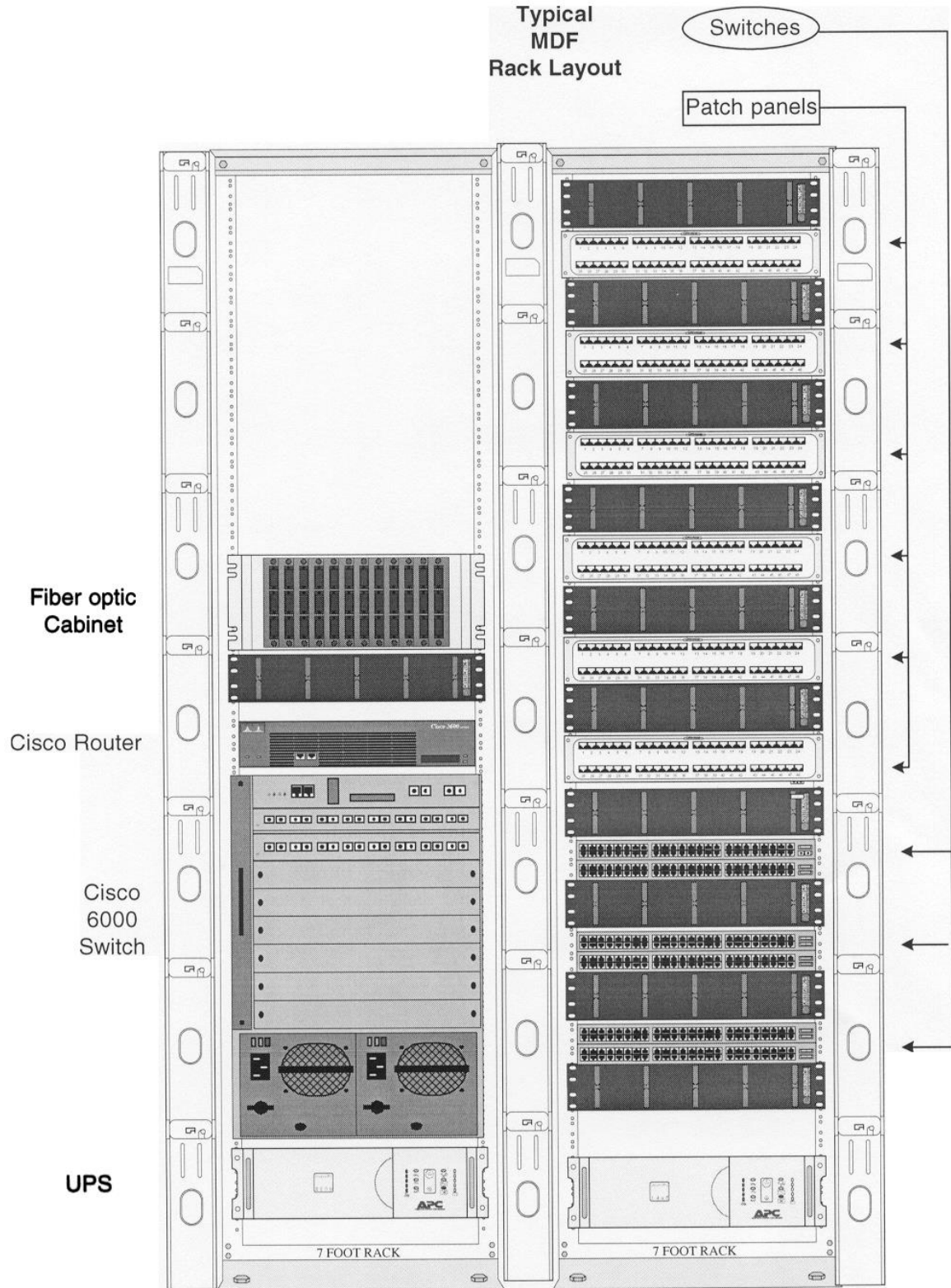
Wall Plate will be labeled with IDF Building and Room number on top and PP and Jack number on bottom. Single drops are not allowed. Connections for Staff work areas are to have bottom right jack in green color. No Exceptions

Patch Panel



Patch Panel shall be labeled as above. Room number followed by --- for each quad drop and Room Number followed by - for each duplex drop.

Appendix "B"



Appendix "C"

Typical IDF

