

RICE UNIVERSITY

Cabling and Technology Specifications

01/29/2019

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Data and Voice Cabling Specifications

SECTION 27 01 10 OPERATION AND MAINTENANCE OF STRUCTURED CABLING AND ENCLOSURES

GENERAL

1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.
- B. This section is inclusive to all Division 27 sections.

2. DRAWINGS

- A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.
- B. All work shall be subject to the Owner's direction and approval.

3. SUMMARY

- A. This project consists of providing a structured cabling system for building construction and renovation. The structured cabling system includes voice and data cabling locations as shown on design drawings. Additional descriptions can be found in each Division 27 section.

4. QUALITY ASSURANCE

- A. In addition to procedures stated in Division 1:
- B. Cutting and Patching
- C. Perform required cutting, drilling and chasing to receive new equipment. In general, perform all patching and repairing necessary to restore to original condition, all surfaces that may become damaged during the installation. All work shall be executed by persons normally employed in the type of work to which they are assigned.
- D. Paint all structural steel and all steel parts used for hangers and for supporting conduits, junction boxes and technology equipment with one (1) coat of "red" oxide primer before erection. After steel is in place, paint again with a minimum of one (1) coat of paint, color as directed by the Architect.
- E. The contractor is responsible for all cutting, patching, plastering and painting associated with the new installation.
- F. Clean Up
- G. The job-site shall be clean at the end of each day. The Contractor must ensure that there is a constant, clean working environment.
- H. Upon completion of the contract, remove all workmen's appurtenances from the premises. Clean the premises of all debris caused by the work and leave the installation clean and in first-class operating condition.
- I. Storage of Material and Equipment
- J. Store materials and equipment in a location approved by the Owner.
- K. Be responsible for the condition of all materials and equipment employed in the installation until final acceptance by the Owner.
- L. Be responsible for the replacement of all damaged or defective work, materials or equipment. Do not install sensitive or delicate equipment until major construction work is completed. Ensure that equipment is protected from all construction site activities.
- M. Observe and conform to all applicable safety regulations required by the Owner and O.S.H.A.

5. INTERPRETATION AND CONFLICTS

- A. Bring any discrepancies determined or omissions found lacking in the Contract Documents to the Technology Consultant's attention before submitting the bid. After award of Contract, the Owner or Technology Consultant will make the interpretation of any conflict.
- B. The failure to question any controversial item will constitute acceptance by the Bidder who shall execute it to the satisfaction of the Owner after being awarded the Contract.
- C. If mention has been omitted pertaining to details, items or related accessories required for the completion of any system, it is understood such item and accessories are included in the Contract. After the Contract is awarded, claims based on insufficient data or incorrectly assumed conditions, or claims based on misunderstanding the nature of the work, will not be recognized.
- D. The General Conditions, Requirements, and Special Provisions, of any larger body of specifications, of which this Specification may be a part, are hereby made a part of this Specification. In the event that any clauses or provisions of the larger body of specification conflict with the letter or intent of this Specification, the Contractor shall immediately notify the Architect and the Technology Consultant for clarification and direction.
- E. All work shown shall be new work provided under this Contract except that work labeled "present to remain" and that equipment labeled "to be furnished by others, but installed by the Contractor".

6. LABELING AND IDENTIFICATION

- A. Clearly LABEL all new equipment, devices and miscellaneous apparatus for easy identification and for safety.
- B. Owner will identify and provide labeling schemes for all patch panels, wall plate end point locations, 110 blocks, fiber termination cabinets, and backbone cables.
- C. All abandoned or unused wires, cables, trunks and the like shall be removed from the plenum, mechanical rooms, chases or closets back to the point of origin. Any new cables, communication trunks, fiber optics and the like shall be labeled with the following information, at minimum: Tenant Name, Service Provider Name, Date Installed, Point of Origin and Termination Point. Any cabling or the like installed in a mechanical room must be labeled every 15 feet and should not be tie-wrapped to existing conduit, pipes, etc. The cabling must be supported separately from existing raceways.

7. LOCATION OF EQUIPMENT AND RACEWAY

- A. The drawings are diagrammatic and indicate the general arrangement of equipment to be installed.
- B. Coordinate the structural, electrical/electronic and finished conditions of work accordingly.
- C. Coordinated locations of all equipment, raceways, junction boxes, cable runs, conduit runs, etc., shall be determined at the site. Install all items to accommodate the various conditions in the building and make deviations necessary without additional cost.

8. WIRING METHODS

- A. Install all wire and cable located in finished areas in new or existing raceways as indicated on Drawings.
- B. Install new raceways in the locations shown on the drawings and as specified.

9. ORDINANCES AND CODES

- A. Nothing contained in the Specifications or shown on the drawings shall be construed as to conflict with any local, municipal or state laws and regulations, governing the installation or other contract work, and all such ordinances and regulations, including the latest: National Electric Code, ANSI/EIA/TIA standards and the National Electric Safety Code, are hereby incorporated and made a part of these Specifications, and shall be satisfied by the contractor at no additional expense to the Owner.
- B. Secure all permits and inspection certificates for submission to the owner.

10. SYSTEM CONTINUITY

- A. Reconnect all existing items that remain in use. Provide all materials and labor required to retain continuity of existing circuits or systems that are disrupted by these alterations even though not indicated on the drawings.

11. SUBMITTALS

- A. Shop drawings shall be checked, corrected and approved by the contractor before being submitted to the Owner/Technology Consultant for approval. Before submitting shop drawings, the Contractor shall carefully examine them and shall certify by his stamp/signature that, to the best of his knowledge, they comply with the Contract Documents. The Contractor must receive written approval from the Owner or an authorized representative of the Owner, in writing, prior to fabricating or installing any materials. Approval will be given based upon shop drawings. The shop drawings shall indicate complete details of work to be performed. Drawings shall include a title block naming the Project, Architect, Technology Consultant, Contractor, drawing title, drawing number, revision number if applicable and date. Submit all Shop Drawings complete as a single submission. Isolated items will not be accepted, except with prior approval.
- B. Where the shop drawings deviate from the requirements of the Contract documents, the Contractor shall (1) correct the shop drawings as required, or (2) where the deviations do not necessarily require correction, notify the Owner/Technology Consultant of the deviations.
- C. Submit to the Architect four (4) sets of shop drawings or otherwise noted documents/equipment for the following equipment and obtain written approval before ordering materials. See the drawings and scope information for applicability of product to phase and project:
 1. Patch Panels (UTP and fiber including connectors)
 2. Cable (UTP and fiber)
 3. Patch Cables
 4. Outlets, Faceplates and Jacks
 5. Cable management Devices
 6. Inner Duct
 7. Punch down blocks
 8. Protection Devices
 9. Racks and cabinets
 10. Nameplates and Identification devices
 11. Basket style cable tray
 12. Ladder style cable tray
 13. Grounding equipment
 14. Hangers and Supports
 15. Strain relief products
- D. All other equipment identified or inferred and as may be required by the Architect, Technology Consultant or Owner.
- E. Submit complete submittal list for Owner/Architect/Technology Consultant approval prior to purchasing any equipment.
- F. In some cases, manufacturer warranty may call for the review of system documentation to assure that the system design meets manufacturer warranty requirements. In such instance, with prior approval of the Owner, the contractor shall provide a complete set of Project Documents and product data to the system manufacturer for review. The system manufacturer shall review the complete system package and provide documentation attesting to the system compliance with manufacturer warranty requirements. This documentation shall be included with the Contractor Shop Drawings submittal. The Technology Consultant will not review the Contractor Shop Drawings submittal, which does not include the manufacturer warranty compliance review documentation.
- G. Each shop drawing shall contain reference to the applicable drawing and specification section and verification of compatibility with the systems involved.
- H. All nameplate data shall be submitted with equipment submittals – refer to other sections for complete identification requirements.
- I. Shop drawings shall show conformance with specified performance characteristics, or the Contractor shall assume responsibility for all deviations including all additional costs as a result of the deviations.

12. STANDARDS OF MATERIAL AND WORKMANSHIP

- A. All work shall be executed by persons skilled in the work to which they are assigned. This shall include all copper and fiber connections including testing, and all plastering and painting.
- B. All materials and equipment in the work shall be new and of first quality, produced by manufacturers of recognized reputation for each line of material and equipment. The fact that materials or equipment offered have been recently developed or are untried may be sufficient justification for their rejection.

13. PROTECTION OF WORK AND EQUIPMENT

- A. This Contractor shall use the required safety precautions, methods and skills to prevent possible unsafe conditions or conditions unduly susceptible to fire.
- B. When this Contractor is working in areas in which the building occupants have access, contractor shall provide suitable barriers around his operation.
- C. This contractor is responsible for containing the undue spread of vapors or odors from his work area.

14. TESTS AND INSTRUCTIONS

- A. Upon completion of the work, and upon the request of the Architect, the Contractor shall be prepared to test all systems in the presence of the Owner, Architect, or Technology Consultant. Such testing shall occur at a time that is mutually acceptable to all parties. The Contractor's representatives assisting in the performance of these tests shall be thoroughly familiar with the details of the system and shall include the field supervisor responsible for installing the system.
- B. Correct all failures or improper conditions.
- C. Demonstrate to the Owner the proper care and maintenance of all new items.

15. GUARANTEE

- A. Unless stated otherwise in Division 1:
- B. The contractor and his surety shall guarantee in writing for a minimum period of one (1) year from the date of final acceptance that all materials, equipment and labor furnished by contractor are free from defects. Refer to cable system warranty for additional requirements.
- C. The Contractor shall further guarantee that if any piece of material or equipment is found to be defective within the guarantee period because of faulty manufacture or faulty installation, in the opinion of the Owner, contractor will replace and install and test such material or equipment without any further expense to the Owner.

PRODUCTS (Not Used)

EXECUTION (Not Used)

END OF SECTION 27 01 10

SECTION 27 05 00 COMMON WORK RESULTS FOR COMMUNICATIONS

1. GENERAL

1.1. RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.
- B. This section is inclusive to all Division 27 sections.

1.2. SUMMARY

- A. This Section includes general administrative and procedural requirements for the structured cabling system and campus inter-building distribution systems. It includes contractor qualifications, terminations and testing parameters. Reference individual sections for further expansion of these requirements.
- B. Permits, Inspections, Codes and Regulatory References
- C. General: Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules, and regulations having jurisdiction for work included under this Contract, and shall submit approval certificates to the Technology Consultant.
- D. Codes: The cabling system installation shall comply fully with all local, county and state laws, ordinances and regulations applicable with electronic and electrical installations.
- E. The following industry standards are the basis for the structured cabling system described in this document.

1. TIA/EIA

- a. TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard
- b. TIA/EIA-568-B.1 General Requirements
- c. TIA/EIA-568-B.2 Balanced Twisted Pair Cabling Components Standard
- d. TIA/EIA-568-B.3 Optical Fiber Cabling Components Standard
- e. TIA/EIA-569-A Commercial Building Standard for Telecom Pathways and Spaces
- f. TIA/EIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- g. TIA/EIA-607 Commercial Building Grounding/Bonding Requirements

2. NFPA

- a. NFPA 70 National Electric Codes (NEC)

3. ISO/IEC

- a. ISO 11801 Generic Cabling for Customer Premises
- F. If there is a conflict between applicable documents, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.
- G. This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project.

1.4. ABBREVIATIONS AND DEFINITIONS

- A. General: In addition to abbreviations defined in Division 1, utilize the following abbreviations and definitions for discernment with the Drawings and Specifications.
- B. Abbreviations:

| | |
|------|---|
| NEC | National Electrical Code |
| OSHA | Occupational Safety and Health Administration |
| ANSI | American National Standards Institute |
| NFPA | National Fire Protection Association |
| ASA | American Standards Association |
| IEEE | Institute of Electrical and Electronics Engineers |
| NEMA | National Electrical Manufacturers Association |
| UL | Underwriter's Laboratories, Inc. |
| ICEA | International Cable Engineers Association |
| ASTM | American Society of Testing Materials |
| ETL | Electrical Testing Laboratories, Inc. |
| TIA | Telecommunications Industry Association |
| ICIA | International Communications Industries Association |
| EIA | Electronic Industry Association |
| OEM | Original Equipment Manufacturers |
| EC | Electrical Contractor |
| SCC | Structured Cable Contractor |
| TC | Technology Consultant |
| GC | General Contractor |
| O | Owner |
| AVC | AudioVisual Contractor |
| OSP | Outside Service Provider |
| NIC | Not In Contract |

- C. Definitions:
 1. PROVIDE means to furnish, install, place, erect, connect, test and turn over to Owner complete and ready for the regular operation, the particular work referred to.
 2. INSTALL means to join, unite, fasten, link, attach, setup or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular work referred to. It is also used to indicate the responsibility of receiving the item at the job site, providing adequate storage, unpacking or uncrating the item, physically securing the item or otherwise making ready the item for its intended use by following the instructions and approved methods of the manufacturer and those contained herein.
 3. FURNISH means to indicate the responsibility to ship or deliver the item to the job site, freight prepaid, for receipt, staging and installation by others.
 4. WIRING means the inclusion of all raceways, fittings, conductors, connectors, patch panels, labeling, junction and outlet boxes, connections, testing and all other items necessary and/or required in connection with such work.
 5. CONDUIT means the inclusion of all fittings, hangers, supports, sleeves, etc.
 6. AS DIRECTED means as directed by the Technology Consultant or his representative.
 7. CONCEALED means embedded in masonry or other construction, installed behind wall furring or within double partitions or installed within hung ceilings.
 8. ACCEPTED means as accepted by the Technology Consultant or his representative.
 9. APPROVED means as approved by the Technology Consultant or his representative.

10. EQUAL means equivalent as approved by the Technology Consultant or his representative.
11. BIDDER is used to indicate that entity generating the bid response.
12. CONTRACTOR is used to indicate the successful Bidder to whom the Owner has awarded the contract.
13. PROVIDED BY OTHERS shall refer to material and work, which is related to this contract, but has been provided by parties other than the Contractor.
14. OWNER FURNISHED CONTRACTOR INSTALLED (OFCI) shall refer to equipment that will be furnished by the Owner for installation by the Contractor. The Contractor shall be responsible for installing and integrating this equipment as detailed herein.
15. The term SHALL is mandatory; the term WILL is informative; and the term SHOULD is advisory.
16. AS SHOWN means as shown on the drawings, shop drawings or other graphical elements of the contract documents.
17. AS REQUIRED means as required by some other part of the contract documents which may include reference specifications or manufacturer's recommended practice.
18. OWNER or CLIENT means Rice University or their designated representative.
19. ARCHITECT means INSERT NAME OF Architect
20. The SPECIFICATION is defined as the body of documentation provided to the Contractor with the Request for Quotation, as well as all addenda to said documentation. Throughout this document, words such as "herein" refer to the entire Specification, and not just this written document. The Specification includes, but is not limited to, this written specification document, all drawings, as listed in the List of Drawings, cable terminations and labeling schedule, additions and/or modifications as detailed in written addenda, additions and/or modifications as detailed in drawing additions or reissues.
21. TECHNOLOGY CONSULTANT refers to Rice University Networking – Office of Information Technology (713) 348-5262 OR <INSERT NAME OF Data/Security Consultant.
22. For the purpose of Division 27, in the event of conflict with an abbreviation or definition in Division 1 and in Division 27, the Division 27 abbreviation or definition shall prevail.

1.5. PERMITS, CODES, STANDARDS, AND INSPECTIONS

- A. Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules and regulations having jurisdiction for work included under this Contract, and shall submit approval certificates to the Technology Consultant.
- B. The installation shall comply fully with all local, county and state laws, ordinances and regulations applicable to electronic and electrical installations.
- C. Unless stated in Division 1, the installation shall be in compliance with the requirements of the latest revisions of:
 1. Occupational Safety and Health Act (OSHA)
 2. Institute of Electrical and Electronic Engineers (IEEE)
 3. National Electric Code (NEC)
 4. National Board of Fire Underwriter's (NBFU)
 5. National Electrical Manufacturer's Association (NEMA)
 6. National Electric Safety Code (NESC)
 7. Legislative Act 235 (1965)-Handicapped
 8. Legislative Act 287 (1974)-Excavation
 9. Building Officials and Code Administrators (BOCA)
 10. Americans with Disabilities Act (ADA)
 11. Electronic Industry Association (EIA)
 12. Telecommunications Industry Association (TIA)

13. All local codes and ordinances in effect and having jurisdiction.
 14. All requirements of electric and telephone utility companies.
 15. The BICSI Telecommunications Distribution Methods Manual (latest edition).
 16. All approved published instructions set forth by equipment manufacturers.
 17. Submit certificates issued by approved authorized agencies to indicate conformance of all work with the above requirements, as well as any additional certificates as may be required for the performance of this contract work.
- D. Should any change in drawings or Specifications be required to comply with governmental regulations, the Contractor shall notify the Technology Consultant prior to execution of the work. The work shall be carried out according to the requirements of such code in accordance with the instructions of the Architect and the Technology Consultant at no additional cost to the Owner.

1.6. CONTRACTOR QUALIFICATIONS

- A. All bidders shall demonstrate their qualifications by providing the following documents:
1. A list of the LAST five (5) Structured Cabling systems that were installed by the bidder:
 - a) The listing shall include only systems that included the installation of fiber optic cable and Category 6, 6A, or 6A F/UTP twisted pair.
 - b) The listing shall be for the last five (5) projects that are completed and have been turned over to the owner.
 - c) The listing shall include a brief description of the project, size of the system, products used, Owner's name, phone number, address, and representative, date started, and date of completion.
 2. The bidder shall furnish a list of all test equipment that will be used in the installation and testing of the fiber optics, multi-pair copper distribution cable and the twisted pair cable.
 3. The bidder shall furnish a listing of the names of full-time employees that will work on the project and list their training and certification in the installations and testing of structured cabling.
 4. The bidder shall have a Registered Communication Distribution Designer (RCDD) with three (3) years' experience, on staff. Submit the RCDD Certificate and project information with bid.
 5. All of the above documents shall be submitted along with the Bid Form, by the Bid due date.
- B. The Contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data and voice network systems. The Contractor shall at a minimum possess the following qualifications:
1. Those licenses/permits required to perform telecommunications installations in the specified jurisdiction.
 2. Personnel trained and certified in the design of the Siemon Cabling Systems.
 3. Personnel trained and certified to install the Siemon Cabling Systems.
 4. The Contractor shall provide proof of current certification for the Siemon Systems.
 5. Personnel must be knowledgeable in local, state, and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall apply.
 6. The Contractor shall have been in the business of installing structured cabling systems for a minimum of five (5) years.
 7. The Contractor must possess and maintain current liability insurance certificates.

1.7. WARRANTIES

- A. Provide complete written warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.
- B. Warranty and Certification of the Cabling systems and connectors:
1. The Contractor shall provide a 20-year performance and product warranty that all cable, connectors and connecting hardware shall be free from defects in material, workmanship and fabrication. Submit detailed warranty documentation with close out documentation.

2. The system shall be certified by the cable/connector manufacturer and warranted for the specified performance for minimum of 20 years. The Contractor shall conform to the manufacturer's certification program including submittal of all required documentation to the manufacturer.
3. The Contractor shall obtain, from the manufacturer, a Registration Document and Certificate for the specific installation. Upon receipt of the Registration Document and Certificate, the Contractor shall forward a copy to the Technology Consultant and deliver the original to the Owner.
4. Any material, equipment or appurtenance whose operation or performance does not comply with the requirements of the Contract or any equipment which is damaged prior to acceptance will be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

1.8. SUBMITTALS

- A. The contractor shall provide product submittals for all system components. These components shall include all cable, termination devices; splice connectors, patch panels, associated racks and enclosures, patch cords and labeling devices. The selected contractor will allow sufficient time in project scheduling for client and review by the Technology Consultant.

1.9. PROJECT DRAWINGS AND SPECIFICATIONS

- A. The Contractor shall carefully examine the Drawings and Specifications of all trades and report all discrepancies to the Technology Consultant in writing to obtain corrective action. No departures from the Contract Documents will be made without prior written approval from the Technology Consultant.
- B. Questions or disputes regarding the intent or meaning of Contract Documents shall be resolved by the interpretation of the Technology Consultant. The Architects' interpretation is final and binding.
- C. The Drawings and Specifications are not intended to define all details, finish materials, and special construction, which may be required or necessary. The Contractor shall provide all installations complete and adequate as implied by the project documents.
- D. Drawings are diagrammatic only and do not show exact routes and locations of equipment and associated wiring. The Contractor shall verify the work of all other trades and shall arrange his work to avoid conflicts. In the event of a conflict, the Contractor shall obtain corrective action from the Technology Consultant.
- E. If there is a conflict between contract documents, the document highest in precedence shall control. The precedence shall be: first; permits from agencies as required by law, second; special provisions, third; specifications, fourth; drawings, fifth; reference specifications and sixth; vendor submittals.

1.10. COOPERATION AND COORDINATION WITH OTHER TRADES

- A. This contractor shall be responsible for all cross connecting and coordination with vendors and other trades to provide a complete operational system.

1.11. PRODUCT LISTING

- A. When two or more items of the same material or equipment are required, they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, conduit, fittings, sheet metal, solder, fasteners, and similar items, except as otherwise indicated.
- B. Provide products that are compatible within systems and other connected items.
- C. All powered equipment shall be UL listed and follow approval criteria defined by the local authority having jurisdiction.

1.12. RECORD DOCUMENTS

- A. When all work has been completed and before final acceptance, the Contractor shall furnish to the Technology Consultant and Owner a complete set of documents that clearly represent all contract

work "as-built". This shall be inclusive of all test results and drawings. The Contractor is responsible for assuring the accuracy of the As-Built documentation. This to include digital and laminated hard copy cabling/port mapping diagrams. Laminated copies to be affixed to an identified location in the MDF.

1.13. MAINTENANCE MANUALS

- A. Prepare maintenance manuals (Record Document) in accordance with the following information for equipment items:
- B. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
- C. Manufacturer's data of each piece of equipment.

1.14. GENERAL WARRANTIES

- A. Provide complete warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.
- B. Any material, equipment or appurtenance whose operation or performance does not comply with the requirements of the Contract Documents or which are damaged prior to acceptance will be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

2. PRODUCTS

2.1. Major items of equipment shall have manufacturer's name, address and catalog number on a plate securely attached. All equipment or apparatus of any one system must be the product of one manufacturer, or approved equivalent products of a number of manufacturer's that are suitable for use in a unified system.

2.2. All materials and equipment for which Underwriter's Laboratories have established standards shall bear a UL label of approval.

2.3. Where proprietary names are used, whether or not followed by the words "or as approved", they shall be subject to substitution only as approved by the Architect, Technology Consultant, and Owner.

2.4. Where the Contractor proposes substitute equipment, contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required

by the specified item, said additional material or work, shall be the responsibility of this Contractor, regardless of the trade involved.

3. EXECUTION

3.1. DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project identified with names, model numbers, types, grades, compliance labels, and other information needed for distinct identification; adequately packaged and protected to prevent damage during shipment, storage and handling.

3.2. INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of systems, materials, and equipment.
- B. Coordinate systems, equipment, and materials installation with other building components.
- C. Verify all dimensions by field measurements.
- D. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for cabling installations.
- E. Sequence, coordinate, and integrate installations of cabling materials and equipment for efficient flow of the Work.
- F. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
- G. Coordinate the cutting and patching of building components to accommodate installation of cabling equipment and materials.
- H. Coordinate the installation of all materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.
- I. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.
- J. Plywood on MDF walls shall be void-free A/C grade and treated on all sides with two coats of fire-resistant paint.
- K. Ensure that the fire rating of all walls and floors is maintained.

3.3. CONDUIT AND RACEWAY

- A. Actual locations of all equipment, raceways, junction boxes, cable runs, conduit runs, etc., shall be determined at the site.
- B. Provide a pull box or pull point immediately before and after any conduit or raceway section containing three ninety-degree bends, or any single run exceeding fifty feet in length. Pull box openings must face in the direction from which personnel will approach and must have a minimum eight inches in front of and to all sides of the opening. Pull boxes shall not be used in place of a bend. Conduits must always exit the pull box from the opposite side it entered (no change of direction inside the pull box will be accepted).
- C. Carefully investigate the structural, electrical/electronic and finished conditions of work accordingly.

3.4. FIRESTOPPING

- A. General
- B. Provide through penetration fire stop systems to prevent the spread of fire through openings made in fire-rated walls or floors to accommodate penetrating items such as conduit, cables and cable tray. Fire stop shall restore floor and wall to the original fire rated integrity and shall be waterproof. The fire stop systems and products shall have been tested in accordance with the procedures of U.L. and material shall be U.L. classified as materials for use in through-penetration fire stops.

- C. The fire stop system shall comply with the NEC and with NFPA 101-Life Safety Code (latest edition) and shall be made available for inspection by the local inspection authorities prior to cable system acceptance. The contractor shall be responsible for verifying the fire rating of all walls and floors having cabling penetrations. Coordinate sealant installation with work of other trades and with the general contractor on site.
- D. Fire stop systems shall be UL Classified to ASTM E814 (UL 1479) or shall be approved by a qualified Professional Engineer (PE), licensed in California. A drawing showing the proposed fire stop system shall be provided to the Owner and Technology Consultant prior to installing the fire stop system(s).

3.5. GROUNDING AND BONDING

- A. Ground communications systems and equipment in accordance with the ANSI/TIA/EIA-607 Grounding Standard and NEC requirements except where the Drawings or Specifications exceed NEC requirements. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, paging equipment, CATV equipment etc. entering or residing in technology spaces shall be grounded to the respective ground system using a minimum #6 AWG solid copper bonding conductor and compression connectors. All wires used for technology grounding purposes shall be identified with green insulated wires. All cables and bus bars shall be identified and labeled in accordance with the Technology Identification requirements.

3.6. TESTING

- A. Contractor, at his own expense, shall make any tests directed by an inspection authority or by the Technology Consultant and shall provide all equipment, instruments and materials to make such tests.
- B. Upon completion of work, all component parts, both singularly and as a whole, shall be set, calibrated, adjusted and left in satisfactory operation condition to suit load conditions, by means of instruments furnished by the Contractor.
- C. Notify the Owner and Technology Consultant seven (7) days prior to the testing dates. Upon completion of a test, a statement of certification shall be forwarded to the Technology Consultant for his approval.

END OF SECTION 27 05 00

SECTION 27 05 28 PATHWAYS FOR COMMUNICATIONS SYSTEMS

1. GENERAL

1.1. RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General Provisions and Supplementary Conditions, Specification Sections, apply to this and the other sections of Division 27.
- B. This section is a Division 27 BASIC section and is a part of each Division 27 section.

1.2. SUMMARY

- A. This Section includes secure support from the building structure for technology items by means of cable tray, hangers, supports, anchors, sleeves, inserts, seals and associated fastenings.
- B. All support shall utilize threaded fasteners for all technology/attachments.
 - 1. Exception:
 - 2. Spring steel fasteners may be used in lieu of threaded fasteners only for ¾" raceways above suspended ceilings.
- C. Types of supports, anchors, sleeves and seals specified in this section include the following:
 - 1. Cable tray
 - 2. Cable basket
 - 3. Clevis hangers
 - 4. Riser clamps
 - 5. C-clamps
 - 6. I-beam clamps
 - 7. Conduit straps
 - 8. Round steel rods
 - 9. Lead expansion anchors
 - 10. Toggle belts
 - 11. Floor seals
- D. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment, are specified as part of that equipment assembly or as specified in Division 26.
- E. Wire basket support systems are defined to include, but are not limited to straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports and accessories.
- F. Ladder cable tray systems are defined to include, but are not limited to straight sections of ladder type cable trays, bends, tees, elbows, drop-outs, supports and accessories. Ladder cable tray is to be installed by the Contractor and supported independent of any cabinet or rack.
- G. This section also defines additional requirements for conduit installations.

1.3. REFERENCES

- A. NFPA 70 – National Electrical Code.
- B. ASTM B633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- C. ASTM A510 – Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
- D. NEMA VE 2-2000 – Cable Tray Installation Guidelines.
- E. ASTM A123 - Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes.
- F. NEMA VE 1-1998 - Metallic Cable Tray Systems.

1.4. DRAWINGS

- A. The drawings indicate the general route of cable tray support systems. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.
- B. Specifications and drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Contractor to make field surveys as part of his work prior to submitting system layout drawings.

1.5. SUBMITTALS

- A. Submit the following in accordance with Conditions of Contract and Supplementary Conditions Specifications Sections.
 - 1. Product Data: Submit manufacturer's data on supporting devices including catalog cuts, specifications, and installation instructions, for each type of support, anchor, sleeve and seal.
 - 2. Where multiple products are shown on one cut sheet, circle product to be used.
 - 3. Shop Drawings: Submit dimensioned drawings of fabricated products, indicating details of fabrication and materials.
 - 4. Submit drawings of cable tray (ladder type and wire basket) and accessories including connector assemblies, clamp assemblies, brackets, splice plates, splice bars, waterfalls, grounding clamps and hold down plates showing accurately scaled components. Show layout, support and installation details.
 - 5. Submit manufacturer's data on cable tray (ladder type and wire basket) support system including, but not limited to, types, materials, finishes, dimensions, colors and inside depths.

1.6. QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of supporting devices, of types, sizes, and ratings requires, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Contractor Qualifications: Firm shall have at least 3 years of successful installation experience with projects utilizing electronic/electrical supporting device work similar to that required for this project.
- C. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of supporting devices.
- D. MSS Compliance: Comply with applicable MSS standard requirements pertaining to fabrication and installation practices for pipe hangers and supports.
- E. UL Compliance: Provide components that are UL listed and labeled.
- F. FS Compliance: Comply with Federal Specification FF-S-760 pertaining to retaining straps for conduit, pipe and cable.
- G. Components shall be listed and labeled by ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.
- H. Comply with NEC, as applicable to construction and installation of cable tray and cable channel systems (Article 392).
- I. Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.
- J. Installer: Qualified with at least 3 years of successful installation experience on projects with technology raceway work similar to that required for this project.

1.7. DELIVERY, STORAGE, AND HANDLING

- A. Deliver cable tray (ladder type and wire basket) support systems and components carefully to avoid breakage, bending and scoring finishes. Do not install damaged equipment.
- B. Store cable tray (ladder type and wire basket) and accessories in original cartons and in clean dry space; protect from weather and construction traffic.

2. PRODUCTS

2.1. MANUFACTURERS

- A. Major items of equipment shall have manufacturer's name, address and catalog number on a plate securely attached. All equipment or apparatus of any one system must be the product of one manufacturer, or approved equivalent products of a number of manufacturer's that are suitable for use in a unified system.
- B. All materials and equipment for which Underwriter's Laboratories have established standards shall bear a UL label of approval.
- C. Where proprietary names are used, whether or not followed by the words "or as approved", they shall be subject to substitution only as approved by the Architect, Technology Consultant, and Owner.
- D. Where the Contractor proposes substitute equipment, contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work, shall be the responsibility of this Contractor, regardless of the trade involved.
- E. Subject to compliance with these specifications, cable tray (ladder type and wire basket) cable support systems to be installed shall be:
 - 1. Cablofil – CF105/200 BC (EZ)
 - 2. Cablofil – CF105/600 BC (EZ)
 - 3. Cablofil – CF54/100 (EZ)

2.2. SECTIONS AND COMPONENTS

- A. Provide cable tray (ladder type and wire basket) of types and sizes indicated; with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.
- B. Material and finish specifications for each metal cable tray type are as follows:
 - 1. Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510 and shall be electro-plated zinc in accordance with ASTM B633.
 - 2. Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510 and shall be coated after the wire basket runway has been fabricated in accordance with ASTM A123 (CSA Type 1). All hot-dip galvanized sections must be returned to the point of manufacture after coating for inspection and removal of all icicles and excess zinc. Failure to do so may result in damage to cables and/or injury to installers.
 - 3. Electro-Galvanized Zinc: Support accessories and miscellaneous hardware shall be coated in accordance with ASTM B633 SC3. All threaded components shall be coated in accordance with ASTM B633 SC1.
 - 4. To provide for allowable amounts of cable bend radius, provide cable fallouts or waterfalls at all points where cable transitions from horizontal to vertical.

2.3. CABLE TRAY AND SUPPORT SYSTEMS

- A. Wire basket shall be made of high strength steel wires and formed into a standard 2 inch by 4-inch wire mesh pattern with intersecting wires welded together. All wire ends along wire basket sides (flanges) shall be rounded during manufacturing for safety of cables and installers.
- B. Wire basket cable tray shall conform to the following nominal criteria:
 - 1. Straight sections shall be furnished in standard lengths.
 - 2. Wire basket shall have a 4 inch usable loading depth by the width identified on the drawings.
 - 3. All fittings shall be field formed as needed.
 - 4. The installation and all fittings of all raceways shall allow Category 6 cable and fiber optic cable to be pulled in and through in such a manner as to not exceed the pulling tension or minimum bending radius.
 - 5. All splicing assemblies shall be the bolted type using flange locknuts.
 - 6. Cable tray supports shall be center support hangers, trapeze hangers or wall brackets and shall be supported by 1/4 inch or 3/8 inch diameter rods.
 - 7. Special accessories shall be furnished as required to protect, support and install all cable tray support systems.
- C. Ladder type cable tray shall conform to the following nominal criteria:
 - 1. Straight section and fitting side rails and rungs shall be extruded from Aluminum Association Alloy 6063. All fabricated parts shall be made from Aluminum Association Alloy 5052.
 - 2. Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced 6 inches on center. Spacing in reduced fittings shall be 9 inches and measured at the center of the tray's width. Rungs shall have a minimum cable-bearing surface of 7/8 inch with reduced edges. No portion of the rungs shall protrude below the bottom plane of the side rails. Each rung must be capable of supporting the maximum cable load, with a safety factor of 1.5 and a 200 pound concentrated load when tested in accordance with NEMA VE-1, section 5.4.
 - 3. Ladder type tray sizes shall have 4 inch minimum usable load depth.
 - 4. Ladder type straight tray sections shall have side rails fabricated as I-Beams. All straight sections shall be supplied in standard 10 foot lengths, except where shorter lengths are permitted to facilitate tray assembly lengths as shown on drawings.
 - 5. Ladder type tray widths shall be 12, 18, or 24 inches as shown on drawings.

3. EXECUTION

3.1. DELIVERY, STORAGE, AND HANDLING

- A. Provide supporting devices that comply with manufacturer's standard materials. Install in accordance with published product information, and as required for a complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is Contractor's option.
- B. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NEC for installations of supporting devices.
- C. Support all technology cables a minimum of every 4 foot with J-hooks, unless other supports are available.
- D. Coordinate with the building structural system and electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- E. Do not fasten supports to pipes, ducts, mechanical equipment and conduit.
- F. Obtain approval from the Architect before drilling or cutting structural members.

- G. Install surface-mounted cabinets and panels with minimum of four anchors.

3.2. MISCELLANEOUS SUPPORTS

- A. Support miscellaneous technology components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panels, control enclosures, pull boxes, junction boxes and other devices.

3.3. FASTENING

- A. Unless otherwise indicated, fasten technology items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, cabinets, panels, boxes and control components in accordance with the following:
 - 1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
- B. Holes cut into reinforced concrete beams or in concrete shall not cut reinforcing bars. If the Contractor cuts into any reinforcing bars, stop work and notify the Technology Consultant immediately. Fill all holes that are not used.
- C. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.

3.4. CABLE TRAY INSTALLATION

- A. Install cable tray (ladder type and wire basket) as indicated; in accordance with recognized industry practices (NEMA VE-2 2000), ensure that the cable tray equipment complies with requirements of the NEC, and all general installation practices.
- B. Coordinate cable tray (ladder type and wire basket) with other electrical and mechanical work as necessary to properly interface installation of raceway with other work.
- C. Provide sufficient space encompassing cable tray (ladder type and wire basket) to permit access for installing and maintaining cables.
- D. For added support and stability, securely fasten cable tray (ladder type and wire basket) to top of racks and to walls in all MDF/IDF rooms at elevations shown on drawings.
- E. Install all raceways parallel to the wall or ceiling lines unless otherwise noted. Support basket cable raceways every 4' minimum and at 6" from ends or boxes.
- F. Ground the raceway per NEC Article 250, 392 and ANSI/TIA/EIA-607.
- G. Route raceways in a manner to avoid steam, water, or other liquid piping.
- H. Fish or blow through every run of conduit before plastering to guard against obstructions or omissions and plug ends carefully with tight fitting wood plugs or bush caps to avoid filling with plaster, dust, etc. and to avoid the possibility of condensation.
- I. Leave nylon or steel fish wire in all raceways where permanent wiring is not being installed under this contract.
- J. Install conduit making the total cross-sectional area of each raceway of sufficient size to permit ready installation or withdrawal of the cables required therein.
- K. Route cable tray (ladder type and wire basket) a minimum of 5" clearance from fluorescent light fixtures, 12" clearance from electrically operated equipment and all wiring at 120 or more volts and 4 ft. from transformers or large motors.
- L. All technology conduits are to be provided with nylon bushings to allow for cable pulling without damage.
- M. For cable support, provide strain relief a minimum of every 10' in vertical conduits runs. Provide the proposed method and products as a product submittal.

- N. In areas without suspended ceilings, install cable tray (ladder type and wire basket) raceways 6" below the lowest obstruction unless otherwise directed.

3.5. TESTS

- A. Test pull-out resistance of one of each type, size and anchorage material for the following fastener types:
 - 1. Expansion anchors.
 - 2. Toggle bolts.
 - 3. Powder-driven threaded studs.
- B. Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain and submit the Structural Engineer's signed approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.
- C. Test cable tray (ladder type and wire basket) support systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance.
 - 1. Manufacturer shall provide test reports witnessed by an independent testing laboratory of the "worst case" loading conditions outlined in this specification and performed in accordance with the latest revision of NEMA VE-1.

END OF SECTION 27 05 28

SECTION 27 05 53 IDENTIFICATION FOR COMMUNICATION SYSTEMS

1. GENERAL

1.1. RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.
- B. Drawings and general provisions including Division 1, apply to this Section.

1.2. SUMMARY

- A. This Section includes requirements for identification of components including but not limited to the following:
 - 1. Identification labeling for cables and conductors
 - 2. Operational or instructional signs
 - 3. Equipment labels and signs
- B. Refer to project drawings and other Division 27 sections for additional specific identification associated with specific items.
- C. Comply with the EIA/TIA Standard 606, "The Administration Standard for the Telecommunications Infrastructure".
- D. The Contractor shall submit, for approval by the Technology Consultant and Owner, a labeling system for the cable installation. The Owner will coordinate the exact verbiage of the labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cabinets, ground bars, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.
- E. All label printing shall be machine generated using indelible ink ribbons or cartridges. Self-laminating labels shall be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.

1.3. SUBMITTALS

- A. Submit the following in accordance with Section 27 01 10 Operation and Maintenance of Structured Cabling and Enclosures.
 - 1. Manufacturer's data for each type of product specified.
 - 2. Schedule of identification and nomenclature to be used for identification signs and labels.
 - 3. Samples of each color, lettering style and other graphic representation required for identification materials.

1.4. QUALITY ASSURANCE

- A. All work shall be in accordance with the general principles outlined in the BICSI TDMM manual latest edition and with the TIA-526, TIA-568-B.2-1 and TIA-606-A Standards.
- B. UL Compliance: Comply with applicable requirements of UL Standard 969, "Marking and Labeling Systems", with regard to type and size of lettering for raceways and cable labels.
- C. NEMA Compliance: Comply with applicable requirements of NEMA Standards WC-1 and WC-2 pertaining to identification of power and control conductors.

- D. Major items of equipment shall have manufacturer's name, address and catalog number on the plate securely attached in a convenient place.

1.5. SUGGESTED NUMBERING AND LABELING SCHEME

A. Workstation cable numbering standard:

1.
$$\frac{xDF \quad ROOM\#}{PORT\# \quad PANEL_LTR \quad PORT\#}$$
 (for first two jacks on duplex or quad outlet)

$$\frac{xDF \quad ROOM\#}{PORT\# \quad PANEL_LTR \quad PORT\#}$$
 (for second two jacks on quad outlet)

- a. xDF is MDF or IDF.
- b. ROOM# indicates the room number for the xDF.
- c. PANEL_LTR is the xDF patch panel letter.
- d. PORT# is the xDF patch panel port number.
- 2. There shall not be any open places on the patch panel except potentially the last panel in the xDF rack.
- 3. Terminate all outlets from the same room sequentially on the same patch panel.
- 4. If an outlet is added, it gets a new number that is next on the sequence even if it is on an existing faceplate.
- 5. Labeling techniques: The label shall be black letters on white background. Labels must be produced by label-making equipment. The blank white label tags that are included in the faceplate hardware are to be installed with clear plastic shields in all positions on the faceplate.
- B. Riser Cables
 - 1. Numbering scheme: Riser cables must be assigned specific numbers. Each shall be tagged with the building abbreviation and room number of the MDF at both ends of the cable clearly shown.
 - 2. Labeling techniques: Each cable is to be labeled on each end within 12" of where it terminates on the cross-connect panel. Cable tags must be securely fastened to the cable sheath. Wrap around tags protected by clear polyurethane tape may be used as well. Tags must be typed and be permanent. Cable tags that appear less than permanent will not be accepted. Directly writing on the cable sheath will not suffice as proper labeling of riser cables.
- C. UTP cabling cross-connect panels.
 - 1. Numbering scheme: 25 pair cables from the Utility RJ21X blocks are terminated on blocks. Cable pairs are numbered in 25 pair increments. The first cable is numbered 1-25, the second 26-50, etc. Pair #1 is terminated on the left position of the top block. Subsequent cable pairs are terminated from left to right and from top to bottom.
 - 2. Labeling techniques: The first label block shall read, "Cables to RJ21X blocks, 1-25". Subsequent label blocks shall denote the same for pairs 26 – 50, etc. The label shall be black letters on white background. Labels must be produced by label-making equipment. Handwritten labels are not allowed.
- D. Fiber optic cross-connect panels.
 - 1. Numbering scheme: Fiber optic cables and terminations shall be numbered and labeled per current EIA/TIA Standards. The numbering scheme denotes the cable function (campus backbone, building entrance, or intra-building), sheath number, and buffer tube number.
 - 2. Labeling techniques: A label shall be installed onto the outside of the front face of the connector housing to read, "Horizontal fiber optic cables to outlets" or "Entrance/riser fiber

optic cables” as appropriate. Labels must be produced by label-making equipment. Handwritten labels are not permitted. Horizontal fiber optic cables shall be labeled on the label tags on the closet connector housing. Each cable terminated shall be labeled with the following information: type of fiber optic cable and outlet number. For example, a label block for a multi-mode horizontal fiber optic cable termination might read, “MM – 17”. Terminations are numbered by the outlet number, not the housing or connector panel position number. Only adapter positions that are terminated are labeled.

- E. OSP fiber optic cables:
 - 1. Numbering scheme: The numbering scheme denotes the cable function (campus backbone or building entrance). Each fiber optic cable sheath shall be tagged in the MDF with the number and type of strands in the sheath (i.e. 18SM/18MM) and the building name of the far end of the cable clearly shown. In each intermediate manhole or hand hole each cable sheath shall be tagged with the number and type of strands in the sheath and the building names of each of the cable endpoints clearly shown.
 - 2. Labeling techniques: Each cable is to be labeled within 36” of where it enters the MDF. Cable tags may be cloth or plastic tape securely fastened to the cable sheath. Wrap around tags protected by clear polyurethane tape may be used as well. Tags must be typed and permanent. Cable tags that appear less than permanent will not be accepted. Directly writing on the cable sheath will not suffice as proper labeling. In intermediate manholes and hand holes, one wrap-around cable marker shall be installed on each cable sheath. Markers shall have a clear Mylar covering reading “Fiber Optic Cable – Caution” with space for cable designation. Cable markers shall be orange in color. Other types of tags, tapes, or sheath marking are not acceptable.
- F. Equipment racks:
 - 1. Numbering scheme: Each rack is numbered sequentially denoting the following information: building name, MDF room number, and rack number. There is no correspondence between the rack equipment configuration (type) and the rack number.
 - 2. Labeling techniques: Two labels shall be installed onto the front face of each equipment rack, one at the bottom of the rack, and one at the top. All labels shall be black letters on white background. Provide engraved stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver’s standard letter style of the sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening.
- G. Telecom room electrical receptacles:
 - 1. Each electrical receptacle in MDF shall be labeled with the following information: room number where electrical panel is located, panel number, and circuit number. Each receptacle is to be labeled on top or front of the faceplate or outlet box. Preprinted adhesive labels or tags shall be used.

2. PRODUCTS

2.1. TECHNOLOGY IDENTIFICATION PRODUCTS

- A. Cable/Conductor Identification bands:
 - 1. Provide Manufacturer’s standard wrap-around cable/conductor markers, of size required for proper application, and numbered to show circuit identification.
- B. Equipment Labels
 - 1. General: Provide engraved stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver’s standard letter style of the sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening.
 - 2. Thickness: 1/16”, for units up to 20 sq. in. or 8” length; 1/8” for larger units.
- C. Lettering and Graphics

1. General: Coordinate names, abbreviations and other designations used in technology identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the technology systems and equipment.
2. Fasteners for Plastic-Laminated Signs shall be self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and lock washers.
3. Exception: Where specifically approved contact type permanent adhesive may be used where screws cannot or should not penetrate substrate.

3. EXECUTION

3.1. GENERAL

- A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application.
- B. Lettering and Graphics: Coordinate names, abbreviations, colors and other designations used in technology identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by standards.
- C. Install identification devices as indicated, in accordance with manufacturers written instructions.
- D. Sequence of work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

3.2. CABLE/CONDUCTOR IDENTIFICATION

- A. Apply cable/conductor identification on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present. Match identification with marking system used on shop drawings, contract documents, and similar previously established identification for project's technology work.

3.3. OPERATIONAL SIGNS

- A. Provide instructional signs with approved legend where instructions or explanations are needed for system or equipment operation.

3.4. OUTLET IDENTIFICATION

- A. Label each voice and data outlet with the proper designation and provide appropriate icon.

3.5. INSTALLATION

- A. Provide equipment identification labels of engraved plastic-laminate on all equipment racks and on major units of technology equipment in buildings. Except as otherwise indicated, provide single line of text, with ½-inch high lettering on 1-½-inch high label (2-inch high where two lines are required), white lettering in black filled. Text shall match terminology and numbering of the Contract Documents and shop drawings.
 1. Provide labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION 27 05 53

SECTION 27 08 00 COMMISIONING COMMUNICATION SYSTEMS

1. GENERAL

1.1. RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General Provisions and Specification Sections, apply to this and the other sections of Division 27.
- B. This section relates to the Structured Cabling Sections of this specification.

1.2. SUMMARY

- A. This Section includes general administrative and procedural requirements for the structured cabling system and campus inter-building distribution systems. It includes terminations and testing parameters. Reference individual sections for further expansion of these requirements.
- B. Codes: The cabling system installation shall comply fully with all local, county and state laws, ordinances and regulations applicable to electronic and electrical installations.
- C. The following industry standards are the basis for the structured cabling system described in this document.

| | |
|-----------------|---|
| TIA/EIA-568-B | Commercial Building Telecommunications Cabling Standard |
| TIA/EIA-568-B.1 | General Requirements |
| TIA/EIA-568-B.2 | Balanced Twisted Pair Cabling Components Standard |
| TIA/EIA-568-B.3 | Optical Fiber Cabling Components Standard |
| TIA/EIA-569-A | Commercial Building Standard for Telecom Pathways and Spaces |
| TIA/EIA-606 | Administration Standard for the Telecommunications Infrastructure of Commercial Buildings |
| TIA/EIA-607 | Commercial Building Grounding/Bonding Requirements |
| NFPA 70 | National Electric Code (NEC) |
| ISO 11801 | Generic Cabling for Customer Premises |
- D. If there is a conflict between applicable documents, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.
- E. This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project.

2. PRODUCTS

2.1. QUALITY ASSURANCE PARAMETERS

- A. All work shall be performed in accordance with these guidelines, current industry testing standards, and with the test equipment manufacturer recommendations. All work shall be in accordance with the general principles outlined in the BICSI TDMM manual, latest edition. The system shall be Category 6 UTP System Registered.
- B. All equipment or apparatus of any one system must be the product of one manufacturer, or approved equivalent products of a number of manufacturer's that are suitable for use in a unified system.

- C. All materials and equipment for which Underwriter’s Laboratories have established standards shall bear a UL label of approval.
- D. Where proprietary names are used, whether or not followed by the words “or as approved”, they shall be subject to substitution only as approved by the Technology Consultant.
- E. Where the Contractor proposes substitute equipment, contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.
- F. Use a (1) calibrated Fluke DTX-1800 Cable Analyzer, including DTX-1800 Main and Smart Remote, LinkWare PC Software, 128MB MMC Card, CAT 6/Class E Permanent Link Adaptors (2), CAT 6/Class E Channel Adapters (2), Headset for Talk (2), AC Chargers (2), carrying case, USB interface cable (Mini-B), Serial RS-232 cable (DB9to IEEE 1394), and user manuals. This tester shall be used during testing of this project.

3. EXECUTION

3.1. UTP CABLE TESTING

- A. Riser and inter-building distribution cable testing: Each cable pair within all UTP riser cables shall be tested for continuity to ensure conductors are terminated in proper sequence, with correct polarity (tip and ring), and without conductor-to-conductor shorts, conductor-to-ground shorts, or opens.
- B. Horizontal cable testing: All UTP station cables shall be tested to prove compliance with the current industry standard, TIA-568-B.2 including Appendix 10 and any subsequent addenda. Channel tests are the only acceptable test format; link tests will not be sufficient.
- C. Horizontal cable testing equipment: The testing of UTP station cables shall be performed using the required test equipment specifically designed to test cables for all CAT 6 parameters from 0 – 250 MHz Testers shall be loaded with the most recent test values per the above referenced standard. The contractor may be required to provide documentation (or demonstration) that the testers used are properly programmed as described above.
- D. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-A including applicable Technical Service Bulletins and amendments. The appropriate level III tester shall be used to verify CAT 6 cabling systems.

3.2. FIBER OPTIC CABLE TESTING

- A. Inter-building cable testing requirements:
 - 1. Test all cables in both directions.
 - a. Test multi-mode strands at 850 nm and 1300 nm.
 - b. Test single-mode strands at 1310 nm and 1550 nm.
 - c. Use optical time domain reflectometer (OTDR) for tests.
 - d. Record the following at the above frequencies:
 - 1) End-to-end attenuation.
 - 2) Polarity.
 - 3) Length.

3.3. TEST RESULTS

- A. Submission. Prior to acceptance, the contractor shall submit a copy of all applicable test results to the Owner/Technology Consultant in both electronic (file) and paper form.
- B. CAT 6 UTP cables: The test results submitted for CAT 6 UTP cables shall include the following:

1. Graphical/numerical data. Both graphical data plots and numerical data are required for the following test parameters:
 - a. NEXT
 - b. PS NEXT
 - c. ELFEXT
 - d. PS ELFEXT
 - e. Attenuation
 - f. Return loss
2. Numerical data. Numerical data only is required for the following test parameters:
 - a. Propagation delay
 - b. Delay skew
 - c. Resistance
 - d. ANEXT
 - e. AFEXT
 - f. PSANEXT
 - g. PSAFEXT
- C. UTP riser cables: Continuity tests shall be performed on each pair. The contractor shall submit a document confirming that these cables were tested satisfactorily per these guidelines.
- D. Fiber optic cables: Provide test report and include as a minimum the following information for all cables:
 1. Fiber cable number.
 2. Fiber length.
 3. Attenuation (loss in dB).
 4. Test Date.
 5. Tester make and model no.
 6. Tester calibration date.
 7. The maximum optical attenuation per connector pair for multimode fiber connectors shall be 0.3 dB or less when measured at 850/1300 nm in accordance with ANSI/EIA/TIA-526-14A, Method A-1. Maximum optical attenuation per connector for singlemode fiber connectors shall be .05 dB or less when measured at 1310/1550 nm in accordance with ANSI/EIA/TIA-256-7, Method B. Reflection shall be ≥ 45 dB.

3.4. SYSTEM DOCUMENTATION

- A. When all work has been completed and before final acceptance, the Contractor shall furnish to the Technology Consultant a complete set of documents that clearly represent all contract work "as-built". This shall be inclusive of all test results and drawings. The Contractor is responsible for assuring the accuracy of the As-Built documentation.
- B. The contractor shall submit, within forty (40) working days of the completion of each phase, three (3) full sets of As-Built documentation to the Technology Consultant for approval. Prior to delivery, each document section and each drawing shall be signed and dated by the Contractor's project manager attesting to the accuracy of the as-built documents.
- C. Electronic drawing files must conform to project drawing standards and be in the AutoCAD 2000 format. The As-Built drawings shall include at minimum, equipment locations, cable routes and outlet locations, and clearly show any deviations from the Contract Documents.
- D. Note -The Technology Consultant is under no obligation to provide the Contractor with digital drawing files. However, digital drawing files may be provided to the Contractor for use in the development of Shop Drawings or As-Built drawings under a separate agreement between the Contractor and the Architect.
- E. Test printouts and electronic documentation (CD's) generated for each cable by the wire (or fiber) shall be submitted as part of the documentation package. The CD's shall contain the electronic equivalent of the test results and be of a format readable from Microsoft Word or Excel.

- F. The As-Built drawings shall include outlet locations. Their sequential number, as defined elsewhere in this document, shall identify outlet locations. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. These documents shall be modified accordingly by the contractor to denote as-built information as defined above and returned to the Technology Consultant.
- G. The Technology Consultant may request that a 3% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by the Architect or Technology Consultant, including a 100% re-test. This re-test shall be at no additional cost to the Owner.
- H. Test Results documentation shall be clearly marked on the outside front cover with the words "Project Test Documentation" and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, and reference setup. The test equipment name, manufacturer, model number, serial number, software version and calibration date shall also be provided at the end of the document. 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.
 - 1. 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.

END OF SECTION 27 08 00

SECTION 27 11 00 COMMUNICATIONS EQUIPMENT ROOM FITTINGS

1. GENERAL

1.1. RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.
- B. Drawings and general provisions including Division 1, apply to this Section.

1.2. SUMMARY

- A. This Section includes the following:
 1. Floor-standing equipment racks.
 2. Cable Management.
 3. Rack mounted power protection and power distribution devices.
- B. Refer to following Specification Sections:
 1. Division 6 Section "Rough Carpentry" for wood framing and blocking for installation of wall-mounted equipment racks.
 2. Division 7 Sections for fire stopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
 3. Division 26 Sections for supports, anchors, identification products, electrical service and connections.
- C. Provide cabinets and racks in accordance with the Contract Documents. Where conflicting data is indicated, verify mounting and equipment requirements prior to ordering.
- D. This section contains specific parts selected by Owner and Technology Consultant. In the event that the parts specified are not available, Owner and Technology Consultant shall be contacted to specify replacements.

1.3. COORDINATION

- A. This contractor shall be responsible for all coordination with the general and electrical contractor and data and voice vendors to provide a complete operational system.
- B. Coordinate layout and installation of equipment racks with adjacent construction.

1.4. SUBMITTALS

- A. Product Data: For copper protection devices, cabinets and equipment racks, termination blocks and patch panels, cable management devices, and power distribution devices.
- B. Shop Drawings: Show fabrication and installation details of components for cabinets, equipment racks, and their associated parts and pieces to make a complete system.
- C. Allow sufficient time in project scheduling for Owner and Technology Consultant review.
- D. Submittals shall be checked by the supplier and made as complete systems including all required accessories and any special tools.
- E. Manufacturer's installation and maintenance instructions.

1.5. QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of enclosure through one source from a single manufacturer.
- B. All work shall be in accordance with the latest edition of all applicable State, and Federal regulations and codes. Further, all work shall also be in accordance with EIA/TIA Standards, the BICSI TDMM manual, latest edition and with the manufacturer's recommendations.

1.6. SEQUENCING AND SCHEDULING

- A. Sequence all work to support the installation of the structured cabling system, electrical work and all cable tray systems installation.

2. PRODUCTS

2.1. MANUFACTURERS

- A. Available Manufacturers are listed in subparagraphs for each Part 2 article below.
- B. Other Manufacturers' products must be submitted for Owner and Technology Consultant review for approval.

2.2. ENTRANCE PROTECTION

- A. Provide proper lightning protection for all copper cables entering New Office.
- B. Provide protectors on both ends of copper backbone cables.
- C. Products shall be Avaya/Lucent Type 480 with 110 connectors and 5-pin solid state protectors with heat coils.

2.3. RACKS

- A. Standard Floor Distribution Frame; for rack mounted installations the telecommunication rooms as shown, provide 7-foot high 19-inch equipment racks. Quantities shall be as shown.
 - 1. The racks shall be made by an ISO 9001 and 14001 Certified Manufacturer; Chatsworth Products (CPI) Rack System or approved equal. Ensure product submittal includes all accessories and insures system compatibility.
 - 2. Provide 7' ft. high, 10 in. wide double-sided vertical cable managers mounted between racks with hinged covers that can handle large quantities of cables and patch cords. Doors shall hinge from either the left or right side. Cable managers must retain cables even when covers are removed. Use 6 in. wide double-sided vertical cable managers at the end of each row.
 - 3. The vertical cable managers shall allow cables to be routed between adjacent racks.
 - 4. The racks shall be 7 ft. high and have standard 19-inch ANSI/EIA-310-C mounting holes having a full 45 RU on front and back of rails.
 - 5. The racks shall utilize black grommets at all cable openings, including unused cable openings.
 - 6. The racks shall have floor mounting holes and a ground lug for 0-6 gauge ground cable provided.
 - 7. Racks shall be Chatsworth (CPI) number 55053-703 (black).
 - 8. Vertical cable managers at both ends of a rack row shall be 6" wide, CPI part number 30095-703 (black).
 - 9. Vertical cable managers between racks shall be 10" wide, CPI part number 30096-703 (black)
 - 10. Provide (1) CPI 30530-719 2-RU horizontal wire management panel for each rack. There shall not be any horizontal wire management panels between patch panels.

3. EXECUTION

3.1. LIGHTNING PROTECTION

- A. All copper cables, either multi-pair or coaxial, are to be terminated on lightning protection within 50 feet of the entrance into the building.

- B. All pairs of inter-building twisted pair copper cable are to be protected on both ends to lightning protection blocks.
- C. Lightning Protection Blocks are to be grounded to the nearest Telephone Main Grounding Bar (TMGB) or Telephone Grounding Bar (TGB).

3.2. RACKS

- A. Preparation
 - 1. Coordinate requirements for riser bases, raised floor riser feet, anchors, bracing, and blocking to ensure adequate means for installation of racks/cabinets.
 - 2. Coordinate requirements for electrical cable pathways from overhead cable trays and management systems.
- B. Installation
 - 1. Install racks in compliance with manufacturer's written instructions and shop drawings.
 - 2. Floor-standing racks/cabinets in the telecommunication rooms shall be securely attached to the concrete floor using minimum 3/8" in diameter hardware utilizing an approved length.
 - 3. Install equipment racks at locations and heights indicated on Drawings. Rows of racks/cabinets shall be placed with a 36-inch (minimum) clearance from the walls on all sides of the rack, unless otherwise indicated on Drawings. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks/cabinets. Where racks/cabinets are shown side by side, securely connect together using manufacturer's ganging hardware to provide a stable system. Supply all miscellaneous parts and pieces to make a complete system.
 - 4. Vertical cable managers shall be installed on both sides (left and right) of each rack in the telecommunications rooms. Every rack will shall have two vertical cable managers even if multiple racks are being installed adjacent to each other (e.g. 2 racks will have 4 vertical cable managers, one on each end, and one double-wide or two single-wide in between). A double-wide vertical cable manager would be preferred for installations between racks, however.
 - 5. Vertical cable managers shall be installed such that the manager is offset toward the front of the rack so that the cable manager fingers line up with the front edge of the rack. It shall not be centered.
 - 6. All racks/cabinets shall be grounded to the ground bus bar in accordance with the drawings and other Sections of this document.
 - 7. Rack mount screws not used for installing patch panels, keys and other hardware shall be bagged and left with the rack upon completion of the installation.

END OF SECTION 27 11 00

SECTION 27 13 00 COMMUNICATIONS BACKBONE CABLING

1. GENERAL

1.1. RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.
- B. This section is inclusive to all Division 27 sections.
- C. Division 7 Sections for fire stopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.

1.2. DRAWINGS

- A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.
- B. In all details, the work shall be subject to the Owner's direction and approval. All work shall conform to its surroundings in best possible manner.

1.3. SCOPE OF WORK

- A. General
 1. This project includes the installation of fiber and copper cables.
 2. All UTP terminations must follow 568A wiring schematic.
 3. Copper cabling shall be manufactured by Superior-Essex or approved equal.
 4. Fiber optic cabling shall be manufactured by Corning.
- B. The Contractor shall provide a complete structured cabling system that will accommodate voice, data, and security for rooms defined in scope.
- C. Inter-Backbone Cabling Description:
 1. The building will be connected to the Rice Campus network via 24-strand SM fiber cable from nearest Rice campus fiber hub or 12-strand SM home run back to Mudd Building and 12-strand SM home run back to BRC building
 - a. Cables will enter the building through 1 of 2 4" conduits terminating in the MDF closet
- D. Intra-Building Backbone Distribution
 1. The fiber backbone will be a 24-strand SM cable and a 24-strand MM cable. Each IDF will have dedicated rack-mounted termination housings in the MDF; both SM and MM fibers will terminate in the same housing. In each IDF, the fiber cables will terminate in a single rack-mounted termination housing. All fiber terminations will use SC connectors.

2. PRODUCTS

2.1. BACKBONE CABLING

- A. Cables allowed for use in the backbone include: 100 Ω UTP multi pair copper cables. The cable shall support voice, security and miscellaneous applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation.
- B. All UTP cables shall conform to ANSI/TIA/EIA-568-A Commercial Building Telecommunications Cabling Standard and ISO/IEC 11801 (International) Generic Cabling for Customer Premises standard.
- C. Provide all necessary appurtenances for a complete system.
- D. Copper Backbone (Multi-pair UTP)
 - 1. Multi-pair cables shall:
 - a. Be manufactured by: Superior-Essex #18-A99-86 50-Pair for intra-building backbone.
 - b. Be 100 Ω cables category 3, greater than 4 pairs.
 - c. Be categorized using power sum testing and meet the hybrid cable requirements for use in horizontal cabling.
 - d. Be appropriate for the environment in which it is installed.
 - E. The backbone cables shall be installed in a star topology, emanating from the main cross-connect to each telecommunications room.
 - F. Backbone pathways shall be installed or selected such that the minimum bend radius of backbone cables is kept within manufacturer specifications both during and after installation.
- G. Fiber Backbone Cables:
 - 1. Armored fiber backbone cable:
 - a. Shall meet the environmental requirements for the areas in which it is installed.
 - b. Armored Fiber backbone cable shall be:
 - 1. Aluminum armored with an outer jacket.
 - 2. Contain tight-buffered fiber.
 - 3. Meet ICEA 5-83-596 test criteria.
 - 4. Nominally plenum rated ONFP
 - c. Armored 288-strand 8.3/125 μm (1310/1550 nm) SM fiber OSP backbone cable shall:
 - 1. Have maximum attenuation of 0.65/0.50 dB/km
 - 2. Be Corning 288WC-T4101D20
 - d. Armored 24-strand 8.3/125 μm (1310/1550 nm) SM fiber backbone cable shall:
 - 1. Have maximum attenuation of 0.65/0.50 dB/km
 - 2. Have an outer jacket color of YELLOW
 - 3. Be Corning 024E88-33131-A3
 - e. Armored 24-strand 50/125 μm (850/1300 nm) 10Gbe MM fiber backbone cable shall:
 - 1. Have maximum attenuation of [3.5/1.5] dB/km
 - 2. Have minimum bandwidth of [1500/500] MHz·km
 - 3. Have an outer jacket color of TEAL
 - 4. Be Corning 024S88-33180-A3
 - f. Armored 24-strand 50/125 μm (850/1300 nm) MM fiber armored backbone cable shall:
 - 1. Have maximum attenuation of 3.5/1.5 dB/km
 - 2. Have minimum bandwidth of 500/500 MHz·km
 - 3. Have an outer jacket color of ORANGE
 - 4. Be Corning 024C88-33131-A3
 - 2. Fiber optic cable shall be terminated in rack mounted panels equipped with sufficient ports, slack storage space and splice trays if required to terminate and secure all fibers.
- H. Backbone Terminations
 - 1. Fiber Terminations:
 - a. Shall be as manufactured by Corning.

- b. Provide the following as shown and as required:
 1. CCH-01U Connector housing accepting two fiber panels
 2. CCH-02U Connector housing accepting four fiber panels
 3. CJP-01U Jumper management panel, 1U height
 4. CJP-02U Jumper management panel, 2U height
 5. FDC-CABLE-GRND Armored cable grounding kit
 6. FDC-CP1P-12-G7 12 fiber 50 μ m MM SC duplex connector panel
 7. FDC-CP1P-12-59 12 fiber SM SC duplex connector panel
- 2. Copper terminations shall:
 - a. Terminated on 110 blocks on wall-fields.
 - b. Have adjacent 110 blocks to create a cross-connect field.
 - c. Cross connect-field will tie to 48-port patch panels in racks for voice.
 - d. Test and label all copper terminations.

3. EXECUTION

3.1. SITE SURVEY

- A. Prior to placing any cable pathways or cable, the Contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.

3.2. PHYSICAL INSTALLATION

- A. Industry requirements; The following installation, documentation, component and system industry specifications shall be met or exceeded:
 1. ANSI/TIA/EIA-568-B.1 and addenda "Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements".
 2. ANSI/TIA/EIA-568-B.2 and addenda "Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted-Pair".
 3. ANSI/TIA/EIA-568-B.3 and addenda "Commercial Building Telecommunications Cabling Standard - Part 3: Optical Fiber Cabling and Components Standard".
 4. ANSI/TIA/EIA-569-A and addenda "Commercial Building Standard for Telecommunications Pathways and Spaces".
 5. ANSI/TIA/EIA-606 and addenda "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings".
 6. ANSI/TIA/EIA-607 and addenda "Commercial Building Grounding and Bonding Requirements for Telecommunications".
 7. ANSI/TIA/EIA-526-7" Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant".
 8. ANSI/TIA/EIA-526-14A "Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant".
 9. IEC/TR3 61000-5-2 - Ed. 1.0 and amendments "Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines - Section 2: Earthing and cabling".
 10. ISO/IEC 11801:2000 Ed1.2 and amendments "Information technology - Generic cabling for customer premises".
 11. CENELEC EN 50173:2000 and amendments "Information Technology - Generic cabling systems".
- B. Cable Pathways

1. Pathways shall be designed and installed to meet applicable local and national building and electrical codes or regulations.
2. Grounding and bonding of pathways shall comply with applicable codes and regulations.
3. Pathways shall not have exposed sharp edges that may come into contact with telecommunications cables.
4. The number of cables placed in a pathway shall not exceed manufacture specifications, nor, will the geometric shape of a cable be affected.

C. Cable Routing

1. In open ceiling cabling, cable supports shall be provided by means that is structurally independent of the suspended ceiling, its framework, or supports. These supports shall be spaced no more than 1.5 m (5 ft.) apart.
2. Telecommunications pathways, spaces and metallic cables, which run parallel with electric power or lighting, which is less than or equal to 480 Vrms, shall be installed with a minimum clearance of 50 mm (2 in).
3. The installation of telecommunications cabling shall maintain a minimum clearance of 3 m (10 ft) from power cables in excess of 480 Vrms.
4. No telecommunications cross-connects shall be physically located within 6 m (20 ft.) of electrical distribution panels, step down devices, or transformers, which carry voltages in excess of 480 Vrms.
5. In the telecommunications rooms where cable trays or cable racking are used, the Contractor shall provide appropriate means of cable management such as reusable color-coded hook and loop cable managers (ties) to create a neat appearance and practical installation.
6. In a false ceiling environment, a minimum of 9 inches shall be observed between the cable supports and the false ceiling.
7. Continuous conduit runs installed by the Contractor should not exceed 30.5 m (100 ft) or contain more than two (2) 90 degree bends without utilizing appropriately sized pull boxes.
8. Maximum conduit pathway capacity shall not exceed a 40% fill. However, Perimeter fill is limited to 60% fill for move and changes.

D. Pulling Tension

1. The maximum cable pulling tensions shall not exceed manufacturer's specifications.

E. Bend Radius

1. The maximum cable bend radii shall not exceed manufacturer's specifications.
2. In spaces with UTP cable terminations, the maximum bend radius for 4-pair cable shall not exceed four times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.
3. During the actual installation, bend radius on 4-pair cable shall not exceed eight times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.

F. Slack

1. In telecommunications rooms, a minimum of 3 m (10 ft) of slack should be left for all cable types. This slack must be neatly managed on trays or other support types.

G. Cable Wraps

1. Hook and loop cable managers should be used in the telecommunications rooms where reconfiguration of cables and terminations may be frequent.

H. Grounding

1. Grounding and bonding shall be done per applicable codes and standards.

I. Fire Protection

1. Properly installed firestop systems shall be installed to prevent or retard the spread of fire, smoke, water, and gases through the building. This requirement applies to openings designed for telecommunications use that may or may not be penetrated by cables, wires, or raceways.

2. Fire stops shall comply with all applicable codes.

J. Workmanship

1. All work shall be done in a workman like fashion of the highest standards in the telecommunications industry. All equipment and materials are to be installed in a neat and secure manner, while cables are to be properly dressed. Workers must clean any debris and trash at the close of each workday.

END OF SECTION 27 13 00

SECTION 27 15 00 COMMUNICATIONS HORIZONTAL CABLING

1. GENERAL

1.1. RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.

1.2. DRAWINGS

- A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.
- B. In all details, the work shall be subject to the Owner's direction and approval. All work shall conform to its surroundings in best possible manner.

1.3. SCOPE OF WORK

- A. General
 1. The Campus network-cabling solution shall be based upon structured cabling system components manufactured by The Siemon Company. This shall include but may not be limited to cable management, faceplates, copper and fiber modules, patch panels, racks, 110/210 blocks, patch cords, labels and grounding lugs.
 2. ALL UTP TERMINATIONS SHALL FOLLOW 568A WIRING SCHEMATIC.
 3. All copper cabling shall be manufactured by The Siemon Company.
 4. The Contractor shall provide a complete structured cabling system that will accommodate voice, data, security and video applications for all areas. This included all locations shown on the drawings for telephones, computers, printers, surveillance cameras, wireless access points, projectors, flat panel displays, etc.
 5. Contractor shall provide other outlets as listed below or indicated on drawings.

2. PRODUCTS

2.1. HORIZONTAL CABLING

- A. The Horizontal Subsystem is the portion of the telecommunications cabling system that extends from the work area telecommunications outlet/connector to the horizontal cross-connect in the telecommunications room. It consists of the telecommunications outlet/connector, the horizontal cables, and that portion of the cross-connect in the telecommunications room serving the horizontal cable.
- B. Cable Types
 1. All UTP cables shall conform to ANSI/TIA/EIA-568-A Commercial Building Telecommunications Cabling Standard (latest amendment and including all applicable addenda) and ISO/IEC 11801 (International) Generic Cabling for Customer Premises standard (latest amendment and including all applicable addenda).
 - a. COPPER: Cable shall meet or exceed the following parameters:
 1. Have a round lead free cable jacket available in both CMR and CMP options with a nominal cable O.D. of less than or equal to 5.64mm (0.222 in.)
 2. Have a construction comprised of 4-pairs of 23AWG solid bare copper conductors

3. Have a spiral isolation member to ensure compliance with alien crosstalk performance
4. Be available in 1000' reels
5. Be available in white, red, gray, yellow, blue and green
6. Provide the following 4-connector nominal channel performance
7. Cable shall be Siemon CAT6 Plenum F/UTP 9A6P4-A5-06-R1A - blue

C. INFORMATION OUTLETS

1. Exceed category 6 component compliance through the frequency range of 1 to 250MHz with usable bandwidth to 250MHz
2. Be available in black, white, red, gray, yellow, blue, orange, ivory, bright white, light ivory and alpine white
3. Have available a gravity feed (45 degree angled) design to help control patch cord bend radius as well as flush mount design
4. Have 310 style insulation displacement connectors with quadrant pair isolation and a Pyramid wire entry system
5. Allow termination with a single conductor 110 style impact tool
6. Have available termination aid (included with each box of 20) for stabilization of module to facilitate lacing and impact during termination
7. Be backwards compatible to allow lower performing categories of cables or connecting hardware to operate to their full capacity
8. Have rear protective strain relief caps with side or rear entry, which can be installed onto cable before or after termination
9. Support industry standards for T568A or T568B wiring options on each individual outlet
10. Allow installation from the front or rear of the faceplate, and allow for the jack to pass through the faceplate without re-termination
11. Have an optional color matching protective, hinged or flexible door to protect the outlet from dust and other airborne contaminants
12. Provide color-coded, slide-in icons available for circuit identification
13. Allow for a minimum of 20 terminations without signal degradation below standards compliance limits
14. Be constructed of high impact, flame-retardant thermoplastic
15. Have, as an option, an outlet, which can be mounted into an IEC 60603-7 compliant opening (keystone)
16. Must be certified by Underwriters Laboratories to United States Standards and C22.2 Canadian Telecommunications Standards
17. Patch panel outlets shall be Siemon part numbers MX6-F01 (flat, black).
18. Information outlets shall be Siemon part number MX6-F02 (flat).
19. Wireless AP patch panel outlets shall be Siemon part number MX6-F07 (flat, green).
20. Security Camera patch panel outlets shall be Siemon part number MX6-F09 (flat, orange).
21. Information outlets in surface mounted raceway or lab benches shall be Siemon part number MX6-F02 (flat).
22. Information outlets for wireless access points shall be Siemon part number MX6-F02 (flat).

D. FACEPLATES: All faceplates shall:

1. Be applicable to both fiber and copper applications.
2. Be available in 2 and 4-port single-gang configurations or 6 and 8-port double-gang configurations.
3. Allow modules to be removed from the front of the faceplate.
4. Allow UTP modules to pass through faceplates even after termination.
5. Have write on designation labels for circuit identification together with a clear plastic cover.

6. Feature easily removable designation label covers which can be removed without use of tools.
 7. Be available in single-gang and double-gang configurations.
 8. Have as a minimum the standard colors of black, white, gray, ivory and light ivory.
 9. Have Designer style faceplates and mounting frames available
 10. Have surface mount boxes and standoff rings available for both single and double gang faceplates.
 11. Be manufactured using UV resistant, high impact thermoplastic to prevent color fading and provide additional durability.
 12. Must be certified by Underwriters Laboratories to United States Standards and C22.2 Canadian Telecommunications Standards.
 13. Shall be Siemon MX-FP-S-04-02 (white, but final color may be altered to match architectural finishes) for single gang applications and MX-FP-D-04-02 (white, but final color may be altered to match architectural finishes) for double-gang applications as shown. Use Siemon Company # MX-WP-K6-SS for wall mounted telephone outlets.
 14. Blank outlet covers shall be provided for all faceplate openings that do not have cable outlets installed.
- E. PATCH PANELS
1. Color shall be black.
 2. Shall contain rear cable management bar(s) to neatly route cable to terminations.
 3. Shall contain removable designation labels
 4. Shall be made by an ISO 9001 and 14001 Certified Manufacturer.
 5. Shall be Siemon MX-PNLA-48 (black).

3. EXECUTION

3.1. SITE SURVEY

- A. Prior to placing any cable pathways or cable, the Contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.

3.2. Physical Installation

- A. Industry requirements; The following installation, documentation, component and system industry specifications shall be met or exceeded:
1. ANSI/TIA/EIA-568-B.1 and addenda "Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements".
 2. ANSI/TIA/EIA-568-B.2 and addenda "Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted-Pair".
 3. ANSI/TIA/EIA-568-B.3 and addenda "Commercial Building Telecommunications Cabling Standard - Part 3: Optical Fiber Cabling and Components Standard".
 4. ANSI/TIA/EIA-569-A and addenda "Commercial Building Standard for Telecommunications Pathways and Spaces".
 5. ANSI/TIA/EIA-606 and addenda "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings".
 6. ANSI/TIA/EIA-607 and addenda "Commercial Building Grounding and Bonding Requirements for Telecommunications".
 7. ANSI/TIA/EIA-526-7 "Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant".
 8. ANSI/TIA/EIA-526-14A "Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant".

9. IEC/TR3 61000-5-2 - Ed. 1.0 and amendments "Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines - Section 2: Earthing and cabling".
 10. ISO/IEC 11801:2000 Ed1.2 and amendments "Information technology - Generic cabling for customer premises".
 11. CENELEC EN 50173:2000 and amendments "Information Technology - Generic cabling systems".
- B. Cable Pathways
1. Pathways shall be designed and installed to meet applicable local and national building and electrical codes or regulations.
 - a. Grounding / Earthing and bonding of pathways shall comply with applicable codes and regulations.
 - b. Pathways shall not have exposed sharp edges that may come into contact with telecommunications cables.
 - c. The number of cables placed in a pathway shall not exceed manufacture specifications, nor, will the geometric shape of a cable be affected.
- C. Cable Routing
1. The combined length of jumpers, or patch cords and equipment cables in the telecommunications room/closet and the work area should not exceed 10m (33 ft) unless used in conjunction with a multi-user telecommunications outlet.
 2. Two horizontal cables shall be routed to each work area. At least one horizontal cable connected to an information outlet shall be 4-pair, 100 Ω unshielded twisted-pair (UTP).
 3. Horizontal pathways shall be installed or selected such that the minimum bend radius of horizontal cables is kept within manufacturer specifications both during and after installation.
 4. In open ceiling cabling, cable supports shall be provided by means that is structurally independent of the suspended ceiling, its framework, or supports. These supports shall be spaced no more than 1.5 m (5 ft.) apart.
 5. Telecommunications pathways, spaces and metallic cables, which run parallel with electric power or lighting, which is less than or equal to 480 Vrms, shall be installed with a minimum clearance of 50 mm (2 in).
 6. The installation of telecommunications cabling shall maintain a minimum clearance of 3 m (10 ft.) from power cables in excess of 480 Vrms.
 7. No telecommunications cross-connects shall be physically located within 6 m (20 ft) of electrical distribution panels, step down devices, or transformers, which carry voltages in excess of 480 Vrms.
 8. For voice or data applications, 4 pair UTP or fiber optic cables shall be run using a star topology from the telecommunications room serving that floor to every individual information outlet.
 9. The Contractor shall observe the bending radius and pulling strength requirements of the 4 pair UTP and fiber optic cable during handling and installation.
 10. Each run of UTP cable between the horizontal portions of the cross-connect in the telecommunication room and the information outlet shall not contain splices.
 11. In the telecommunications room where cable trays or cable racking are used, the Contractor shall provide appropriate means of cable management such as reusable color-coded hook and loop cable managers (ties) to create a neat appearance and practical installation.
 12. In a false ceiling environment, a minimum of 3 inches (75 mm) shall be observed between the cable supports and the false ceiling.
 13. All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.
 14. The number of horizontal cables placed in a cable support or pathway shall be limited to a number of cables that will not cause a geometric shape of the cables.
 15. Maximum conduit pathway capacity shall not exceed a 40% fill. However, Perimeter fill is limited to 60% fill for move and changes.

16. Horizontal distribution cables shall not be exposed in the work area or other locations with public access.
 17. Cables routed in a suspended ceiling shall not be draped across the ceiling tiles. Cable supports shall be mounted a minimum of 75 mm (3 in) above the ceiling grid supporting the tiles.
 18. All horizontal cables, regardless of media type, shall not exceed 90 m (295 ft.) from the telecommunications outlets in the work area to the horizontal cross connect.
- D. Work Area Termination
1. All UTP cables wired to the telecommunications outlet/connector shall have 4-pairs terminated in eight-position modular outlets in the work area. All pairs shall be terminated.
 2. The telecommunications outlet/connector shall be securely mounted at planned locations.
 3. The height of the telecommunications faceplates shall be to applicable codes and regulations.
 4. The maximum cable pulling tensions shall not exceed manufacturer's specifications.
- E. Bend Radius
1. In spaces with UTP cable terminations, the maximum bend radius for 4-pair cable shall not exceed four times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.
 2. During the actual installation, bend radius on 4-pair cable shall not exceed eight times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.
 3. The maximum cable bend radii shall not exceed manufacturer's specifications.
- F. Slack
1. In telecommunications room/closets a minimum of 3 m (10 ft) of slack should be left for all cable types. This slack must be neatly managed on trays or other support types.
 2. In the work area, a minimum of 300 mm (12 in) should be left for UTP, while 1 m (3 ft.) be left for fiber cables
- G. Cable Tie Wraps
1. Hook and loop cable managers should be used in the telecommunications rooms where reconfiguration of cables and terminations may be frequent.
 2. Only plenum rated hook and loop Velcro style cable ties are permitted. Zip-tie cable wraps shall NOT be used.
 3. Tie wraps shall be used at appropriate intervals to secure cable and to provide strain relief at termination points. These wraps shall not be over tightened to the point of deforming or crimping the cable sheath.
- H. Grounding
1. Adherence to ANSI/TIA/EIA-607 and addenda "Commercial Building Grounding and Bonding Requirements for Telecommunications".
- I. Fire Protection
1. Fire stops shall comply with applicable codes.
 2. Properly installed firestop systems shall be installed to prevent or retard the spread of fire, smoke, water, and gases through the building. This requirement applies to openings designed for telecommunications use that may or may not be penetrated by cables, wires, or raceways.
- J. Workmanship

SECTION 27 16 00 COMMUNICATIONS CONNECTING CORDS AND DEVICES

1. GENERAL

1.1. RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.

- B. This section is inclusive to all Division 27 sections.
- C. Division 7 Sections for fire stopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.

1.2. DRAWINGS

- A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.
- B. In all details, the work shall be subject to the Owner's direction and approval. All work shall conform to its surroundings in best possible manner.

1.3. SCOPE OF WORK

- A. General
 - 1. This project includes the supply of patch cords, adaptors and devices.
 - 2. All UTP terminations must follow 568A wiring schematic.

2. PRODUCTS

2.1. CORDS, DEVICES, AND ADAPTORS

- A. This portion of the communications system includes termination of copper and fiber cables using modules and adaptors, faceplates, and patch cords.
 - 1. Work Area: This section outlines specifications for the work area equipment cords, and telecommunications outlets at the users work area. The connection between the information outlet and the device (computer/telephone) is achieved by means of this subsystem.
- B. Work Area Equipment Cords shall meet or exceed the following criteria:
 - 1. Category 6, modular equipment cords shall:
 - a. Be category 6 component compliant out to 250MHz with operational bandwidth to 250MHz.
 - b. Be factory assembled and 100% transmission tested with laboratory grade network analyzers for proper performance up to 250MHz
 - c. Be backwards compatible with lower performing categories
 - d. Be equipped with identical modular 8-position plugs on both ends, wired straight through with standards compliant wiring
 - e. Incorporate internal stranded cordage isolator within a round, dual flame-retardant jacket to provide extended alien crosstalk performance, flex life and maintain ideal pair geometry
 - f. Use bend relief compliant boots (with optional color-coded icons) to ensure proper augmented category 6 performance
 - g. Use modular plugs, which exceed FCC CFR 47 part 68 subpart F and IEC 60603-7 specifications, and have 50 micro-inches minimum of gold plating over nickel contacts
 - h. Have an optional color-coded boot with a latch guard to protect against snagging
 - i. Be available in standard lengths of 3, 5, 7, 10, 15 and 20 ft. with custom lengths available upon request
 - j. Offer multiple cable colors (with color matching boots) in standard colors of black, white, red, gray, yellow, blue and green for proper circuit identification
 - k. Be certified by Underwriters Laboratories to United States Standards and C22.2 Canadian Telecommunications Standards
 - l. Shall be Siemon MC6-XX-02 Double-ended, 4-pair UTP stranded modular cords part number MC6-(XX)-02 (WHITE). *XX equals length as noted and shown.*
 - m. Quantities shall be:

- (1) Supply 40% of cords at 5' length.
 - (2) Supply 40% of cords at 15' length.
 - (3) Supply 20% of cords at 25' length.
- C. Telecommunications Room: This section outlines specifications for the equipment cords between the rack mounted patch panels and active electronic equipment.
1. Telecommunications Equipment Cords, modular equipment cords shall:
 - a. Be category 6 component compliant out to 250MHz with operational bandwidth to 250MHz
 - b. Be factory assembled and 100% transmission tested with laboratory grade network analyzers for proper performance up to 250MHz
 - c. Be backwards compatible with lower performing categories
 - d. Be equipped with identical modular 8-position plugs on both ends, wired straight through with standards compliant wiring
 - e. Incorporate internal stranded cordage isolator within a round, dual flame-retardant jacket to provide extended alien crosstalk performance, flex life and maintain ideal pair geometry
 - f. Use bend relief compliant boots (with optional color-coded icons) to ensure proper augmented category 6 performance
 - g. Use modular plugs, which exceed FCC CFR 47 part 68 subpart F and IEC 60603-7 specifications, and have 50 micro-inches minimum of gold plating over nickel contacts
 - h. Have an optional color-coded boot with a latch guard to protect against snagging
 - i. Be available in standard lengths of 3, 5, 7, 10, 15 and 20 ft. with custom lengths available upon request
 - j. Offer multiple cable colors (with color matching boots) in standard colors of black, white, red, gray, yellow, blue and green for proper circuit identification
 - k. Be certified by Underwriters Laboratories to United States Standards and C22.2 Canadian Telecommunications Standards
 - l. Shall be Siemon MC6-XX-02, Double-ended, 4-pair UTP stranded modular cords part number MC6-(XX)-(YY). *XX equals length as noted and shown. YY indicates color.*
 - m. Quantities shall be:
 - (1) Use BLACK path cords for VOICE: MC6-(XX)-01
 - (2) Use WHITE patch cords for DATA: MC6-(XX)-02

3. EXECUTION

3.1. Termination

- A. All UTP cables wired to the telecommunications outlet/connector shall have 4-pairs terminated in eight-position modular outlets in the work area. All pairs shall be terminated.
- B. The telecommunications outlet/connector shall be securely mounted at planned locations.
- C. The height of the telecommunications faceplates shall be to applicable codes and regulations.
- D. The maximum cable pulling tensions shall not exceed manufacturer's specifications.
- E. Bend Radius
 1. The maximum cable bend radii shall not exceed manufacturer's specifications.
 2. In spaces with UTP cable terminations, the maximum bend radius for 4-pair cable shall not exceed four times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.
 3. During the actual installation, bend radius on 4-pair cable shall not exceed eight times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.
- F. Slack

1. In the work area, a minimum of 300 mm (12 in) should be left for UTP, while 1 m (3 ft.) be left for fiber cables.
 2. In telecommunications room/closets a minimum of 3 m (10 ft.) of slack should be left for all cable types. This slack must be neatly managed on trays or other support types.
- G. Fire Protection
1. Properly installed firestop systems shall be installed to prevent or retard the spread of fire, smoke, water, and gases through the building. This requirement applies to openings designed for telecommunications use that may or may not be penetrated by cables, wires, or raceways.
 2. Fire stops shall comply with applicable codes.
- H. Workmanship
1. All work shall be done in a workman like fashion of the highest standards in the telecommunications industry. All equipment and materials are to be installed in a neat and secure manner, while cables are to be properly dressed. Workers must clean any debris and trash at the close of each workday.

END OF SECTION 27 16 00