

## **SECTION 27 00 00**

### **COMMON WORK RESULTS FOR COMMUNICATIONS**

#### **PART 1 - GENERAL**

##### **1.1 SCOPE**

- A. The objective of this and related specification documents is to define a universal and structured communications cable plant infrastructure for use on this project. The goal of such a cable plant is to accommodate all current and anticipated voice and data systems with little or no modification, thus reducing administration and maintenance demand for resources.
- B. The cable plant standards address a range of typical work areas found. The areas include fixed offices, open office furniture systems, raised floor areas, open ceiling areas, conference rooms and all support spaces. This document specifies the design and installation for the station outlet, station cabling, communication support rooms, equipment rooms, backbone cabling and the service provider company and access provider company entrance facilities.
- C. This document does not specify the communications equipment such as the network hubs, routers, telephone switch and servers. However, the interface between such equipment and the cable plant is defined herein.
- D. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and to all Division 27 Sections.

##### **1.2 RELATED WORK**

- A. 27 05 26 – GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
- B. 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS
- C. 27 05 36 – CABLE TRAYS FOR COMMUNICATIONS SYSTEMS
- D. 27 05 37 - FIRESTOPPING FOR COMMUNICATIONS SYSTEMS
- E. 27 05 53 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS
- F. 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS
- G. 27 13 00 - COMMUNICATIONS BACKBONE CABLING
- H. 27 15 00 – COMMUNICATIONS HORIZONTAL CABLING
- I. 27 16 00 – COMMUNICATIONS CONNECTING CORDS, DEVICES AND ADAPTERS

### **1.3 REFERENCES & STANDARDS**

- A. This Infrastructure Standard is based on the TIA-568-D Series - Commercial Building Telecommunications Cabling Standards, and TIA-569-C Commercial Building Standard for Telecommunications Pathways and Spaces, along with others noted below. These documents are published by the Telecommunications Industry Association.
- B. The design, cable and component selection, and installation practices shall conform with the following:
  - 1. TIA/EIA-526-7: Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
  - 2. TIA-526-14-B: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 edition 2, Fiber-Optic Communications Subsystem Test Procedure- Part 4-1: Installed cable plant- Multimode attenuation measurement
  - 3. ANSI/TIA-568-D.0, Generic Telecommunications Cabling For Customer Premises
  - 4. ANSI/TIA-568-D.1, Commercial Building Telecommunications Infrastructure Standard
  - 5. ANSI/TIA-568-D.2, Balanced Twisted-Pair Telecommunications Cabling and Components standard
  - 6. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard
  - 7. ANSI/TIA-569-C, Telecommunications Pathways and Spaces
  - 8. ANSI/TIA-606-C, Administration Standard for Commercial Telecommunications Infrastructure
  - 9. ANSI/TIA-607-C Commercial Building Grounding and Bonding Requirements for Telecommunications
  - 10. ANSI/TIA/EIA-492AAAC, Detail Specification for 850nm Laser Optimized 50 Micron Core Diameter/125 Micron Cladding Diameter Class Ia Graded Index Multimode Optical Fibers
  - 11. ANSI/TIA/EIA 492AAAD Detail Specification for 850-NM Laser-Optimized, 50-um Core Diameter/125- um Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers Suitable for Manufacturing OM4 Cabled Optical Fiber
  - 12. TIA-758-B: Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
  - 13. TIA/EIA-862: Building Automation Systems Cabling Standard for Commercial Buildings
  - 14. ANSI/TIA TSB-75: Additional Horizontal Cabling Practices for Open Offices
  - 15. ANSI/BicSI 002 – 2011: Data Center Design and Implementation Best Practices
  - 16. TIA-942: Telecommunications Infrastructure Standards for Data Centers
  - 17. TIA-1005: Telecommunications Infrastructure Standard for Industrial Premises
  - 18. TIA-1152: Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
  - 19. TIA-1179: Healthcare Facility Telecommunications Infrastructure Standard

20. Federal Communications Commission Title 47 / FCC Part 15, FCC Part 68
21. Institute of Electrical and Electronic Engineers (IEEE) 802.3, 802.5, 802.11
22. National Electrical Code Article 770 "Optical Fiber Cables" and Article 800 "Communications Circuits"
23. National Electrical Manufacturers Association (NEMA)
24. Local Electrical Code
25. National Fire Protection Association (NFPA) 70 National Electrical Code
26. NFPA 75 Protection of Electrical Computer/Data Processing Equipment
27. OSHA 29 CFR 1926/1910 Safety and Health Standards
28. Applicable Underwriters Laboratories, Inc. (UL) Listings and Approvals
29. UL 444 Communications Cables
30. National, state and local health, safety and building codes
31. BICSI: Telecommunications Distribution Methods Manual (TDMM), 13th Edition Building Industry Consulting Services International (BICSI) or most current

#### **1.4 DEFINITIONS AND ABBREVIATIONS**

- A. The following definitions are specific to the communications environment and shall apply to this document and its companion sections for clarification and direction.
1. Contractor: The Communications Contractor or sub-contractors responsible for installation, termination, test and documentation of communications cabling, termination components, pathway hardware, telecommunications equipment room hardware and related components detailed in the technical sections of this Division of work.
  2. Communications Cable Plant: All communications cabling, wiring, termination hardware, racks, cabinets, labeling and all other associated hardware.
  3. Communications Outlet: The device used to terminate station cables in couplers or connectors at user locations. It is the interface between the Station Cable and the end user's equipment.
  4. Horizontal (Station) Cabling: The portion of the communication link that connects the Communications Outlet to the TR. It is typically run horizontally on the same floor in a star topology emanating from the TR(s).
  5. Outlet ID: A unique alpha-numeric identification used for referencing a communications outlet. The Outlet ID is a subset of the Cable ID.
  6. Cable ID: A unique alpha-numeric identification used for tagging the station cables, the jacks within a communications outlet and the termination blocks.
  7. 110-Block: References throughout this document to a 110-Block signify a 100-pair 110-block that is 4 rows high by 25-pair positions (i.e. 6 x 4-pair UTP cables) wide or a 300-pair 110-block that is 12 rows high by 25-pair positions (i.e. 6 x 4-pair UTP cables or 1 x 25-pair cable) wide regardless of manufacturer or mounting type, unless otherwise noted.

8. Station Field: 8-position, 8-conductor Modular (8P8C; "RJ-45") termination panel used at the TR to distribute the station cables to the Station Outlets.
9. Backbone Cabling: The portion of the communication link that connects each TR with the Data Center, Telecommunications Equipment Room or Entrance Facility. The Backbone cabling is typically run vertically in a star topology emanating from the Data Center, Telecommunications Equipment Room or Entrance Facility to all TRs. Backbone cabling consists of both copper and fiber cables.
10. Copper Backbone Field: RJ-45 style termination panel or 110-Block used to terminate backbone cabling in the Data Center, Telecommunications Equipment Room, Entrance Facility or TR.
11. Fiber Backbone Field: Fiber Optic Patch Panels used to terminate backbone cabling in the Data Center, Telecommunications Equipment Room, Entrance Facility or TR.
12. Data Equipment Field: The area in a 19" rack that contains the active equipment that makes up the local area network. This equipment could be made up of hubs, switches or other active hardware.
13. TR Zone: An area served by a Telecommunications Room. All Station Cabling from outlets in a TR Zone originate from that TR.
14. Entrance Facility (EF): The room where the telephone Company point-of-demarkation (DEMARC) is installed or originates from their public facilities. This is the service hand-off point or the point of origin for extending the DEMARC to other rooms within the building.
15. Permanent (Cable) Link: Includes the Communications Outlet, station cable and termination at the Telecom Room.
16. Channel: Same as Basic Link, but also includes patch cords at the Communications Outlet and in the Telecom Room.
17. Cross-Connect: Group of connection points, wall or rack mounted, used to mechanically terminate and administer building wiring.
18. Zone Cabling: A cabling plan, typically used in an open office area, which provides for a reconfigurable link between the horizontal cross-connect or interconnect (e.g. at the Telecom Room) and the work area / user. An intermediate connection point is positioned close to the workstations served.
19. Consolidation Point: In a Zone Cabling system, an intermediate connection point between the permanently installed cabling extending from the horizontal cross-connect or interconnect, and moveable horizontal cabling extending to the Telecommunications Outlet.
20. BDF: Technology space in an NYULMC campus building from which all building IDF's are served. Within an element (building), this technology space is of the highest criticality. BDF's contain distribution layer LAN, localized voice system components, security, AV, various RF antenna systems, etc. There will be multiple BDF's on the campus, and if a building is not provided with two (2) BDF's, the one IDF will act as a primary IDF and will provide a redundant network route from the building to the TER's or another BDF.
21. IDF: Technology space on a floor in an NYULMC building from which all horizontal services to users are served. On a floor, one (1) or more IDF Rooms will be provided. Clinical use will have two IDF's as a minimum on a floor. IDF Rooms will converge IT, AV, Security, BMS, RF, Nurse Call, Telemetry, Public Address, etc., into one room, with the majority of these systems migrating to Ethernet.

22. Technology Equipment: Technology equipment encompasses servers, LAN switches, routers, SAN, NAS, MDF cabling racks, carrier demarcation equipment, etc.
23. N" System: An "N" system is the minimum system configuration which will deliver the required system capacity without redundant components.
24. "N+1" Redundancy: "N+1" redundancy is the minimum system configuration which will deliver the required system capacity and includes one (1) spare power conversion device (i.e., pumps, fans, UPS modules, engine-generators). In an N+1 system, the energy delivery paths (i.e., pipes, ductwork, wire) can either be redundant or non-redundant.  
Accordingly, the path of distribution may need to be designated as either single or dual (redundant).
25. "2N" Redundancy: "2N" redundancy (system + system) is a system configured as two (2) "N" systems operating in parallel, each with the minimum number of power converters required to deliver the required system capacity. In a 2N system, the energy delivery systems (i.e., pipes, ductwork, wire) are also redundant with each system having the capacity to support the entire load. Each system must be adequately separated to ensure failures and required maintenance shutdowns of a single system do not result in the shutdown of the redundant system.
26. MEP: Mechanical, Electrical and Plumbing Systems. Mechanical systems (sometimes noted as HVAC) provide cooling, heating, ventilation and humidification through a system of fans, cooling towers, chillers, pumps, piping, ductwork, etc.
27. Electrical systems provide normal (utility) power, clean UPS power, back-up emergency power (EPS) to serve critical technology equipment and mechanical systems which support technology equipment and occupied spaces. Fire alarm systems fall under the electrical system category, typically, and consist of a system of devices intended to detect and alarm fire-related conditions to ensure the safety of occupants and to protect physical assets, from a building to technology equipment.
28. Plumbing systems provide hot and cold water sources for domestic use as well as water make-up for (HVAC) cooling equipment. Plumbing systems also provide waste removal and condensate removal. Fire protection systems, when not separately identified as "FP", typically are included in the plumbing discipline. Fire protection systems consist of sprinkler systems, pre-action systems, fire pumps, standpipe risers, gaseous suppression systems, etc., in order to provide a means of detecting and suppressing a fire, either automatically or manually.
29. UPS: An Uninterruptible Power Supply (UPS) system which consists of conversion module(s), batteries and electrical distribution equipment arranged in a manner which supports critical equipment in the event of a loss of normal input power. UPS systems either filter and/or re-create the power sine wave, creating a clean, continuous supply of electrical energy during normal operation and when input power is lost. Besides providing clean, filtered power, UPS systems also act to bridge input power failures until a supply source such as the power utility can be re-established, or until a back-up emergency generator source, such as a generator, can be started. During a sustained loss of all input power sources, UPS systems can remain operational until

their batteries systems are drained. UPS systems typically serve technology equipment, and are only used for cooling where high density computing pods cannot sustain the intense heat production of servers until restoration of a power source to the cooling system (such as when a generator starts) is complete.

30. EPS: An Emergency Power Supply (EPS) System which consists of generators, or another alternative source of power than the electric utility, along with electrical distribution equipment arranged in a manner which supports critical equipment in the event of a loss of normal input power. EPS systems require a small amount of time to start up, and as such are often utilized in conjunction with UPS systems to ensure continuous power. Automatic transfer switches (ATS's), in detecting a loss of normal power, send a signal to the EPS system to come on-line. When the EPS systems is at an acceptable operating level, usually in a 10 to 60 second time frame, the ATS units will transfer to the EPS system to provide a longer duration of back-up supply. In the case of a generator system EPS solution, the back-up supply of power can provide service as long as the fuel oil storage and re-supply is maintained. EPS systems, in addition to serving life safety equipment loads, serve critical environments by supplying UPS systems, technology room cooling systems, and lighting.
31. EPDU: Enclosure Power Distribution Unit (smaller multi-outlet assembly typically located in technology cabinets and racks.
32. CRAC: Computer Room Air Conditioner or any air conditioning (A/C) which is dedicated to cooling IT hardware rather than comfort cooling. These standalone units typically use chilled water, condenser water or refrigerant in association with remote heat rejection equipment to provide cooling via direct air supply (overhead or underfloor) or ducted distribution.
33. PDU: Power Distribution Unit. PDU's are typically combination transformer and panelboard units, rated between 50 and 300 kVA. These units are found serving and usually located within larger technology spaces.
34. EMR: Electronic Medical Records.

## **1.5 ABBREVIATIONS AND ACRONYMS**

- A. The following abbreviations and acronyms shall apply to this document and its companion sections for clarification and direction.

8P8C	Eight Position, Eight Conductor modular Jack. Often referred to as an "RJ-45".
AFF	Above Finished Floor
ANSI	American National Standard Institute
ATM	Asynchronous Transfer Mode
AWG	American Wire Gauge
BAS	Building Automation System
BDF	Building Distribution Frame
CM	Communications cable rated for general purpose use
CMP	Communications cable rated for use in plenum areas
CMR	Communications cable rated for use in risers and vertical runs
CRAC	Computer Room Air Conditioner

## **COMMUNICATIONS**

dB	Decibel
EIA	Electronic Industries Association
EMR	Electronic Medical Records
EF	Entrance Facility
ELFEXT	Equal-Level Far-End Cross Talk (pair-to-pair)
EPS	Emergency Power Supply
FCC	Federal Communications Commission
ft.	feet
F/UTP	Foiled Unshielded Twisted Pair No shielding around individual pairs and an overall foil shield under the cable jacket
HCP	Horizontal Connection Point
IDF	Intermediate Distribution Frame
IEEE	Institute of Electrical and Electronic Engineers
in.	inch
lbs.	Pounds
LAN	Local Area Network
Mbps	Megabits per second
MHz	Mega Hertz (1E6 Hz)
MEP	Mechanical, Electrical and Plumbing Systems
µm	Micrometer or micron (10E-6 meter)
N	Newton
NEXT	Near End Cross Talk
OFNP	Optical Fiber Nonconductive Plenum
OFNR	Optical Fiber Nonconductive Riser
OTDR	Optical Time Domain Reflectometer
PBX	Private Branch Exchange (Telephone Switch)
PDU	Power Distribution Unit
PSNEXT	Power Sum Near End Cross Talk
PVC	Polyvinyl Chloride
RU	Rack Unit (1.75 inches)
TIA	Telecommunications Industry Association
UPS	Uninterruptible Power Supply
USOC	Universal Service Order Code
UTP	Unshielded Twisted Pair
WAN	Wide Area Network

## **1.6 WORK BY OWNER**

- A. Owner will provide:
1. Active electronics for interface with building voice and data cabling systems.

## **1.7 SUBMITTALS**

- A. Submit shop drawings for cabling and equipment provided under this Section:
1. Note that for satisfying submittal requirements for Division 27, "Product Data" is usually more appropriate than true "Shop Drawings"

as defined in Division 1. However, expression "Shop Drawings" is generally used throughout specification.

- B. Refer to Division 1 for general guidelines on product or installation information to be submitted.
- C. Mark general catalog sheets and drawings to indicate specific items submitted.
- D. Include proper identification of equipment by name and/or number, as indicated in specification and shown on drawings.
- E. When manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. Submittals shall be clearly marked and noted accordingly.
- F. When equipment and items specified include accessories, parts and additional items under one designation, submittals shall be complete and include required components.
- G. Submittals should be grouped to include complete documentation of related systems, products and accessories in a single submittal. Where applicable, dimensions shall be marked in units to match those specified.
- H. Submittals shall be in electronic form (Adobe Acrobat PDF) or paper.
  - 1. Paper documents shall be original catalog sheets or photocopies thereof.
  - 2. Facsimile (fax) sheets shall not be accepted.
- I. Where submittals cover products containing potentially hazardous non-metallic materials, include "Material Safety Data Sheet" (MSDS) from manufacturer stating physical and chemical properties of components and precautionary considerations required.
- J. Upon request by the owner or engineer, the contractor shall submit one 2-foot section of each cable type from cable reels sent to the site for Engineer's final approval. This two-foot section shall have manufacturer's cable markings visible.
- K. Submit floor plan outlet labeling drawings indicating the Communications Outlet ID for each communications outlet.
  - 1. Refer to Section 270553, Identification for Communications Systems, for description of Communications Outlet ID.
    - a. Floor plan outlet labeling drawings shall be provided, in AutoCAD.
  - 2. Drawings shall be submitted a minimum of twelve (12) weeks prior to substantial completion of the work associated with the corresponding outlets.



## **1.8 SUSTAINABLE BUILDING SUBMITTALS**

- A. Sustainable Building Submittals are required to verify compliance with criteria identified under the "SUSTAINABLE BUILDING REQUIREMENTS" and "PART 2: PRODUCTS" headings of this section.
- B. Refer to Section 018113, Sustainable Design and Construction, for detailed descriptions of the submittal documents listed below.
- C. Green Building Materials Certification Form (GMF): Submit a completed GMF for the materials included in this section (blank copy is appended to Section 018113). The following information shall be provided:
  - 1. Itemized material costs for the Green Building Focus Materials (GBFMs) identified under the "SUSTAINABLE BUILDING REQUIREMENTS" heading of this section.
  - 2. Percentage of post-consumer and/or post-industrial recycled content in the GBFMs, where applicable.
  - 3. The Volatile Organic Compound (VOC) content for all field-applied adhesives, sealants, paints and coatings used.
- D. Supplementary Information: In addition to the GMF, the following Sustainable Building submittal information shall be provided per Section 018113:
  - 1. GMF Back-Up Documentation
  - 2. Product Cut Sheets
  - 3. Green Seal Compliance
  - 4. Verification of Prohibited Compounds in Adhesives, Sealants, and Sealant Primers
  - 5. Green Packaging Materials
- E. Submittal Package: The Sustainable Building submittal information shall be assembled into one (1) package per Section or sub-contractor. Incomplete or inaccurate Sustainable Building submittals may be used as the basis for rejecting the submitted products or assemblies.

## **1.9 SUSTAINABLE BUILDING REQUIREMENTS**

- A. Green Building Focus Materials (GBFMs) for all work specified in Division 27:
  - 1. Field-applied adhesives, sealants, paints, and coatings
  - 2. Firestopping Materials
- B. Provide Field-applied adhesives, sealants, paints and coatings shall which meet the volatile organic compound (VOC) and chemical component limitations defined in Section 018115, "Volatile Organic Compound Limits for Adhesives, Sealants, Paints and Coatings". This includes products both specified and not specified but required to complete the work of this section.
- C. Packaging: Material and equipment manufacturers shall demonstrate efforts to reduce packaging waste and/or to use environmentally-preferable

packaging materials. Examples include, but are not limited to, the following:  
1) reusable and/or returnable pallets or crates; 2) FSC-certified wood or salvaged wood pallets or crates; 3) high recycled-content cardboard, paper, steel, or plastic packaging; and 4) bio-based foam packing materials.

#### **1.10 QUALITY ASSURANCE**

- A. Cable and component manufacturer(s) shall be a company specializing in communications cable, accessories and/or equipment with minimum of 5 years documented experience in producing cable, accessories and/or equipment similar to those specified herein.
- B. The Contractor shall have been in this business for minimum of 5 years and completed three (3) projects equal in magnitude to the project specified in the following sections.
- C. The Contractor shall have the necessary certifications to provide for the Warranty as specified herein.
  - 1. The Contractor shall be an active participant in the Installers Program operated by the Manufacturer of the Cabling and/or Termination Components used. The Contractor shall be a participant in this program at the time of Bidding and remain so throughout the project.
  - 2. Upon request, the Certified Installer(s) assigned to the Project shall be identified to the Engineer.

#### **1.11 WARRANTY**

- A. This Article is applicable to all Division 27 Sections.
- B. Refer to Division 1 General Provisions.
- C. Unless specified otherwise in the technical sections which detail the requirements for each subsection, the Contractor shall warranty materials, equipment, etc. for a minimum of ten (10) years from date of substantial completion of work.
  - 1. This is inclusive of all Horizontal and Backbone Cabling and connecting components.
  - 2. Coverage shall include all labor, materials and travel time.
  - 3. Warranty on Structured Cabling System shall be direct from manufacturer(s) of cabling and connecting components to Owner.

### **PART 2 - PRODUCTS**

#### **2.1 FIRE-STOPPING**

- A. Mineral-fiber stopping materials that are exposed to supply or return air plenums or that are located above suspended ceilings must be encapsulated

or fully sealed to prevent direct exposure of the mineral fibers to the plenum. Where sealants are used to encapsulate the mineral fiber materials (e.g. smoke sealants used at perimeter firestopping joints) the sealants shall meet the requirements of Section 018115.

- B. All mineral wool products shall contain minimum 75% combined post-consumer and post-industrial recycled content and shall be documented in accordance with the "Sustainable Design and Construction", Section 018113.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Refer to the individual technical specification sections for detailed Cable Routing and Installation, Testing and Documentation requirements. The following apply to all communications cabling and termination work.

### **3.2 CABLE ROUTING– GENERAL**

- A. Backbone cables should be routed separately from other building services so as to protect the cabling from unnecessary abuse. Separate conduit or a telecommunications riser shaft is recommended when it is deemed feasible.
- B. When redundant riser paths are available, the backbone cables should be run in the two different paths to provide backup in the case of damage to one of the cables. The size of each redundant cable should be half of the typical single backbone run, so that the total strand/pair count of the two cables is equal to the total strands/pairs required for the TR.

### **3.3 CABLE INSTALLATION – GENERAL**

- A. The contractor shall furnish all required installation tools to facilitate cable pulling without damage to cable jacket.
- B. All routing shall be kept clear of other trades work and supported using the method(s) detailed in the pertinent technical section(s).
- C. During pulling operation an adequate number of workers shall be present to allow cable observation at all points of raceway entry and exit, as well as to feed cable and operate pulling machinery.
- D. Pull cables in accordance with cable manufacturer's recommendations.
- E. Pull all cable by hand unless installation conditions require mechanical assistance.
  - 1. Where mechanical assistance is used, ensure that maximum tensile load for cable is not exceeded. This may be in the form of continuous

monitoring of pulling tension, use of "break-away" or other approved method.

- F. All cables shall be installed splice-free unless otherwise specified.
- G. Avoid abrasion and other damage to cables during installation.
- H. Cable manufacturers recommended pulling tensions shall not be exceeded.
- I. Pulling lubricant may be used and shall:
  - 1. Be non-injurious to cable jacket and other materials used.
  - 2. Not harden or become adhesive with age.
- J. Minimum bend radii, as specified by the manufacturer, must be adhered to for cable pulling and final installation.
  - 1. Any cables bent or kinked to radius less than recommended dimension are not allowed and shall be replaced at no expense to Owner.
- K. Repair damage to interior spaces caused by installation of cable, raceway or other hardware. Repairs must match preexisting color and finish of walls, floors and ceilings.
- L. Replace contractor-damaged ceiling tiles to match color, size, style and texture.
- M. Pull cord (200 lb minimum) shall be installed with cable installed in conduit or innerduct.
- N. Cabling shall be neatly laced, dressed and supported.
- O. In a high-rise environment, provisions must be made to support the backbone cable passing vertically through the building. The cables should be supported on each floor using an industry approve support method.

### **3.4 TESTING**

- A. Tests shall be conducted by the contractor during the course of construction when identifiable portion(s) of installation is complete. Alternatively, testing can be conducted after entire installation is complete if this does not delay the project schedule.
- B. Prior to testing, the contractor shall submit a written description of the intended test procedures and submit sample test forms to the Engineer.
  - 1. The submitted information shall include the proposed file naming format to be used in identifying the balanced twisted-pair cable (by 4-pair unit or pair), or optical fiber (by pair or strand) which is the subject of the test record.

2. Failure to provide the above information shall be grounds for the Engineer or the Owner to reject any and all Documentation of Results on related testing and to require a repeat of the affected test.
- C. Prior to testing, the contractor shall submit to the owner (or owners representative) and the Engineer, a proposed schedule for acceptance testing. This notification shall be a minimum of five (5) working days in advance to allow for witnessing of the tests by a duly authorized representative.
- D. The Contractor is responsible for supplying all equipment and personnel necessary to conduct the acceptance tests.
- E. Testing shall be completed and accepted by Owner and Engineer before Owner furnished equipment and cross connects are installed.
- F. All tests shall be documented.
- G. Test results shall be submitted in the native software of the field test measurement device, within ten (10) working days of the completion of each testing phase (e.g. subsystem, cable type, area, floor, etc.) or no later than three (3) weeks prior to the scheduled occupancy of the subject area, whichever is earlier.
  1. Interim documentation of Test Results in the native software of the field test measurement device shall be submitted in electronic form on CD-ROM for review and distribution.
- H. Test results in the native software of the field test measurement device shall also be part of the Final Documentation package submitted by the Contractor on the project.

### **3.5 DOCUMENTATION**

- A. Upon completion of the installation, the Contractor shall provide System Documentation to the Engineer for approval. Documentation shall include:
  1. Test Results
  2. Record Drawings
  3. Copies of all approved submittals indicating products used in the installation.
  4. Phone numbers, physical addresses and Internet/webpage (URL) of local parts suppliers and service companies covering the products installed.
- B. Submit four (4) copies of all required documentation.
- C. Documentation of Test Results shall be submitted in electronic form on CD-ROM for review and distribution.
  1. Test results shall be submitted in the format(s) native to the test instrument(s) used in performing the testing.

2. Where unique software (other than MS-Word™ compatible Word Processor or MS-Excel™ spreadsheet) is required for viewing of the test results, the Contractor shall provide along with the above documentation, three (3) licensed copies of such software. The software shall run on a MICROSOFT Windows-based personal computer supplied by the Owner.
- D. Final Documentation shall be submitted no later than three (3) weeks prior to the scheduled occupancy of the subject area. This is inclusive of all Test Results and draft Record Drawings.
1. Draft drawings may include mark-ups done by hand.
  2. Machine generated (final) copies of all drawings shall be submitted within thirty (30) working days of the completion of each testing phase.
- E. The Engineer or Owner may request that a 10% 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 and in the technical sections. If findings contradict the documentation submitted by the Contractor, additional testing can be requested to the extent determined necessary by the Engineer or Owner, including a 100% re-test. This re-test shall be at no additional cost to the Owner.
- F. All documentation - including hard copy and electronic forms of all Test Data and Record Drawings- shall become the property of the Owner.

**END OF SECTION**