SECTION 27 00 00

COMMUNICATIONS

PART 1 – GENERAL

1.1 PURPOSE

A. This guideline is intended to provide useful information to the Professional Service Provider (PSP) to establish a basis of design. PSP is to apply the principles of this section such that the University of Texas at Arlington (UTA) may achieve a level of quality and consistency in the design and construction of their facilities. Deviations from these guidelines must be approved by UTA and may require justification through Life Cycle Cost (LCC) analysis and submitted to UTA for approval.

1.2 **LESSONS LEARNED AND DESIGN CONSIDERATIONS**

A. Telecommunications Contractor shall review and adhere to all of University of Texas at Arlington Standards of Installation for Network Cabling.

1.3 SUMMARY/OVERVIEW

A. This section includes general communications design requirements, administration topics, and installation for communications systems.

B. Related Sections

1. Section 26 00 00 – Electrical (including related sub-sections)
2. Section 27 05 26 – Grounding and Bonding for Communications Systems
3. Section 27 05 28 – Pathways for Communications
4. Section 27 05 43 – Underground Ducts and Raceways for Communications Systems
5. Section 27 11 00 – Communications Equipment Room Fittings
6. Section 27 13 00 – Communications Backbone Cabling
7. Section 27 15 00 – Communications Horizontal Cabling
8. Section 27 41 00 – Audio-Visual Systems
9. Section 27 41 70 – Community Access Television (CATV)
10. Section 28 00 00 – Electronic Security (including related sub-sections)

1.4 SCOPE OF WORK

A. This section establishes a communications infrastructure to be used as signal pathways for voice and high-speed data transmission. Contractor shall:

1. Comply with all Master Specifications documents and the following requirements for a complete project installation.
2. Provide a structured cabling system as described hereafter that includes, but is not limited to, supplying, installing and testing of: fiber backbone, fiber and voice riser cable; data copper, fiber, and voice copper horizontal cabling, cable connectors, communications outlets and terminations, and equipment racks/cabinets for networking hardware and patch panels.
3. Furnish all labor, materials, tools, equipment and services for the installation described herein. Provide add/deduct unit pricing for all components as part of the bid response. All requirements and specifications will be enforced. Cable pathways and runs to individual outlets are not shown in their entirety, but shall be provided as if shown in their entirety.
4. Coordinate with electrical tradespersons to verify conduit routing does not cause cabling to exceed specified electrical length.
5. Follow industry standard installation procedures for communications cable to assure that the mechanical and electrical transmission characteristics of this cable plant and equipment are maintained.

B. Work of this section covers a complete installation of both permanent and channel links for a data and voice communications network utilizing copper and fiber transmission media that includes, but is not limited to the following. The Contractor shall:

1. Provide and install fabric and/or either plenum, PE or PVC Innerduct, rated appropriately for the installation environment.
2. Provide, install, terminate, test, and document all fiber backbone, fiber and copper riser cable.

3. Provide, install, terminate, test, and document all fiber, copper voice, and data horizontal cable.
4. Provide and place all termination devices such as, but not limited to, modular patch panels, termination blocks, information outlets (jacks and plates), phone jacks, fiber distribution panels, bulkheads, connectors, and fiber fan out kits.
5. Provide in quantities specified interconnect components such as, but not limited to, copper patch cords, fiber patch cables and data station cables.
6. Provide and place horizontal and vertical cable support devices such as, but not limited to, rack and wall-mounted horizontal and vertical cable management, cable runway, telecommunications cable runway, and all required mounting hardware, unless otherwise noted.
7. Provide and install all equipment mounting racks, cabinets and/or brackets.
8. Provide and install UL-approved firestopping systems in all communication pass-throughs, conduits and cable trays, and ceiling, wall and floor penetrations in coordination with General Contractor.
9. Provide all appropriate consumable items required to complete the installation.
10. Grounding and bonding in MC and TR rooms to grounding bus provided by Division 26.
11. Provide complete documentation and demonstration of work.
12. Completion of all punch list deficiencies within 10 working days.
13. Provide indexed and organized complete Test Results of all copper and fiber cable and their components.
14. Provide Submittals as outlined below.
15. Conduct a final document handover meeting with client, consultant, and PM to review, discuss and educate the Owner on the test results and As-Built Drawings.
16. Provide a Manufacturer's Extended Product Warranty and System Assurance Warranty for this wiring system.

1.5 PRODUCTS AND WORK BY OTHERS (NIC) INCLUDES:

A. The Owner may separately purchase and/or provide certain equipment and miscellaneous items that will be installed during the course of the installation process. Such items may not be indicated in the documents. Contractor shall cooperate with the Owner and his suppliers when considering:
   1. Provision and installation of phone systems, computer hardware, and related networking software and equipment.
   2. Provision and installation of multi-port routers, hubs, and UPS in communications rooms.
   3. Communications grounding busbars and grounding wires connecting to the main building electrode system.
   4. Dedicated power panels, ground busbars, circuits and utility outlets.
   5. Provide installation and finishing of plywood backboards.
   6. Building mechanical ductwork, cooling/heating system, and environmental control sensors.
   7. Communication pathway devices such as, but not limited to, cable tray and flex-tray in corridors, office spaces and open areas, conduits, conduit sleeves, and penetrations in walls and floors.

1.6 MEASUREMENT PROCEDURES:

A. The Contractor shall
   1. Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on shop drawings.
   2. Coordinate fabrication schedule with construction progress to avoid delaying the work.
   3. Where field measurements cannot be made without delaying the work, establish dimensions and coordinate with the General Contractor.
   4. When approved, proceed with fabricating units without field measurements.
   5. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

1.7 ALTERNATES:

A. If an alternate material is proposed that is equal to or exceeds specified requirements, Contractor shall provide manufacturers' specifications in writing for Owner approval prior to purchase and installation.
B. Substitutions of material by the Contractor shall be in writing complete with written manufacturers' specifications. The material substituted shall not void, alter or change manufacturers' structured cabling system warranty.
C. Contractor shall:
   1. Provide a complete cabling infrastructure according to these written specifications and drawings. If the

Owner changes the scope of work to be performed by the Contractor, it shall be in writing.
2. Respond to these changes with a complete material list, including pricing, labor, and taxes in writing presented to the Owner for approval.
3. Not proceed with additional scope of work without a signed approval by the Owner.

D. Owner will not pay for additional work performed by the Contractor without signed approval of these changes. Contractor will submit a copy of signed change order upon billing.

1.8 SUBSTITUTION PROCEDURES

A. Substitution may be considered when a product becomes unavailable through no fault of the Contractor.
B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Include in each request for substitution:
   1. Product identification, manufacturer's name and address.
   2. Product Data: Description, performance and test data, reference standards, finishes and colors.
   3. Samples: Finishes
   4. Complete and accurate drawings indicating construction revisions required (if any) to accommodate substitutions.
   5. Data relating to changes required in construction schedule.
   6. Cost comparison between specified and proposed substitution.
C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
D. The Owner will be the final judge of acceptability, with the distribution of the acceptance by the Architect. No substitute shall be ordered, installed or utilized without the Architect's prior written verification of acceptance from the Owner.

1.9 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.
B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean reference to the latest printed edition of each in effect at the date of contract.
C. Conflicts:
   1. Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general, the specifications determine the nature and quality of the materials and tests, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the communications system components.
   2. If there is an apparent conflict between the drawings and specifications, or between specification sections, the items with the greater quantity or quality shall be estimated and installed.
   3. Clarification with the Owner and/or Data Communications Designer about these items shall be made prior to the ordering and installation.
D. Codes and Standards (Most recent editions with addenda/TSB, etc.):
   1. ANSI/TIA-568-C, Commercial Building Telecommunications Wiring Standards.
   2. ANSI/TIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces.
   3. ANSI/TIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
   4. ANSI/NECA/BICSI-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
   5. Underwriters Laboratories (UL) Cable Certification and Follow-Up Program.
   6. National Electrical Manufacturers Association (NEMA)
   7. American Society for Testing Materials (ASTM)
   8. National Electrical Code (NEC); current edition
   9. National Electrical Safety Code (NESC); current edition.
   10. Institute of Electrical and Electronic Engineers (IEEE)
   11. UL Testing Bulletin
   12. Building Industry Consulting Services International (BICSI) Information Transport Systems Methods Manual (ITSMM)
   13. Local, county, state and federal regulations and codes in effect as of date of installation.

14. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

E. Related Documents:
1. Drawings and General provisions of the contract, including Uniform General Conditions, Supplementary General Conditions, architectural plans and specifications, requirements of Division 1, electrical, mechanical, plumbing, audio visual, security and telecommunications specifications and plans apply to the telecommunications section, and shall be considered a part of this section. The Contractor shall read all sections in their entirety and apply them as appropriate for work in this section.
2. In order to accomplish the conditions of this agreement, the Contractor shall perform the specific duties listed herein.
3. Contract Documents: Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general, the specifications determine the nature and quality of the materials, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the communications system components. Clarification with the Owner about these items shall be made prior to ordering and installation.
4. The Contractor shall procure, submit for review, and maintain for the duration of this agreement insurance against claims for injuries to persons or damages to property which may arise from, or in connection with, the performance of work hereunder by the Contractor, his agents, representatives, employees or subcontractor. The Contractor shall pay the cost of such insurance. The Owner, its directors, officers, representatives, agents and employees, respectively, shall have no responsibility to the Contractor with respect to any insurance in accordance with the provisions set forth herein.
5. Project and cost payment: Refer to General Contractor contract documents and/or master specifications issued by Architect.
6. Contractor will respect and protect the privacy and confidentiality of Owner, its employees, processes, products, and intellectual property to extent necessary, consistent with the legal responsibilities of the Owner policies.
7. Contractors shall sign a non-disclosure agreement and abide by the requirements to keep confidential all information concerning bid documents and this project.
8. Use of Subcontractors: Successful bidder shall inform the Owner's contact and General Contractor in writing about the intention to use Subcontractors and the scope of work for which they are being hired. The Owner or Owner's designated contact must approve the use of Subcontractors in writing prior to the Subcontractor's hiring and start of any work.
9. The Contractor's designated project manager will be recognized as the single point of contact. The Project manager shall oversee all work performed to ensure compliance with specifications as outlined in bid documents (which includes all specifications and drawings) to ensure a quality installation.

1.10 DEFINITIONS:

A. Abbreviations:

1.	BET	Building Entrance Terminal
2.	BD:	Building Distributor also referred as MDF
3.	C/W:	Complete With
4.	CBC:	Coupled Bonding Conductor
5.	CFCI:	Customer Furnished Customer Installed
6.	Div.1:	Division 1 General and Performance Requirements
7.	Div. 23:	Division 23 Heating, Ventilating, and Air Conditioning
8.	Div. 25:	Division 25 Plumbing
9.	Div. 26:	Division 26 Electrical
10.	Div. 27:	Division 27 Communications, CATV, and Audio Visual
11.	Div. 28:	Division 28 Electronic Safety and Security
12.	E.E.	Electrical Engineer
13.	EMI:	Electromagnetic Interference
14.	FD:	Floor Distributor also referred as HC
15.	GE:	Ground Equalizer
16.	HC:	Horizontal Cross-Connect (IDF)
17.	IC:	Intermediate Cross-Connect
18.	IDC:	Insulation Displacement Connector

19. IDF: Intermediate Distribution Frame
20. I/O: Information Outlet or Work Area Information Outlet
21. LAN: Local Area Network
22. MC: Main Cross-Connect
23. MDF: Main Distribution Frame also referred as BD
24. N/A: Not Applicable
25. NIC: Not In Contract
26. OFCI: Owner Furnished Contractor Installed
27. OFOI: Owner Furnished Owner Installed
28. OTDR: Optical Time Domain Reflectometer
29. RCDD: Registered Communications Distribution Designer
30. RFI: Radio Frequency Interference
31. TBB: Telecommunications Bonding Backbone
32. TBC: Telecommunications Bonding Conductor
33. TBD: To Be Determined
34. TGB: Telecommunications Ground Bus Bar
35. TMBC: Telecommunications Main Bonding Conductor
36. TMGB: Telecommunications Main Grounding Bus Bar
37. TR: Telecommunications Room
38. UON: Unless Otherwise Noted
39. UTP: Unshielded Twisted Pair
40. WA: Work Area

1.11 SYSTEM DESCRIPTION

A. The objective of this project is to provide a complete communications cabling infrastructure system installation including, but not limited to: fiber backbone, riser system, horizontal data and voice cabling with attendant terminations, mounting equipment, cable pathway and management systems, testing and other items/materials, as specified in drawings, these specifications, and contract documents.

1.12 SUBMITTALS

A. The Contractor:
   1. Shall not perform any portion of the work requiring submittal and review of shop drawings, product data, or samples until Owner has approved the respective submittal. Such work shall be in accordance with approved submittals.
      a. Shop drawings include a minimum of two sets of a plan view and elevations of all work to be installed. The Contractor shall make any corrections required by the consultant team, file with him two corrected copies and furnish such other copies as may be needed. The consultant's approval of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless he has in writing called the Architect's attention to such deviations at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules.
   2. Shall not perform any portion of the work requiring approval of the System Assurance Warranty manufacturer's warranty registration qualification procedures that would disqualify any part or all of the wiring system from that warranty qualification.
B. The Contractor shall provide the appropriate documentation from the certifying manufacturer showing the project is registered and qualified for the System Assurance Warranty. All subsequent work shall be in accordance with approved submittals.
C. The Contractor's BICSI Registered Communications Distribution Designer (RCDD) supervisor shall review, approve and stamp all documents prior to submitting. The Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein upon completion of all work.
D. Product Certificates shall be signed by manufacturers of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.
E. Contractor shall submit the required Field Test Reports in the format and media specified, upon completion of testing the installed system.
F. Contractor shall deliver manufacturer's signed long-term Warranty of installed cabling system to include all components that comprise the complete cabling system. Delivery to be effected within two weeks of the time of final punch list review. Failure of any component to pass system component tests shall be promptly

corrected, repaired or replaced to meet standards compliance. Contractor shall coordinate with manufacturer for warranty paperwork and procedures prior to the start of the project.

G. Contractor must clearly identify any resubmitted drawing sheets, documents or cut sheets either by using a color to highlight or cloud around resubmitted information. Maintain drawing numbering or page/sheet scheme consistency as per previously issued drawings/documents.

H. Cable Testing Plan:
   1. The Contractor shall:
      a. Provide a complete and detailed test plan for approval of the cabling system specified herein, including a complete list of test equipment for copper and fiber optic components and accessories prior to beginning cable testing. The following minimal items shall be submitted for review:
         1) All testing methods that clearly describes procedures and methods.
         2) Product data for test equipment
         3) Certifications and qualifications of all persons conducting the testing.
         4) Calibration certificates indicating that equipment calibration meets National Institute of Standards and Technology (NIST) standards and has been calibrated at least once in the previous year of the testing date.
         5) Examples of test reports, including all graphs, tables, and charts necessary for display of testing results.
      b. Include validation, and testing. Owner will require that the telecommunications cabling system installed by the Contractor be fully certified to meet all necessary requirements to be compliant with referenced IEEE and EIA/TIA specifications and vendor's warranty.
      c. Will determine the source/cause of test failure readings and correct malfunctioning component and/or workmanship within each channel or permanent link and retest to demonstrate compliance until corrected failure produces a passing result.

I. Cable Testing Reports: The Contractor shall submit cable test reports as follows:
   1. Submit certified test reports of Contractor-performed tests.
      a. The tests shall clearly demonstrate that the media and its components fully comply with the requirements specified herein.
      b. Two (2) set(s) of electronic and hardcopy versions of test reports shall be submitted together and clearly identified with cable identification.
      c. Cable inventory data shall be submitted for all fiber, copper, and coaxial cabling and termination equipment. Submit data electronically on CD-ROM, listing products furnished, including:
         1) Manufacturer's name.
         2) Manufacturer's part numbers.
         3) Cable numbers.
         4) Location and riser assignments.
         5) Product Data:
   2. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.

J. Shop Drawings:
   1. The Contractor shall:
      a. Submit catalogue cut-sheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten and/or highlighted to indicate exact selection.
      b. Identify applicable specification section reference for each product performance for each component specified for approval prior to purchase and installation.
      c. Submit for approval diagrams showing room layouts, rack layouts (including elevations), riser layouts, etc.

K. Samples:
   1. For workstation outlet connectors, jack assemblies, housings and faceplates for color selection and evaluation of technical specifications and requirements. Confirm with Architect, interior designer, and Owner representative for color before purchasing materials.

L. Qualifications:
   1. The Contractor shall submit qualification data sheets for firms and persons as specified in the "Quality Assurance", Section 1.11 of this specification. Provide evidence of applicable registration or

certification.

M. Closeout Submittals (As-built Drawings):
   1. Communications Design drawings to be supplied by the Architect to prepare the master "As-Built" drawings.
   2. As-Built drawings shall be in AutoCAD format, same version as used by Architect and consultant. Dimensions and scale of the drawing sheets submitted shall match the size of the drawing used for the contract documents, and shall include the cable numbers labeled in accordance with this document.
   3. Utilize normal recognized drafting procedures that match AutoCAD standards, Architect and consultant guidelines and methodology.
   4. The As-Built drawings shall incorporate all changes made to the building identified in, but not limited to, addendum, change notices, site instructions or deviations resulting from site conditions.
   5. Dimensioned plan and elevation views of networking components.
   6. All communications data/voice outlet locations complete with outlet/cable labeling.
   7. Cable routing paths of communications cables to identified infrastructure pathways.
   8. All rack and cabinet locations and labeling thereof.
   9. One-line diagram of equipment/device interconnecting data/voice cabling of the data and voice systems.
   10. Standard or typical installation details of installations unique to Owner's requirements.
   11. Graphic symbols and component identification on detail drawing shall conform to the latest ANSI/TIA 568-B, ANSI/TIA 606-A and ANSI/NECA/BICSI 607 conventions.

N. Submit one soft (compatible with Microsoft software) and hard copy with project deliverables within three weeks subsequent to substantial completion.

1.13 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Contractor shall supply all city, county, and state telecommunication cabling permits required by appropriate governing agency.
   2. Contractor shall be state-licensed and/or bonded as required for telecommunications/low voltage cabling systems.

B. Certifications:
   1. Contractor shall submit an up-to-date and valid certification verifying qualifications of the Contractor and installers to perform the work specified herein at time of bid submission.
   2. Contractor shall have a complete working knowledge of low voltage cabling applications such as, but not limited to data, voice and video network systems.
   3. Contracting firm shall have installed similar-sized systems in at least ten (10) other projects in the last five years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document. Certification shall include, but not be limited to, items such as name and location of project contacts and numbers, total square footage, total number of cables/drops, types of media, etc.
   4. Contractor shall provide certificates for the appropriate insurance coverage as defined in contract documents.
   5. All installer personnel that will be assigned to this project shall be listed in the qualification questionnaire document. 80% shall have a minimum of 3 years' experience in the installation of the types of systems, equipment, and cables specified in this document prior to this bid. Any personnel substitutions shall be noted in writing to Owner prior to commencement of work.
   6. Contractor shall submit evidence of compliance with these requirements prior to beginning work on the project.
   7. Cabling installers shall be trained and certified by the cable manufacturer for telecommunication cabling installations and maintenance of said materials. Refer also to General Conditions.

C. Administrative Requirements and Coordination:
   1. The Contractor shall:
      a. Provide a specified contact person (name and contact number) for coordination to attend project meetings with the telecommunication consultant, the Owner and others.
      b. Coordinate work of this section with Owner's telephone system specifications, workstations, equipment suppliers, and installers.
      c. Coordinate installation work with other crafts (examples include ceiling grid contractors, HVAC and sheet metal contractors, etc.) to resolve procedures and installation placement for cable trays and cable bundle pathways. The goal of this coordination will be to establish priority pathways for critical

data/voice network cable infrastructure, materials, associated hardware, as well as mitigate delays to the project and to allow service access for communications and HVAC components. Damage by Contractor to the craftwork of others will be remedied at the Contractor's expense in a timely manner.

d. Exchange information and agree on details of equipment arrangements and installation interfaces. Record agreements reached in meetings and distribute record to other participants, Owner and telecommunication consultant.
e. Adjust arrangement and locations of distribution frames, patch panels, and cross-connect blocks in equipment rooms and racks to accommodate and optimize arrangement and space requirements of any service provider equipment, telephone system, and LAN equipment. Tasks shall be coordinated with Owner or his representative, and other trades' installation representatives.
f. Where installed, confirm exact locations and method of mounting outlets in modular furniture. Follow furniture manufacturers' written instructions for installing cable and devices in modular partitions. Obtain modular furniture and power pole locations from the General Contractor. Wiring locations noted in plans along walls for modular furniture are approximate and will have to be determined by Contractor at time of installation. Field condition adjustments for installation may have to be made and coordination efforts with the electrical contractor for pathway must take place early on in the project to comply with 40% conduit fill factor requirements.
g. When requested by Owner or Owner's representative, furnish extra materials that match specified products and that are factory packaged with protective covering for storage and identified with labels describing contents.

D. Contract Administration:
1. Change orders shall be submitted to the Owner/Project Manager complete with price breakdown and description for approval before any work is done.
2. Data Communication Designer will provide job field reports upon inspection of Contractor's installation, materials, supporting hardware, coordination with other trades and progress to schedule to the client.
3. Job Field Report outline:
a. General installation progress in relation to scheduled work made by the Contractor up to that date.
b. All deficiencies noted in the cable installation to be corrected by the Contractor.

E. Pre-Installation Meetings - Contractor shall:
1. Attend and/or arrange a scheduled pre-installation conference prior to beginning any work of this section.
a. Agenda: This venue is to ask and clarify questions in writing related to work to be performed, scheduling, coordination, etc. with consultant and/or project manager/Owner representative.
b. Attendance: Communications project manager/supervisor shall attend meetings arranged by General Contractor, Owner's representatives, and other parties affected by work of this document.
c. All individuals who will be installers of communication cables and equipment in an on-site supervisory capacity, including project managers and lead installers, shall be required to attend the pre-installation conference. Individuals who do not attend the conference will not be permitted to supervise the installation of, or install, terminate, or test communications cables on the project. This includes supervisors, project managers, and lead installers of this project.

F. Post-Installation Meetings:
1. At the time of substantial completion, or shortly thereafter, the Contractor shall call and arrange for a post-installation meeting to present and review all submittal documents to include, but not limited to as-built drawings, test reports, warranty documentation, etc. Attendees shall be Owner staff, Data Communication Designer, General Contractor, and others that the General Contractor deems appropriate.
2. At this meeting the Contractor shall present and explain all documentation, and asking for feedback on its completeness. Any discrepancies or deviations noted by and agreed to by participants shall be remedied by Contractor and resubmitted within one week of meeting.

1.14 DELIVERY, STORAGE, AND HANDLING:

A. Coordination with delivery companies, drivers, site address, and contact person(s) will be the responsibility of the Contractor.

B. Contractor Shall:
1. Be responsible for prompt material deliveries to meet contracted completion date.
2. Coordinate deliveries and submittals with the General Contractor to ensure a timely installation.
3. No equipment materials shall be delivered to the job site more than three weeks prior to the commencement of its installation.
4. Equipment shall be delivered in original packages with labels intact and identification clearly marked.

5. Equipment shall not be damaged in any way and shall comply with manufacturer's operating specifications.
6. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.
7. Contractor shall be responsible for all handling and control of equipment. Contractor is liable for any material loss due to delivery and storage problems.

C. Owner/General Contractor shall supply a list of security requirements for Contractor to follow.

1.15 PROJECT/SITE CONDITIONS

A. For all environmental recommendations, refer to master Architectural section.
B. For all security recommendations, refer to related consultant sections.
C. After completing system installation, including outlet fittings and devices, inspect exposed finish. Contractor will remove burrs, dirt, and construction debris. If applicable, the Contractor will repair damaged finishes, including chips, scratches, and abrasions.
D. Contractor shall provide daily a clean work environment, free from trash/rubbish accumulated during and after cabling installation.
E. Contractor shall keep all liquids (drinks, sodas, etc.) off finished floors, carpets, and tiles. If any liquid or other detriment (cuts, soils, stains, etc.) damages the above finishes, Contractor shall provide professional services to clean or repair scratched/soiled finishes, at Contractor's expense.

1.16 WARRANTY

A. Contractor shall provide a minimum one (1) year warranty on installation and workmanship PLUS an Extended Product Warranty and System Assurance Warranty for this wiring system and shall commit to make available local support for the product and system during the Warranty period.
   1. The Extended Product Warranty shall apply to all passive structured cabling system components and shall cover the replacement or repair of defective products and labor for the replacement or repair of such defective products for a minimum of one (1) year.
   2. The System Assurance Warranty provides a complete system and product warranty that will be extended to the end-user, ensuring the structured cabling system will be free of defects in materials and workmanship, will meet or exceed applicable performance requirements defined in the most current version of the Commercial Building Telecommunications Cabling Standards, and support all current and future network applications for a minimum of twenty (20) years.
B. System Certification: Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate, from the manufacturer, registering the installation.

1.17 MAINTENANCE

A. Support Availability: The Contractor shall commit to make available local support for the product and system during the Warranty or Extended Warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Identification (Labeling) System:
   1. Brady
   2. Dymo
   3. Hellerman-Tyton
   4. Acceptable alternate
B. Fire-Stop Systems
   1. Hilti
   2. SpecSeal
   3. 3M
   4. Acceptable alternate

PART 3 – EXECUTION

3.1 INSTALLERS

A. Submit written proof that the following experience requirements are being met:
B. The Contractor shall be a certified Manufacturer's Value Added Reseller (VAR) and/or Authorized Installer and provide a minimum 20-year, end-to-end product warranty, adhere to the industry standard engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this project.
C. Provide and pay for all labor, supervision, tools, equipment, test equipment, tests and services to provide and install a complete inside and outside plant fiber and copper infrastructure system. Pay all required sales, gross receipts, and other taxes.
D. All members of the installation team shall be certified by the Structured Cabling System Assurance Warranty provider as having completed the necessary training to complete their part of the installation and capable of an installation that falls under manufacturer's guidelines necessary to obtain the Manufacturer's System Assurance Warranty.
E. Resumes of the entire team shall be provided along with documentation of completed training courses.
F. A BICSI RCDD shall supervise and approve all on-site work as a recognized member of the Contractor's installation team. All installation team members must demonstrate knowledge and compliance with all BICSI, ANSI/TIA, UL, and NEC methods, standards and codes.

3.2 EXAMINATION

A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work
B. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

3.3 PREPARATION:

A. Contractor's on-site RCDD supervisor shall review, approve and stamp all shop drawings, coordination drawings, record drawings and submittal documents.
B. Pre-installation inspection:
    1. The Contractor shall visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport. Visibly damaged goods are not acceptable and shall be replaced by the contractor at no additional cost to the Owner.

3.4 INSTALLATION

A. General
    1. Contractor shall install work following specifications, drawings, manufacturer's instructions and approved submittal data.
    2. Allowable Cable Bend Radius and Pull Tension:
        a. In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to cable manufacturer's bend radius recommendations for the maximum allowable limits.
        b. After installation, exposed cable and other surfaces must be cleaned free of lubricant residue. Use only lubricants specifically designed for cable installation.
B. Pull Strings:
    1. Horizontal Cable
        a. The Contractor shall
            1) Provide pull strings in all new conduits, including all conduits with cable installed as part of this contract.
            2) Pull string shall have a rated average breaking strength of 200 pounds.
            3) Data and video cables can be pulled in tandem with pull strings. During pulling sessions, pull strings must move freely to prevent cable jacket/cable damage.
C. Conduit Fill:
    1. Reference manufacturer's Design Installation Guidelines manual.
D. Patch cables
    1. Provide 1 meter patch cords in an amount equal to 1/3 the number of terminated data ports for each telecommunications room. Also provide 2-meter patch cords in an amount equal to the remaining 2/3's of the terminated data ports for each telecommunications room. All copper patch cables shall be bootless.

2. All copper patch cables to be manufactured from the same manufacturer as the horizontal cabling to maintain warranty, unless approved by Owner.

E. Firestop Procedures:
   1. Contractor shall:
      a. Install and seal penetrations (conduit, sleeves, slots, chases) into or through fire-rated barriers created by or made for or on the behalf of the Contractor to prevent the passage of smoke, fire, toxic gas, or water through the penetrations.
         1) All through penetrations in a fire rated surface require a sleeve, regardless of penetration diameter or penetrating cable count.
         2) Using a "ring and string" method of installing cabling for membrane penetrations in a wall cavity is acceptable, provided the solution was accepted by the Owner. Code-compliant firestopping rules still apply.
      b. Provide approved fire-resistant materials to restore originally-designed fire- ratings to all wall, floor, and ceiling penetrations used in the distribution and installation for communications cabling system. Coordinate firestopping procedures and materials with General Contractor. Following the pathway of others through compliant and non-compliant penetrations does not remove the requirement to maintain code-compliant firestopping.
      c. Provide and install removable, intumescent mechanical systems in floor chases in an approved fashion in all openings greater than 4 inches.
      d. Provide and install removable, intumescent, firestop bricks in an approved manner in all openings greater than 4 inches where there are penetrations through walls. Bricks shall be listed for insertion in fire-rated openings and require restraining materials or apparatus as needed per manufacturers' specifications.
      e. Shall supply Owner with training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.
      f. Provide manufacturer recommended material for rated protection for any given barrier.
      g. Shall laminate and permanently affix adjacent to chases the following information:
         1) Manufacturer of firestop system.
         2) Date of installation/repair.
         3) Part and model numbers of system and all components.
         4) Name and phone numbers of local distributor and manufacturer's corporate headquarters.
      h. Solutions and shop drawings/submittals for firestop materials and systems shall be presented to the General Contractor for written approval of materials/systems prior to purchase and installation.
      i. Materials shall be installed per manufacturer instructions, be UL-listed for intended use, and meet NEC and locals codes for fire stopping measures.
      j. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and maintain the characteristics for which it is designed to allow for the removal and/or addition of communication cables without the necessity of drilling holes in the material.
      k. The firestopping material shall maintain/establish the fire-rated integrity of the wall/barrier that has been penetrated.

F. Labeling
   1. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.
   2. Flat-surface labels: Self-adhesive vinyl or vinyl-cloth labels, machine printed with alphanumeric cable designations
   3. Contractor shall:
      a. Provide transparent plastic label holders, and 4-pair marked colored labels.
      b. Install colored labels according to the type of field as per ANSI/EIA/TIA 606-A color code designations.
   4. Use ANSI/EIA/TIA 606-A designation strip color-code guidelines for voice, data, cross-connect, riser, and backbone fields.

G. All materials shall be UL- and/or ETL-approved and labeled in accordance with NEC for all products where labeling service normally applies.

H. Materials and equipment requiring UL 94, 149 or 1863 listing shall be so labeled. Modification of products that nullifies UL labels is not permitted.

I. Within the normal office environment, the installed systems shall not generate nor be susceptible to any

harmful electromagnetic emission, radiation, or induction that degrades, or obstructs any equipment.

J. All material and equipment as provided should be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacturing of such products. All shall be typical commercial designs that comply with the requirements specified. All material and equipment shall be readily available through manufacturers and/or distributors.

K. All equipment shall be standard catalogued items of the manufacturer and shall be supplied complete with any optional items required for proper installation.

L. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance and backward compatibility.

M. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in patch panels, cross connects, and terminal strips, and space in cable pathways and backboard layouts to accommodate 20% future increase in campus distribution and active workstations.

N. Backward Compatibility: The provided solution shall be backward compatible with lower category ratings such that if higher category components are used with lower category components, the basic link and channel measures shall meet or exceed the lower channel's specified parameters.

O. Component Compliance: The provided solution's components shall each meet the minimum transmission specifications listed herein such that no individual component will be less than specifications for permanent link and channel, regardless of the fact that tests for link and channel ultimately meet required specifications.

P. In the event of a breach of the representations and warranties contained herein, the Contractor, at their own expense, shall take all measures necessary to make the cabling system work and comply with the applicable manufacturer written technical recommendations and standards.

Q. Site Tests:

1. Upon completion of the communications infrastructure systems, including all pathways and grounding, the Contractor shall test the system.
    a. Cables and termination modules shall be affixed, mounted or installed to the designed/specified permanent location prior to testing.
    b. Any removal and reinstallation of any component in a circuit, including faceplates, shall require retesting of that circuit and any other disturbed or affected circuits.
    c. Cable/jack shall be affixed, mounted or installed to the designed/specified permanent location prior to testing. Any removal and reinstallation of any component in the circuit shall require retesting of that circuit.
    d. Approved instruments, apparatus, services, and qualified personnel shall be utilized.
    e. If tests fail, Contractor shall correct as required to produce a legitimate passing test.
    f. Manipulation of tester parameters on a failing test in order to achieve a passing test is unacceptable.
    g. If the Contractor is found to have manipulated any failing test result for any reason (without written notice and approval of the Owner), the Contractor shall be required to employ a Third- Party Testing Agent selected by the Owner to retest the complete cable plant and shall be required to pay all costs associated with this retesting.
2. These specifications will be strictly enforced. The Contractor must verify that the requirements of the specifications are fully met through testing with an approved tester (rated for testing parameters listed elsewhere), and documentation as specified below. This includes confirmation of requirements by demonstration, testing and inspection. Demonstration shall be provided at final walk-through in soft copy and printed test data.
3. Notification of the likelihood of a cable exceeding standardized lengths must be made prior to installation of the cable. Without contractor's prior written notice and written approval by the Owner, testing that shows some or all pairs of cable not meeting specifications, shall be replaced at Contractor's expense (including respective connectors).
4. With the Owner's written approval, the over-length cable(s) shall be excluded from requirements to pass standardized tests and shall be explicitly identified.
5. Testing is still required for non-compliant cabling. The tests shall be for wire-mapping, opens, cable-pair shorts, and shorts-to-ground. The test results must be within acceptable tolerances and shall be submitted with the Owner's acceptance document.
6. Third-Party testing of the completed cable infrastructure is an Owner option that can be implemented and completed after (1) all Contractor testing is complete and submitted, and (2) Contractor certifies that cable plant meets or exceeds test result requirements as specified in these and ANSI/TIA/EIA test standards. Third-Party testing can be implemented at the Owner's discretion by:
    a. The Owner's preference to independently confirm the submitted Contractor's standards- compliant

testing results.

1) Payment of all Third-Party testing shall be by the Owner if the Third-Party testing is requested for confirming Contractor's complete and standards-compliant test results.
2) Third-Party shall pick a randomized sample of 15% of total installed cable plant. Prior to testing, this party shall develop and submit a test schedule for approval by Owner.
3) Third-Party testing processes will adhere to the testing protocols delineated in this document under Section 1.10, Parts H and I.
4) All Third-Party tested cables that test as failed shall be retested by the Third Party to confirm failure.
5) If Third-Party tests show a failure rate of 1.5% or greater of tests of all completed cabling, this shall force the retesting of the complete cable plant by the Third-Party at the Contractor's expense.
6) All confirmed failures shall be promptly corrected and retested by Contractor and Third- Party under the same testing protocols and guidelines.

b. The consequence of the Contractor providing test results that meet the conditions delineated in Section 3.4, Part Q.1.g shall force the retesting of the complete cable plant by the Third- Party at the Owner's expense.
   1) Payment of all Third-Party testing shall be by Contractor from Contractor's original accepted bid if Third-Party testing is required under the conditions delineated in Section 3.4, Part Q.1.g.
   2) Third-Party shall retest 100% of the total installed cable plant. Prior to testing, this party shall develop and submit a test schedule for approval by Owner.
   3) Third-Party testing processes will adhere to the testing protocols delineated in this document under Section 1.10, Parts H and I.
   4) All Third-Party tested cables that test as failed shall be retested by the Third Party to confirm failure.
   5) All confirmed failures shall be promptly corrected and retested by Third-Party under the same testing protocols and guidelines.

7. Contractor will complete all work and documentation according to manufacturer guidelines to ensure manufacturer's warranty remains in effect. Contractor shall obtain certificates from manufacturer attesting to warranty being in effect and include certificates with other deliverables due at the completion of the project.
8. Owner reserves the right to be present during any or all testing.

3.5 CLEANING

A. Work areas will be kept in a broom clean condition throughout the duration of the installation process.
B. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.
C. The Contractor will damp clean all surfaces prior to final acceptance by Owner.

3.6 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with contract documents, the Owner shall notify Contractor in writing of formal acceptance of the system.
B. Contractor must warrant in writing that 100% of the installation meets the requirements specified herein (Standards Compliance & Test Requirements).
C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation soft and hard copies as describe herein.

END OF SECTION