(NOTE TO DESIGNER: These Specifications are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer.)

SECTION 27 05 00
COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Summary

B. Related Documents

C. Reference Standards And Codes

D. Administrative Requirements

E. Work Results - Description Of Project

F. Proposal Submittals

G. Submittals For Project Record

H. Equipment Relocation And System Startup

I. Sequencing And Scheduling

J. Quality Assurance - Contractor Qualifications

K. Product Schedule

L. Warranty

M. Delivery, Storage, And Handling

N. Product Quality Assurance

O. Site Conditions

P. Examination

Q. Preparation

R. Demolition / Removal

S. Firestopping

T. Construction Waste Management

U. Labeling

V. Closeout Activities

1.2 SUMMARY

A. This document identifies the design and specification requirements for a complete and functional communications cable plant to be performed for University of Houston. The communications cable plant as specified herein will support the voice, data, AV connectivity and various other low voltage signaling and control devices.

B. The technology infrastructure will be compliant with the latest versions of the TIA/EIA 568-B Series Commercial Building Telecommunications Cabling Standards and UH adopted cabling standards.

C. The Architectural Plans and Specifications, General Conditions, Supplementary General Conditions and other requirements of Division 1, the Mechanical Plans and Specifications, the Electrical Plans and Specifications, and the Communications Plans may apply to the work specified in the Division 27 Sections, and shall be complied with in every respect. The Contractor shall examine all of these documents, which make up the Contract Documents, and shall coordinate them with all communications work on the Communications plans and in the Division 27 specifications.

D. All work associated with Telecommunication and Equipment Rooms shall comply with the National Electrical Code, state and local building codes. The guidelines developed by ANSI/TIA/EIA and BICSI shall be followed in both design and construction.

E. 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. If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be estimated upon and installed. Clarification with the Owner, or their designated representative, about these items shall be made prior to bid response.

F. The Architect may at any time, by written order, make changes within the general scope of any contract resulting from this proposal document. If such changes expand, reduce, change or modify the scope of work, the price for the change shall be increased or decreased at the unit prices set forth in the Unit Pricing Section, and the amount shall be deducted from, or added to, the sale price of the system to the Owner. No costs will be added to the project without prior written approval from the Architect.

1.3 RELATED DOCUMENTS

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

B. Related Division 27 Sections include:
1. 27 05 00 Common Work Results for Communications
2. 27 05 26 Grounding and Bonding
3. 27 05 28 Pathways for Communications Systems
4. 27 05 43 Underground Duct and Raceways
5. 27 05 53 Identification for Communications Systems
6. 27 11 00 Communications Equipment Room Fittings
7. 27 13 00 Communications Backbone Cabling
8. 27 15 00 Communications Horizontal Cabling
9. 27 16 19 Patch Cords, Station Cords,& Cross-Connect Wire
10. 27 20 00 Data Communications Equipment
11. 27 30 00 Voice Communications Equipment

1.4 AGENCIES, REFERENCE STANDARDS AND CODES

A. Agencies
1. ANSI American National Standards Institute
2. BICSI Building Industry Consulting Service International
3. EIA Electronic Industries Association
4. FCC Federal Communications Commission
5. FOTP Fiber Optic Testing Procedures
6. IEEE Institute of Electrical and Electronic Engineers, Inc.
7. NBC National Building Code

8. NFPA National Fire Protection Agency
9. NEC National Electrical Code
10. TIA Telecommunications Industry Association
11. UL Underwriters Laboratories
12. TAC State of Texas Department of Information Resources: http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=4&ti=1&pt=10&ch=208
13. UH MAPP UH Manual of Administrative Policies and Procedures

B. Codes and Standards (Latest issue and addenda)
1. ADA Standards for Accessible Design 28 CFR Part 36
2. American Society for Testing Materials (ASTM)*
3. ANSI/TIA/EIA-568-B.1 - Commercial Building Telecommunications Cabling Standard*
4. ANSI/TIA/EIA-568-B.2 - Commercial Building Telecommunications Cabling Standard*
5. ANSI/TIA/EIA-568-B.3 - Optical Fiber Cabling Components Standard*
6. ANSI/TIA/EIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces*
7. ANSI/TIA/EIA-606-A - Administration Standard for Commercial Telecommunications Infrastructures, June 21, 2002*
8. ANSI/TIA/EIA J-STD-607-A, Commercial Building. Grounding/Bounding Requirements- Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2002*
9. ANSI/TIA/EIA-758-A - Customer-owned Outside Plant Telecommunications Infrastructure Standard, May 2005*
10. BICSI TDM, Cabling Installation, LAN Design, and Customer-Owned Outside Plant Manuals-Latest Editions
11. Chapter 208- State of Texas Communications Wiring Standard
12. International Standards Organization/International Electrotechnical Commission (ISO/IEC) IS 11801, 2000*
13. National Electric Code (NEC), Latest Issue
14. National Electrical Manufacturers Association (NEMA)*
15. OSHA - U.S. Department of Labor Occupational Safety & Health Administration
16. UL - Underwriters Laboratories (UL) Cable Certification and Follow Up Program*
17. UH Information Technology Telecommunications Infrastructure Standards
18. UH MAPP - Manual of Administrative Policies and Procedures

C. Acronyms and Abbreviations
1. ADA Americans with Disabilities Act
2. AKA also known as
3. ANSI American National Standards Institute
4. AP access provider
5. ASTM American Society for Testing and Materials
6. AWG American Wire Gauge
7. BICSI Building Industry Consulting Services International
8. CATV community antenna television
9. CO-OSP customer owned outside plant
10. EF entrance facility
11. EIA Electronic Industries Alliance
12. EMI electromagnetic interference
13. FCC Federal Communications Commission
14. HVAC heating, ventilation, and air conditioning
15. IEEE Institute of Electrical and Electronics Engineers
16. ITNO Information Technology Network Operations
17. ISO International Organization for Standardization
18. LAN local area network

19. Mb/s megabits per second
20. MC main cross-connect AKA Main Distribution Frame (MDF)
21. MDF main distribution frame AKA main cross-connect (MC)
22. NEMA National Electrical Manufacturers Association
23. NESCO National Electrical Safety Code
24. NFPA National Fire Protection Association
25. OFOI Owner Furnished Owner Installed
26. RCDD Registered Communications Distribution Designer
27. RFP Request for Proposal
28. RFO Request for Offer
29. SCS Structured Cabling System
30. TBB telecommunications bonding backbone
31. TR telecommunications room AKA Intermediate Distribution Frame (IDF)
32. TGB telecommunications grounding busbar
33. TMGB telecommunications main grounding busbar
34. TIA Telecommunications Industry Association
35. UL Underwriters Laboratories
36. UTP unshielded twisted-pair
37. WA work area
38. WAP wireless access points
39. X cross-connect

1.5 ADMINISTRATIVE REQUIREMENTS *(Designer to provide a detailed summary of all work to be performed; examples below.)*

A. Coordination
1. The Communications Cabling Contractor, here after referred to as “Contractor”, shall provide all materials, components, tools and labor necessary for the complete installation of all communications work required in the contract documents and specified herein.
2. The Electrical Contractor, here after referred to as “Electrical Contractor”, shall provide materials, components, tools and labor to complete a communications cabling pathway, electrical power distribution and communications building grounding system as set forth in the Structured Cabling System specifications and electrical specifications and T and E drawings.
3. Work furnished and installed by the Contractor as specified in Division 27 and as shown in E and T drawings includes:
   a. The overhead cable runway system (ladder rack) within the new ER;
   b. Identification for Communications Systems;
   c. Communications Equipment Room Fittings;
   d. Communications Backbone Cabling;
   e. Communications Horizontal Cabling;
   f. Patch Cords, Station Cords, and Cross-Connect Wire;
   g. Coordination with OFOI Communications Services;
   h. Coordination with OFOI Data Communications Equipment;
   i. Coordination with OFOI Voice Communications Equipment;
4. Work under this Division not in contract (NIC) that will be Owner Furnished/Owner Installed (OFOI) includes:
   a. Communications services;
   b. Voice communications equipment;
   c. Phone cords at the work area;
5. Work furnished and installed by the Electrical Contractor as specified in Division 27 and as shown in E and T drawings includes:
   a. The conduits and back boxes for the work area telecommunications outlets.
   b. Installation of the TMGB in the new ER;

c. Installation of the TBB from the new ER to the new TRs;
d. Installation of the Bonding Conductor for Telecommunications (BCT) that bonds the TMGB to the electrical power ground compliant with ANSI J STD-607 A Standards;
e. Bonding conductors from all cable tray, sleeves and conduits;
f. Electrical circuits in the telecom rooms.

6. Work furnished and installed by others.
   a. Telecommunications room(s) walls shall be covered, floor to ceiling, with rigidly fixed ¾" fire rated plywood, void free, and capable of supporting attached connecting hardware. Plywood should be covered with two coats of fire retardant paint per Section 27 05 53.
   b. Fire walls shall be marked for easy identification and painted with two coats of fire retardant paint.

1.6 WORK RESULTS - DESCRIPTION OF PROJECT *(Designer to provide a detailed summary of all work to be performed; examples below.)*

A. Administrative Services
   1. Contractor is required to provide test results and as-built documentation/record drawings prior to job acceptance.

B. Underground Ducts and Raceways *(Designer to provide a detailed summary of all work to be performed; examples below.)*
   1. The Outside Plant cable pathway shall connect the_____- building to the campus network through a new concrete ductbank connected to an existing utility tunnel leading to the _____ building. The Service entrance for communications shall be a minimum of _____ 4" conduits from the nearest utility tunnel exit to the _____.
   2. No more than two 90° bends are allowed between pulling points when installing underground entrances. All bends must be long, sweeping bends with a radius no less than 10 times the internal diameter (ID) of the conduit.
   3. Communication conduits shall be the top tier utility within the ductbank with a minimum of 18" separation from high voltage cabling.
   4. Conduits shall have a pull cord having a metallic member (tone tape) with a minimum test rating of 200 lbs pulling strength in each conduit. Reference: Arnco DL WP12LC Tone Tape or equivalent. All pull cords shall be secured at each end to prevent accidental removal.
   5. Underground Ducts and Raceways described in Section 27 05 43.

C. Grounding and Bonding *(Designer to provide a detailed summary of all work to be performed; examples below.)*
   1. Provide and install a Telecommunications Grounding Busbar (TGB) in Telecommunications Rooms (TRs).
   2. Provide and install a Telecommunications Main Grounding Busbar (TMGB) in buidling's Main Equipment Room (MER)/ER.
   3. Bonding conductors from the TMGB or TGB will be installed to all communications terminating to equipment cabinets, equipment racks, raceway, cable ladder rack, cable tray, sleeves and conduits. Bond all TGBs to the TMGB per Section 27 05 26.
   4. Bond TMGB to building ground per Section 27 05 26.
   5. Final design and specifications for the Grounding and Bonding system shall be coordinated with the Electrical Engineer of Record.
   6. Building entrance protection for copper cabling.
   7. Grounding and Bonding for Communications described in Section 27 05 26.

D. Pathways for Communications Systems *(Designer to provide a detailed summary of all work to be performed; examples below.)*
   1. The primary horizontal cable support system will be conduit to cable tray. One inch (1") conduit

servicing end users information outlets shall be "stubbed" to above the ceiling, and routed to the nearest corridor/hallway telecommunications horizontal cable tray pathway leading to the telecommunications room. Wall penetrations shall transition to properly firestopped sleeves, then back to cable tray.

2. Outlets having one single cable require a single gang box that routes to the cable tray via minimum one inch (1") conduit with pull string.
3. Outlets having two or more cables require a double gang box with a single gang reducer that routes to the cable tray via minimum one inch (1") conduit with pull string.
4. Conduit runs may not be longer than 100ft or contain more than two 90 degree bends between pulling points, pull boxes or reverse bends without the use of a properly sized junction box. Insulated throat compression fittings must be used for communications conduit runs, with termination points having plastic or grounding bushings installed.
5. Riser sleeves in ER/TR must be properly installed with bushings and fire sealed. Initial sealing of the sleeve penetration is to be completed by the sleeve installer.
6. Provide Shop drawings of all core drilling locations for coordination with Architect and Owner prior to drilling.
7. All sleeves shall be reamed and grommets placed prior to cable installation to prevent cable damage.
8. All telecommunications conduit shall be provided with a measured pull tape.
9. Pathways for Communications described in Section 27 05 28.

E. Identification for Communications Systems *(Designer to provide a detailed summary of all work to be performed; examples below.)*
   1. All labeling will be compliant with TIA/EIA606-A - Administration Standard for Commercial Telecommunications Infrastructures as described in Section 27 05 53.
   2. All labeling will comply with Owner administrative labeling scheme of cabling and its numerical positions on the termination hardware. Ensure compliance with Owner's preferred administrative labeling standards.

F. Communications Equipment Room Fittings *(Designer to provide a detailed summary of all work to be performed; examples below.)*
   1. The communications service entrance point is located in the _____-level. The new service entrance pathway will consist of _____ 4" conduit(s) from the ER through a new ductbank or existing tunnel system to existing _____Building ER.
   2. Space for new outside plant fiber cable and terminating hardware will be provided in the ER.
   3. The new ER will be located on the _____ level of the facility with TRs vertically stacked above the ER with _____4" sleeves/conduits between telecom rooms.
   4. Contractor shall provide each ER/TR with 19" floor mounted equipment racks installed per T drawings. Equipment racks shall be properly bonded.
   5. Communications Equipment Room Fittings described in 27 11 00.

G. Communications Backbone Cabling *(Designer to provide a detailed summary of all work to be performed; examples below.)*
   1. Provide ____ strand, 9/125 micron single-mode fiber from Building ER to each Building TR.
   1. Provide ___ pair of vertical/horizontal copper backbone cabling consisting of 50- pair unshielded twisted pair Category 3 copper cables from the Main cross-connect field in ER to each TR rooms cross-connect field. Copper cable shall meet or exceed the mechanical and transmission performance specifications in ANSI/TIA/EIA-568-B.2 up to 16 MHz shall be installed.
   2. Copper cable shall be provided as required in NEC 2002; Listed Type CMR, CMP, MPR and/or MPP.
   3. All copper backbone cables shall have a minimum 10ft service loop, and all fiber backbone cables shall have a minimum 20ft service loop.
   4. Multi-mode fiber optic cabling is no longer installed for network use at the University of Houston.

5. Multi-mode outside plant fiber optic cable shall be provided for fire alarm connectivity only.
6. Communication Backbone Cabling requirements described in 27 13 00.

H. Communications Horizontal Cabling *(Designer to provide a detailed summary of all work to be performed; examples below.)*
1. All voice and data horizontal cables will consist of plenum rated, Category 6, 4 pair UTP copper cables terminated on 48 port RJ45 Category 6, 568A patch panels in the ER/TRs. The maximum horizontal distance from the work station to the patch panel shall be 295 feet.
2. Provide RG6 coaxial cable for CATV System locations as detailed on the T drawings.
3. Communications Horizontal Cabling requirements described in 27 15 00.

I. Termination Hardware *(Designer to provide a detailed summary of all work to be performed; examples below.)*
1. All cable termination hardware shall be mounted in one of the Contractor provided and installed 19" racks – refer to T-drawings for rack locations and counts.
2. Fiber backbone cabling shall terminate in, fully populated, rack mounted Fiber Panels using ST connectors and adapters.
3. Horizontal cabling shall terminate on rack mounted Category 6 48 port patch panels in the ER/TRs, and on RJ45 568A Category 6 inserts at the outlet.

J. Patch Cords, Station Cords, and X-Connect Wire
1. Contractor shall provide two (2) Category 6 patch cords per horizontal cable installed: 50% 5' length, 50% 15' length.
2. Contractor shall provide one (1) duplex fiber optic patch cords per fiber termination; patch cords shall be consistent with fiber type.
3. Contractor shall provide one (1) duplex fiber optic patch cords per fiber termination; patch cords shall be consistent with fiber and connector type. Lengths as required for neat and professional installation. Average length 10m. Coordinate with Owner prior to ordering.
4. All copper patch cords shall be installed in minimum one inch (1") plenum rated innerduct from cabinet to cabinet.

K. Data Communications Equipment
1. Data communications equipment will be OFOI.

L. Voice Communications Equipment
1. Voice communications equipment will be OFOI.

M. Network Connectivity for Other Trades:
1. Audio/Visual – Provide network connectivity as required for A/V elements. Refer to AV drawings and specifications for details.
2. Electronic Safety and Security – Provide copper and fiber cabling and termination hardware as required facilitating voice and data network connectivity for IP cameras, Emergency Call Towers, Access Control Panels, etc. Refer to Security drawings and specifications for details.
3. Fire Alarm – Provide copper/ fiber connectivity as required for Fire Alarm Panels.
4. Building Management System – Provide network connectivity as required facilitating operation of BMS/DDC.
5. Elevator Equipment Room – Provide copper connectivity to elevator equipment room(s). Coordinate with elevator equipment provider.

N. Commissioning Administration
1. Contractor shall comply with General Commissioning Requirements of the technology infrastructure system.

O. Project Meetings
1. Contractor shall attend preconstruction meetings with Project Team.

2. Contractor shall provide representation on Project Team Meeting as specified in Division 1 and by the General Contractor as required.
3. Contractor will provide representation on the Commissioning Team as required for implementation of the Commissioning Plan.

P. Preconstruction Evaluation
1. Examination of buildings and site shall be the responsibility of the Contractor. Examine conditions for compliance with Communications design specifications. Validate Communications section is in accordance with related Contract Documents and the specified Owner's operational needs.

Q. Construction Documentation
1. Contractor shall coordinate requirements with general provisions specified in Division 1 - Construction Progress Documentation.
2. Contractor shall provide weekly progress report including synopsis of previous week's completed tasks, list of ongoing work, and updated schedule addressing milestones. Also include items for Owner coordination.
3. Contractor shall provide weekly report of inspection by project RCDD to confirm Contractor's work is compliant with industry and manufacturer standards.

1.7 PROPOSAL SUBMITTALS *(Designer to provide a detailed summary of all work to be performed; examples below.)*

A. Contractor Certification:
1. Contractor shall be a licensed Panduit Certified Integrator (PCI) Design and Installation Company and a Uniprise Certified Installer (UCI) capable of issuing a numbered registration certificate for the entire cable system. A copy of the PCI Company and UCI certificate or verification by Panduit and/or Uniprise records must accompany contractor bid, expired certificates and/or certificates issued under Panduit or Uniprise past certification programs will not be accepted. Proof of certification must be included in proposal.
2. Submit written proof that the contractor is certified by the manufacturer of the products and adheres to the engineering, installation and testing procedures and utilizes the authorized manufacturer components and distribution channels in provisioning this Project.
3. Contractor must be a member of Building Industry Consulting Services International (BICSI).
4. 100 percent of on-site personnel shall have either a Uniprise or Panduit Certification in effect through, the bidding process, installation, testing, documentation, and acceptance. Documentation of all on-site personnel shall be provided post recommendation of selected contractor before final ITNO approval will be given.
5. 100 percent of on-site installation personnel shall have BISCI certification in effect through the bidding process, installation, testing, documentation and acceptance. Documentation of all on-site personnel shall be provided post recommendation of selected contractor before final ITNO approval will be given.
6. Contractor must have a minimum of one (1) Registered Communications Distribution Designer (RCDD) on staff, with Panduit approved Certification plus RCDD equivalent, submitted and approved by Panduit or Uniprise prior to project award. Submit a resume and copy of certifications for Contractor's RCDD.
7. The RCDD shall provide approval on the design, installation, and documentation of communications system along with ensuring all Panduit Integrity System or Uniprise Warranty documentation and requirements are met and submitted to Panduit or Uniprise upon completion of the project. Documentation of all on-site personnel shall be provided before final ITNO approval is granted.
8. Contractor shall not subcontract installation of voice/data/video cabling, termination or testing without the written consent of University of Houston and with Panduit's or Uniprise's review and confirmation to University of Houston of proposed subcontractor's current and valid Panduit PCI and Uniprise UCI certified status.
9. Contractor shall have worked satisfactorily for a minimum of five (5) years on systems of this type

and size.

10. Design and Installation Certificates: Signed by local cable manufacturer's representative certifying that design is acceptable with cable manufacturer's Design Engineer(s) and Contractor is authorized by manufacturer to install registered (warranty) cabling system.
11. A minimum of five (5) representative educational facilities cabling projects must be submitted as references to include the school's name, location, Architect or Engineer, cost of the cabling project and the contact person at the school district to include phone number.
12. Upon request by ITNO, furnish a list of references with specific information regarding type of project and involvement in providing of equipment and systems.

B. A list of technical product education (training) completed by the Contractor's project personnel.
   1. All members of the installation team must be certified by the Manufacturer as having completed the necessary training to complete their part of the installation. Submit resumes of the entire team and completed training courses and copies of BICSI Installer as well as Uniprise or Panduit training course certificates.
   2. Submit cable tester manufacturer or a third party certification for copper and fiber cable test technicians.

C. Warranty
   1. Unless otherwise specified, unconditionally guarantee in writing the materials, equipment, and workmanship for a period of not less than fifteen (15) years from date of acceptance by ITNO or 20 years for Uniprise.

D. Price Quotation Information -
   1. Itemized Unit Pricing for Labor and Material;
   2. Itemized Add/Deduct Unit Pricing for Labor and Material for Pre-Cutover (200' average length) FOUR (4) CAT 6 Drops;
   3. Itemized Add/Deduct Unit Pricing for Labor and Material for Post-Cutover (200' average length) FOUR (4) CAT 6 Drops.

1.8 SUBMITTALS FOR PROJECT RECORD *(Designer to provide a detailed summary of all work to be performed; examples below.)*

A. Follow Division 1 and this Section.
   1. Drawings: As-built documentation must be submitted five (5) business days prior to obtaining approval for cutover to any portion of the new cable plant system. Furnish for review and comments, 4 complete sets of E size (30 by 42) and 4 complete sets of C size as-built drawings along with 4 CDs containing all electronic AutoCAD 2000 or newer (DWG) files.
   2. Submit project record drawings at conclusion of the project to include:
      a. Final approved Shop Drawings
      b. Plan drawings indicating location and identification of work area outlets, nodes, plan and elevation of telecommunication rooms, cable pathway details, and backbone cable type and locations and cable ID numbers.
   3. 4 sets of cable inventory data must be submitted for all copper and fiber, termination hardware (prior to cutover to new cable plant if applicable.) Submit data in binders and electronically on CDs in "Microsoft Excel" format, listing products furnished, including:
      a. Manufacturer's name and part numbers.
      b. Cable numbers utilizing the Owner's cable numbering standard.
      c. Telecommunication and Equipment Room termination detail sheets
      d. Location and riser assignments.
      e. Cross-connect schedules including entrance point, main cross-connects, intermediate and horizontal cross-connects.
      f. Labeling and administration documentation
      g. Warranty documents for equipment
      h. Copper certification test result printouts and diskettes

i. Optical fiber power meter/light source test results.

4. Manufacturer Certificates: Within 10 days of completion of the project, Contractor shall deliver letter signed by local Structured Cabling Components representatives and Contractor's RCDD stating that installed cabling system complies with all requirements specified in manufacturer's installation guidelines and that there were no accidents, improper installation, mishandling, misuse, damage while in transit, unauthorized alteration, unauthorized repair, failure to follow instructions, or misuse with the structured cabling system that could adversely impact warranty.
5. Test Reports: 4 sets of hard copies with 4 copies on CD in compliance with related Test Result Documentation.
6. Submitted test results and other submittals that are non-compliant will be reviewed and returned to the Contractor with comments.
7. Re-submitted test results and other submittals that are non-compliant will be reviewed and returned to the Contractor with comments.
8. Subsequent reviews of test results and other submittals will be performed jointly by the Contractor and the Communications Consultant and Contractor will pay Communications Consultant's published hourly rate during third review and thereafter.
9. Manufacturer's warranty to the Owner. This shall include, but is not limited to: Owner's name and project name and address. (Within three weeks of substantial completion).
10. Within 10 days of completion of the project, Contractor shall deliver letter signed by local SCS Manufacturers representative and Contractor's RCDD stating that installed cabling system complies with all requirements specified in installation guidelines and that there were no accidents, improper installation, mishandling, misuse, damage while in transit, unauthorized alteration, unauthorized repair, failure to follow instructions, or misuse with the structured cabling system that could adversely impact warranty.
11. Within 21 days of completion of a project the communications contractor and/or the manufacturer's local representative will provide owner The Structured Cabling Performance Warranty signed by the manufacturer. The warranty shall list the owner and name of the Facility including location as the holder of the warranty.

1.9 EQUIPMENT RELOCATION AND SYSTEM STARTUP *(Designer to provide a detailed summary of all work to be performed; examples below.)*

A. Upon notice of construction completion, the selected Contractor will be responsible for system startup services for the new telecommunication room. The Contractor shall be responsible for ensuring the new equipment rooms, cabinets, floors and walls are clean and ready for equipment installation. On behalf of the Owner, the Contractor shall be responsible for coordinating with the GC and other trades to keep the ER and TRs clean and dust free at all times.

B. It shall be the responsibility of the Contractor to develop and implement a full migration project schedule detailing the responsibilities of assigned personnel, along with contingency plans, and submit it to the Owner, or their designated representative, for approval.

C. During the transition period, Contractor shall have the necessary supervisory, technical, and other personnel available throughout technology relocations and cutover of the telephone, networking, and video systems. This is to ensure that technicians are on site to observe the operation and maintenance of the equipment, and to resolve any cabling related issues during system start-up.

D. Contractor shall ensure all amenities are present prior to equipment relocation. Contractor shall immediately contact the Owner, or their designated representative, if a required service such as HVAC, electrical, UPS, etc., are not present.

E. Contractor shall accomplish a smooth and successful transition of operations and services to the new telecommunication room. The transition includes the coordination, migration, testing, and problem resolution with the system vendors.

1.10 SEQUENCING AND SCHEDULING *(Designer to provide a detailed summary of all work to be performed; examples below.)*

A. An initial planning meeting will be held with the successful bidder to clarify all requirements (systems, services, distribution methods, etc.), identify responsibilities, and schedule the events that will transpire during the implementation of the project. Within two (2) weeks of the initial meeting, the Contractor shall provide a written report and project schedule to clearly document the events and responsibilities associated with the project.

B. Contractor shall be responsible for the development and implementation of a complete project schedule detailing the responsibilities of assigned personnel and submit it to the GC and Owner for approval.

1.11 QUALITY ASSURANCE - CONTRACTOR QUALIFICATIONS *(Designer to provide a detailed summary of all work to be performed; examples below.)*

A. Follow Division 1 and this Section.

B. Voice/Data
1. The installation company shall have a full-time RCDD on staff during all phases of the installation including testing and documentation. RCDD documentation shall be included in all responses to RFP/RFO.
2. The Installer shall have either Uniprise or Panduit Certification in effect throughout installation, testing, documentation and acceptance.
3. One hundred percent (100%) percent of on-site personnel shall be CommScope certified. The contractor's project manager or lead technician shall be BICSI certified to facilitate on-site installation practices and to provide inspections of on-going work.
4. Untrained, undocumented, or otherwise unqualified personnel are not allowed to perform any portion of the communications infrastructure installation.
5. All personnel must be permanent employees of the telecommunications contractor, or approved sub-contractors.

PART 2 - PRODUCTS

2.1 PRODUCT SCHEDULE

A. Refer to Division 27 sections for approved product and schedules.
1. 27 05 26 Bonding and Grounding For Communications System
2. 27 05 28 Pathways For Communications Systems
3. 27 05 43 Underground Duct And Raceways
4. 27 05 53 Identification For Communications Systems
5. 27 11 00 Communications Equipment Room Fittings
6. 27 13 00 Communications Backbone Cabling
7. 27 15 00 Communications Horizontal Cabling
8. 27 16 19 Patch Cords, Station Cords And Cross-Contact Wire
9. 27 20 00 Data Communications Equipment
10. 27 30 00 Voice Communications Equipment

2.2 WARRANTY

A. A 20-year CommScope Extended Product Warranty and System Assurance Warranty for this wiring system shall be provided.

B. The warranty covers all CommScope cables installed, tested and registered in a structured cabling system for a period of 20 years. A structured cabling system is defined as a cabling infrastructure, designed and installed to current ANSI/TIA/EIA-568-B series standards.

C. The Extended Product Warranty shall ensure against product defects, that all approved cabling

components exceed the specifications of ANSI/TIA/EIA 568B and ISO/IEC IS 11801, exceed the attenuation and NEXT requirements of ANSI/TIA/EIA 568B and ISO/IEC IS 11801 for cabling links/channels, that the installation will exceed the loss and bandwidth requirements of ANSI/TIA/EIA 568B and ISO/IEC IS 11801 for fiber links/channels, for a twenty year period. The warranty shall apply to all passive SCS components.

D. Unless otherwise specified, unconditionally guarantee in writing the materials, equipment, and workmanship for a period of not less than twenty (20) years from date of acceptance by Information Technology Network Operations.

E. Warrant installation against all product defects, and that all approved cabling components meet or exceed the requirements of TIA/EIA-568B and ISO/IEC 11801 for a period of 20 years.

F. The Extended Product Warranty and the System Assurance shall cover the replacement or repair of defective products and labor for the replacement or repair of such defective products.

G. Within 10 days of completion of the project, Contractor shall deliver letter signed by local SCS Manufacturers representative and Contractor's RCDD stating that installed cabling system complies with all requirements specified in installation guidelines and that there were no accidents, improper installation, mishandling, misuse, damage while in transit, unauthorized alteration, unauthorized repair, failure to follow instructions, or misuse with the structured cabling system that could adversely impact warranty.

H. Within 21 days of completion of a project the communications contractor and/or the manufacturer's local representative will provide owner The Structured Cabling Performance Warranty signed by the manufacturer. The warranty shall list the owner, name of the facility including location as the holder of the warranty.

I. The Owner shall not be responsible for any aspect of ensuring the warranty is issued or updated. It shall be the Contractor's responsibility in conjunction with the Manufacturer.

J. During the warranty period, Owner may engage any (manufacturer approved) communication contractor to perform future moves, adds and changes to the system. Owner approved contractors shall be responsible for updating any required documentation. Owner shall not be responsible for any aspect of updating and maintaining the warranty.

K. The Labor, Material and Performance Warranty shall cover the testing and replacement of all structured cabling components. The structured cabling system shall be a complete certified system. The system and all components shall be performance matched and guaranteed by the manufacturer.

L. Person / Entity Covered
   1. This warranty is for the sole benefit of Owner and any successor in interest to the site in which such Registered SCS was originally installed.
   2. All communications work and materials not included in the SCS components shall be warranted by the contractor that performed the work for a minimum of three years from the date of substantial completion.

2.3 DELIVERY, STORAGE, AND HANDLING

A. Delivery Requirements: Follow Division 1 Requirements.

B. Packing, Shipping, Handling, and Unloading
   1. Protect equipment during transit, storage, and handling to prevent damage, theft, soiling and misalignment.
   2. Coordinate with ITNO for temporary secure storage of equipment and materials during project timeframes.
   3. Do not store equipment where conditions fall outside manufacturer’s recommendations for environmental conditions.

4. Do not install damaged equipment; remove from site and replace damaged equipment with new equipment.

C. Acceptance at Site
1. All risk of damage or loss will remain with the Contractor until project completion and acceptance of the installation by the Project Manager. Upon acceptance, risk of loss will pass to the Owner. Prior to that time, the Contractor shall be solely responsible for security of all Contractor provided project materials.

D. Storage and Protection
1. All materials and equipment delivered and placed in storage shall be stored with protection from the weather, humidity, and temperature variation, dirt, and dust, or other contaminants.
2. Material will be properly packaged in original factory-fabricated type containers and protected from damaging fumes, construction debris, and traffic until installation or job completion.
3. Any flammable materials or hazardous materials shall be kept and/or stored in suitable places approved by the General Contractor and outside the buildings at all times.

2.4 PRODUCT QUALITY ASSURANCE

A. All materials and equipment provided shall be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufactures of such products. All materials shall be typical commercial designs that comply with the requirements specified. All materials and equipment shall be readily available through manufacturers and/or distributors. All equipment shall be supplied complete with any optional items required for proper installation.

B. 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 correct and make the cabling system work in compliance with the applicable manufacturer written technical recommendations and standards.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Existing Site Conditions
1. Cable pathways and runs to individual outlets are not shown in their entirety but shall be provided as if shown in their entirety. The Contractor shall coordinate with other trades to determine exact routing.

B. Environmental Limitations
1. Due to the critical nature of the environment, the Contractor shall use extra effort to provide a clean work environment, free from trash/rubbish accumulated during and after cabling installation. Contractor shall remove all rubbish from job site daily at his or her own expense.

C. Use of Site
1. Proceed with work without interfering with ordinary use of streets, aisles, passages, exits, and operations of the University of Houston including Information Technology Network Operations.
2. Contractors will adhere to the University of Houston's Contractor Badge program and will wear assigned contractor's badge on person in a clearly visible location following the Contractor Badge program standards as administered and provided by Facilities Planning & Construction.
3. Access to buildings where work is to be performed shall be directed by Information Technology Network Operations.
4. Contractors shall provide proper safeguards with personnel or appropriate safety barricades when pulling cables in any University of Houston building or related off-site areas.

D. Continuity of Services
1. Previous arrangements must be made with the University representative to avoid interference with, or interruption of, existing building services. The work shall be arranged to minimize down

time.

3.2 EXAMINATION

A. Examination of buildings and site shall be the responsibility of the Contractor. Examine conditions for compliance with requirements of other sections in which related work is specified and determine if conditions affecting performance of the work of this Section are satisfactory. Do not proceed with work of this Section until unsatisfactory conditions have been corrected in an acceptable manner.

B. Verify liquid-carrying pipes are not installed in or above voice and data system equipment rooms.

C. Verify fire-rated backboards are properly installed and painted following Section 06105. Notify the Project Manager immediately and prior to installation in the event that the backboards are not installed or painted properly.

D. Verify conduit, raceways, and boxes are properly installed.

E. Prior to starting the installation, the assigned installation supervisor shall participate in a walk-through of the project site with the Project Manager to review the installation documentation, verify that all construction necessary for the installation has been completed, and verify all installation methods and cable routes.

F. The Contractor shall provide a complete cabling infrastructure according to the written specifications and drawings. If the scope of work to be performed by the Contractor changes, it shall be in writing. Contractor shall respond to these changes with a complete material list, including pricing, labor, and taxes in writing per Division 1 requirements. Contractor shall not proceed with additional scope of work without signed approval by the General Contractor.

3.3 PREPARATION

A. Protection of Surroundings
   1. Repair: Patching and repair of facilities, finishes, and equipment. Any damage to building or site caused by Contractor, including grass, paving, curbs etc., shall be restored at Contractor's expense to match condition prior to damage. If necessary and requested by the General Contractor, Contractor shall provide professional services to clean or repair scratched/soiled finishes at their own expense.
   2. Contractor shall keep all foods and liquids (water, drinks, etc.) in designated break areas.
   3. The Contractor shall obtain the Architect's and Engineer's written permission via the General Contractor before proceeding with any work necessitating cutting into or through any part of building structures such as girders, beams, concrete or tile floors, partition and/or ceilings.
   4. If it becomes necessary to cut through any wall, floor, or ceiling to install any work under this Section of the Contract or to repair any defects that may appear up to the expiration of the guarantee period, such cutting shall be done by the Contractor under the supervision of the General Contractor.
   5. Patching of all openings cut by the Contractor, or repairing of any damage to the work of other trades caused by cutting or by the failure of any part of the work installed under this Contract, shall be performed by the appropriate trade but shall be paid for by the Contractor.
   6. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Architect/Engineer. Impact-type equipment shall not be used except where specifically approved by the Architect/Engineer.
   7. All openings shall be restored to “as-new” condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.
   8. Refer to Division 1 for additional information.

3.4 DEMOLITION/REMOVAL

A. Unless indicated otherwise, all items that must be removed due to interference with work of this

contract remain the property of the Owner, and are to be salvaged at the Owner's discretion. Any material to be salvaged, other than Contractor's waste material, must be approved in writing by the General Contractor.

3.5 FIRESTOPPING

A. The Contractor is required to properly fire-stop any penetrations through fire barriers utilized for the placement of telecom cabling. Provide fire resistant intumescent materials to restore fire ratings to wall, floor, or ceiling penetrations according to local and national codes.

B. Verify the hourly rating of the barrier.

C. Select the UL Listing to match or exceed the barrier.

D. Adhere to cable loads and fill procedure in the Listing.

E. Seek pre-approval from the Authority Having Jurisdiction (Inspector).

F. When installing the System, be sure not to exceed the listing limitations.

G. After installation, place information labels and take digital photographs of both sides of each firestopped penetration in the System for future reference.

H. All openings shall be restored to “as-new” condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.

I. Provide fire resistant materials to restore fire ratings to all wall, floor, or ceiling penetrations used in the distribution and installation for communications cabling system. Coordinate fire stopping procedures and materials with General Contractor and Div.7.

J. Solutions and shop drawings/submittals for fire stop materials and systems shall be presented to the General Contractor for written approval of materials prior to purchase and installation.

K. Materials shall be installed per manufacturer instructions, be UL listed for intended use, and meet NEC codes for fire stopping measures.

L. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and remain resilient and pliable to allow for the removal and/or addition of communication cables without the necessity of drilling holes in the material.

M. The fire stopping material shall maintain/establish the fire rated integrity of the wall/barrier that has been penetrated.

N. Contractor shall coordinate with electrical contractor and ensure Communications Pathway firestopping is properly identified and labeled. Contractor shall laminate and permanently affix to each side of a fire wall/floor penetration, the following information:
   1. Installing Contractor's name, address and phone number.
   2. Alpha-numeric unique identifier (floor/penetration - A1)
   3. Name of manufacturer of fire stop system.
   4. Part & model numbers of system and all components.
   5. Phone numbers of manufacturer's corporate headquarters in U.S. and local distributor's name and phone number.

3.6 CONSTRUCTION WASTE MANAGEMENT

A. Contractor shall remove all excess material and debris from the site upon completion of work each day and in a manner approved by the General Contractor's Project Manager. See Division 1.

3.7 LABELING

A. Confirm administrative labeling scheme of cabling and its numerical positions on the termination

hardware. Ensure compliance with Owner's preferred administrative labeling standards.

3.8 CLOSEOUT ACTIVITIES

A. Acceptance shall be subject to substantial completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation as described herein.
   1. All Proposal Submittals and Project Record Submittals.
   2. Training to Owner's representative on methods to add and remove fire stop barriers, add and remove isolation conduit seals and, when necessary, add and remove IP 67 rated outlets.
   3. Maintenance manuals specified in Div. 1 to GC and Owner regarding structured cabling system, firestopping and conduit sealing methods and manufacturer's recommended maintenance instructions.
   4. Contractor shall complete all punch list items within five (5) days of notification by GC.
   5. Contractor shall wipe down all equipment, racks, cabinets, and sweep and mop ER/TR floors prior to Substantial Completion. Project will not be considered complete until cleaning has been done.
   6. Contractor shall complete Closeout Checklist listing status of all submittals, maintenance manuals, Owner training, and punch list items and deliver per Division 1.

END OF SECTION

(NOTE TO DESIGNER: These Specifications are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer.)

SECTION 27 05 26
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Work covered by this Section consists of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of grounding and bonding infrastructure as described on the Drawings and/or required by these specifications.

1.2 RELATED SECTIONS

A. Refer to Section 27 05 00 for detailed information on scope of work.

B. Refer to Section 27 05 53 for all labeling requirements.

1.3 DEFINITIONS

A. MER - Main Equipment Room: The main room, which typically contains the PBX, MDF and main Data Communications equipment.

B. ER - Equipment Room: Any additional room containing switches, hubs, patch panels and cross-connects away from a central location to serve areas out of distance from the MER.

C. TO - Telecommunications Outlet: Point of connectivity for voice, data or video on the wall or in the floor. Refer to Telecommunications Drawings and Symbol sheet(s) for quantities and types of media at each outlet.

D. MDF - Main Distribution Frame: A termination frame for unshielded twisted pair cable, usually providing a connection field for PBX telephone ports and feeder/riser cables to TR's. The MDF is normally located in the MER.

E. IDF - Intermediate Distribution Frame: A termination frame for unshielded twisted pair cabling providing a connection field for horizontal wiring from the workstation and feeder/riser cables extended from the MER.

F. TMGB - Telecommunications Main Grounding Busbar: The dedicated extension of the building grounding electrode system for the telecommunications infrastructure.

G. TGB - Telecommunications Grounding Busbar: The grounding connection point for telecommunications systems and equipment in the area served by an ER.

H. TBB - Telecommunications Bonding Backbone: A bonding conductor that provides direct connection between the TGB's and TMGB.

1.4 SECTION INCLUDES

A. Grounding electrodes and conductors.

B. Equipment grounding conductors.

C. Bonding.

D. Communication system grounding.

E. Electrical equipment and raceway grounding and bonding.

F. Control equipment grounding.

1.5 REFERENCES

A. Follow Section 01423

B. American Society for Testing and Materials (ASTM):
   1. B 3 Soft or Annealed Copper Wires
   2. B 8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft
   3. B 33 Tinned Soft or Annealed Copper Wire for Electrical Purposes

C. Institute of Electrical and Electronics Engineers (IEEE):
   1. 142-82 Recommended Practice for Grounding of Industrial and Commercial Power Systems
   2. 1100 Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems.

D. Underwriters' Laboratories (UL):
   1. 83 Thermoplastic Insulated Wire and Cables
   2. 96 Lightning Protection Components
   3. 96A System Installation
   4. 467 Grounding and Bonding Equipment

E. National Fire Protection Association (NFPA):
   1. 780 Lightning Protection Code
   2. 70 National Electrical Code (NEC)
      a. NEC Article No. 250 - Grounding

F. American National Standards Institute/Telecommunications Industry Association/Electronic Industries Alliance (ANSI/TIA/EIA):
   1. J-STD-607-A Commercial Building Grounding and Bonding Requirements.
   2. Telcordia – Network Equipment Building Systems (NEBS) GR-1275.

G. Building Industry Consulting Services International (BICSI):
   1. Telecommunications Distribution Methods Manual
   2. Customer Owned Outside Plant Design Manual

H. Local, county, state and federal regulations and codes in effect as of date of “notice to proceed” shall be complied with.

PART 2 - PRODUCTS

2.1 GROUNDING BUSBARS

A. Telecommunications Main Grounding Busbar (TMGB)
   1. Chatsworth #10622-012 ground busbar with Chatsworth #10622-000 busbar insulators or equivalent.

B. Telecommunications Grounding Busbar (TGB)
   1. Chatsworth #10622-012 ground busbar with Chatsworth #10622-000 busbar insulators or equivalent.

2.2 GROUNDING JOINTS AND SPLICES

A. Grounding conductor joints/splices shall be mechanical type, copper alloy, with a minimum of two bolts and a separate section for each conductor equal to Burndy “QPX”, OZ/Gedney “XTP” or “PMX” or Penn-Union “VX” or copper compression type with two (2) indents equal to Burndy, T&B or Blackburn.

B. Grounding conductor terminations (lugs) shall be single barrel, mechanical screw type, copper alloy with machined contact surfaces equal to OZ type “SL”, T&B, or Burndy or copper compression type with two (2) indents equal to Burndy, T&B or Blackburn.

2.3 BONDING CONDUCTORS

A. Cable Tray Bonding Conductor
   1. Green #8 AWG insulated bonding jumper (12" max) with appropriate lugs or manufactured braided copper grounding jumper equal to B-Line #CAM-GJ, T&B #BD12, OZ/Gedney type "FB" or Mono-Systems.

B. Equipment Frame Bonding Conductor
   1. Panduit #TRGK672 Telecommunications Rack Grounding Kit.

C. Bonding Conductor (BC)
   1. Green insulated copper bonding conductor, size as required by NEC.
   2. The BC shall be, as a minimum, the same size as the TBB.

D. Telecommunications Bonding Backbone (TBB)
   1. Green insulated copper conductor, minimum size of No. 6 AWG. The TBB shall be sized at 2 kcmil per linear foot of conductor length up to a maximum size of 3/0 AWG. Insulation shall meet fire ratings of its pathway.
      a. Table 1
         1) Sizing of the TBB
         2) TBB length (ft) TBB Size (AWG)
            (a) Less than 13 6
            (b) 14-20 4
            (c) 21-26 3
            (d) 27-33 2
            (e) 34-41 1
            (f) 42-52 1/0
            (g) 53-66 2/0
      b. Greater than 66 3/0

PART 3 - EXECUTION

3.1 TELECOMMUNICATIONS INSTALLATION

A. Installation of the TMGB
   1. Install the TMGB at the bottom of plywood backboard near the outside plant entrance conduits in the "MDF".
   2. TMGB shall be installed so that the BC for telecommunications is as short and straight as possible.
   3. Conductor shall be installed in continuous 3/4" conduit.

B. Installation of the TGB
   1. Install the TGB at the bottom of plywood backboard near the copper riser terminations in each "IDF".
   2. TGB shall be installed so that the TBB for telecommunications is as short and straight as possible.

C. Installation of the TBB
   1. Install Green insulated copper grounding conductor (refer to 2.03.D for conductor size) from the TMGB to each TGB.

D. Installation of Grounding Conductor Joints/Splices
   1. Install mechanical type, copper alloy, with a minimum of two bolts and a separate section for each conductor or copper compression type with two (2) indents.
   2. Install manufactured insulating cover or heavy tape insulation over joints/splices.

E. Grounding of Cable Tray
   1. Install Green #8 AWG bonding jumper (12" max) with appropriate lugs at each cable tray joint or install manufactured braided copper grounding jumper equal to B-Line #CAM-GJ, T&B #BD12, OZ/Gedney type "FB" or Mono-Systems.

2. Install Green #8 AWG grounding conductor with appropriate lugs from side of cable tray down to TMGB or TGB. Drill and tap side of cable tray (for appropriate size bolt, ¼" x 20 min.), making sure that bolt does not extend into wire management part of tray.

F. Grounding of Equipment Frame
1. Install Panduit or equivalent Telecommunications Rack Grounding Kit from equipment frame to grounded cable tray, TMGB, or TGB.

END OF SECTION

(NOTE TO DESIGNER: These Specifications are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer.)

SECTION 27 05 28
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior communications pathways and supports.

B. Outlets and conduit runs.

C. Risers in ER/TR(s).

D. Grounding and bonding of pathways.

E. Pathway fire stopping requirements.

1.2 RELATED SECTIONS

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

B. Related Division 27 Sections include:
   1. 27 05 00 Common Work Results for Communications
   2. 27 05 53 Identification for Communications Systems
   3. 27 13 00 Communications Backbone Cabling
   4. 27 15 00 Communications Horizontal Cabling

1.3 SUMMARY

A. This Section specifies the requirements for the Pathways for Communications Systems for the University of Houston [Project Name]. [Insert Project description.].

B. Communication Pathways are defined to include, but are not limited to innerduct, conduit, pull boxes, sleeves, cable trays, supports, accessories, associated hardware and fire stopping materials.

C. Final design and specifications for conduits shall be made by the Electrical Engineer of Record.

D. Work furnished and installed by Electrical Contractor as specified in this Section and as shown in E and T drawings includes:
   1. The conduits and back boxes for the work area telecommunications outlets.
   2. The floor poke through hardware.
   3. Fire stopping of cable tray and conduit cable pathway

E. Work furnished and installed by the Cable Contractor as specified in this section and as shown in E and T drawings includes:
   1. The overhead cable runway system (ladder rack) within the new ER.
   2. Bonding and grounding of overhead cable runway system (ladder rack), racks and cabinets within the ER/TR.

F. The primary horizontal cable support system will be cable tray, installed as shown in T drawings. Cable tray will be properly grounded. Wall penetrations shall transition to properly firestopped 1”- 4” sleeves, then back to cable tray.

G. Outlets having one single cable require a single gang box that stubs up into the ceiling void via one (1) 1” conduit with pull string. Use of flexible conduit is expressly discouraged.

H. Outlets having two or more cables require a double gang box with a single gang reducer that stubs up into the ceiling void via one (1) 1" conduit with pull string.

I. Conduit runs may not be longer than 100ft or have more than two 90 degree bends without the use of a properly sized junction box. Insulated throat compression fittings must be used for communications conduit runs, with termination points having plastic or grounding bushings installed.

J. Minimum radii for conduit bends shall be as follows:
   1. Internal diameter of less than two (2) inches is 6 times the internal diameter.
   2. Internal diameter of more than two (2) inches is 10 times the internal diameter.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Pathways:
   1. J-Hooks: Panduit
      a. J-Pro

B. Cable Tray: Cablofil
   1. 12" x 2" – CF54 /300 EZ
   2. 12" X 4" – CF105 / 300 EZ

2.3 CABLE HOOK SYSTEMS

A. J-hooks shall be installed 4ft to 5ft apart. Uniform spacing should be avoided to minimize problems with signal degradation.

B. J-hooks shall be supported from decking or building structure using methods approved by the manufacturer.

C. Cable count shall not exceed manufacturer's recommended maximum. Add separate parallel J-hook pathway when cable count requires it.

2.4 CONDUITS AND FITTINGS

A. For each communication outlet indicated, provide a complete assembly of conduit, tubing or duct with fittings including, but not necessarily limited to, connectors, nipples, couplings, locknuts, bushings, expansion fittings, other components and accessories as needed to form a complete system of the same type indicated.

B. See SECTION 26 05 33 - RACEWAYS, CONDUITS AND BOXES

C. Minimum conduit size for Telecommunications Outlets shall be 1 (one) inch.

2.5 WALL AND CEILING OUTLET BOXES

A. All wall outlets shall be mounted in a minimum four (4)-inch by four (4)-inch by two and one-half (2 1/2)-inch deep double gang outlet box with a single gang mud-ring.

B. Outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.

2.6 PULL / JUNCTION BOXES

A. Pull boxes used with telecommunications conduits in interior locations shall be rated NEMA- 1. Pull boxes used in damp or wet locations such as plumbing chases or out of doors shall be rated NEMA-3R. Pull boxes shall be installed in conduits run at an interval no greater than every 100 feet. A pull box shall be installed in conduit runs whenever there are two 90°sweeps, or a total of 180°of sweeps, in a conduit run. A pull box may not be used to change the direction of a conduit run. Any deviations from these

criteria must have prior approval from UH Information Technology.

2.7 PLENUM RATED FIBER OPTIC INNERDUCT

A. All fiber shall be installed in 1 ¼" corrugated, non-metallic plenum rated innerduct when not installed in conduit or in utility tunnel tray.
   1. Innerduct shall be UL Listed with Flame Propagation compliant with UL 2024.
   2. Only manufacturer's fittings, transition adapters, terminators and fixed bends shall be used.

B. Products
   1. White or orange, plenum rated, UL Listed, flexible optical fiber/communication raceway.
   2. Recognized per NEC Articles, 770 and 800 for plenum areas for optical fiber and telecommunications cables.
   3. Provide all fittings to form a complete integrated raceway system.

C. Fabrication
   1. Footage shall be sequentially marked.

2.8 CABLE TRAY SECTIONS AND COMPONENTS

A. General: Except as otherwise indicated, provide metal cable trays, of types, classes and sizes indicated; with splice plates, bolts, nuts and washers for connecting units. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.

B. Tray Sizes shall have 4 inch minimum usable load depth, or as noted on the drawing.

C. Straight tray sections shall have side rails fabricated as I-Beams. All straight sections shall be supplied in standard12 foot lengths, except where shorter lengths are permitted to facilitate tray assembly lengths as shown on drawings.

D. Tray widths shall be twelve (12) inches or as shown on drawings.

E. All fittings must have a minimum radius of 24 inches.

F. Splice plates shall be the bolted type made as indicated below for each tray type. The resistance of fixed splice connections between adjacent sections of tray shall not exceed .00033 ohms. Splice plate construction shall be such that a splice may be located anywhere within the support span without diminishing rated loading capacity of the cable tray.

G Cable Tray Supports: Shall be placed so that the support spans do not exceed maximum span indicated on drawings. Supports shall be constructed from 12 gauge steel formed shape channel members 1-5/8 inch by 1-5/8 inch with necessary hardware such as Trapeze Support Kits (9G-55XX-22SH) as manufactured by Cooper B-Line, Inc. [or engineer approved equal]. Cable trays installed adjacent to walls shall be supported on wall mounted brackets such as B409 as manufactured by Cooper B-Line, Inc. [or engineer approved equal].

H. Trapeze hangers shall be supported by 1/2 inch (minimum) diameter rods.

I. Barrier Strips: Shall be placed as specified on drawings and be fastened into the tray with self-drilling screws.

J. Accessories - special accessories shall be furnished as required to protect, support, and install a cable tray system. Accessories shall consist of but are not limited to; section splice plates, expansion plates, blind-end plates, specially designed ladder dropouts, barriers, etc.

PART 3 - EXECUTION

3.1 SUMMARY

A. Final design and specifications for the Communications Systems conduits shall be made by the Electrical Engineer and Architect of record.

B. All communication pathways shall be sized in accordance with the requirements of BICSI and the NEC where conduit, pull boxes, cable tray and other raceway sizes are not specifically shown on contract drawings. No conduit shall be less than 1".

C. Conduits entering the Telecommunications Room shall be located allowing for the most flexibility in the routing and racking of cables.

D. Conduits between Building Telecommunication Rooms shall be four (4) inches.

E. Conduits or conduit sleeves entering through the floor of the Telecommunications Room shall terminate two (2) inches above the finished floor. The outer diameter of the conduit shall be located within four (4) inches of room walls.

F. All metallic telecommunications conduits entering the Telecommunications Room, Equipment Room, or Entrance Facility shall be bonded together, and bonded to the Telecommunications Main Grounding Busbar with a #6 AWG ground cable.

G. Conduits shall be installed in the most direct route possible from the Telecommunications Room to the work area.

H. Conduits shall not be run next to hot water lines, steam pipes, or other utilities that may present a safety hazard or cause a degradation of system performance.

I. All in-use and spare conduits entering the Telecommunications Room, Equipment Room, or Entrance Facility shall be sealed to prevent the intrusion of water, gasses, and rodents throughout the construction project. Within five days of releasing the conduit for the installation of cable, the conduit installation contractor shall prove all conduits to be clean and dry.

J. All conduits and cables that penetrate fire rated walls or floors must be fire stopped.

K. Cables shall be neatly dressed along common paths with Velcro tie wraps with voice cables separated from data cables. Maximum number of cables per bundle shall not exceed manufacturer specifications.

L. Layout cable pathway runs in advance to determine space requirement along pathways, and to ensure non-interference from other trade installations.

M. Do not support communication pathway from, or lay on, ceiling suspension system or use electrical, plumbing, or other pipes for support. Communication pathway supports shall be permanently anchored to building structure or joist.

N. Provide attachment hardware and anchors designed for the structure to which attached, and that are suitably sized to carry the weight of the pathway and cables to be supported. Confirm with architect and/or construction manager on installation procedures for cable support system prior to implementation.

O. Conduits shall be reamed to eliminate sharp edges. Metallic conduit shall be terminated with an insulated bushing. Initial sealing of the sleeve penetration shall be completed by the sleeve installer.Refer to ANSI/TIA/EIA-606 and Section 27 05 53 for administration of the pathway system.

P. The inside of the cable tray or wireway shall be free of burrs, sharp edges or projections that can damage cable insulation. Abrasive supports (e.g., threaded rod) shall have the portion within the tray protected with a smooth, non-scratching covering so that sable can be pulled without physical damage. When a wireway passes through a partition or wall, it shall be an unbroken length. Installation of telecommunications cables shall not exceed the fill requirements. Openings in fire-rated walls, floors and ceilings shall be properly firestopped. Barriers between power and telecommunications cables shall be installed per electrical code. Cable trays and wireways shall not be used as walkways or ladders unless

specifically designed and installed for that purpose.

Q. Supports should be located where practicable so that connections between sections of the tray fall between the support point and the quarter section of the span. The support centers shall be in accordance with the load and span for the applicable class as specified in the electrical code. A support should be placed within 600 mm (2 ft) on each side of any connection to a fitting. Wireways shall be supported on 1500 mm (5 ft) centers unless designed for greater lengths.

R. A minimum of (12 in) access headroom shall be provided and maintained above a cable tray. Care shall be taken to ensure that other building components e.g., air conditioning ducts) do not restrict access to trays or wireways.

3.2 MINIMUM CLEARANCES

A. Communication Pathway minimum clearances from:
1. Minimum of 1 foot parallel, 3 inches crossover from power cables and conduits.
2. Minimum of 6 inches above ceiling tiles.
3. Minimum of 24 inches Hot Flues, Steam pipes, Hot water pipes and other hot surfaces.
4. Minimum of 3 feet separation from electrical panel boards.
5. Minimum of 5 inches from fluorescent fixtures.
6. Minimum of 6 feet separation from electrical motors and transformers.
7. Minimum of 2-inches from exposed all-thread rods.

3.3 FIRE STOPPING

A. Provide fire resistant materials to restore fire ratings to all wall, floor, or ceiling penetrations used in the distribution and installation for communications cabling system. Coordinate fire stopping procedures and materials with General Contractor and Electrical Contractor.

B. Solutions and shop drawings/submittals for fire stop materials and systems shall be presented to the General Contractor for written approval of materials prior to purchase and installation.

C. Materials shall be installed per manufacturer instructions, be UL listed for intended use, and meet NEC codes for fire stopping measures.

D. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and remain resilient and pliable to allow for the removal and/or addition of communication cables without the necessity of drilling holes in the material.

E. The fire stopping material shall maintain/establish the fire rated integrity of the wall/barrier that has been penetrated.

F. Cable Contractor shall laminate and permanently affix to the MDF wall, adjacent to chases, the following information:
1. Name of manufacturer of fire stop system.
2. Part & model numbers of system and all components.
3. Phone numbers of manufacturer's corporate headquarters in U.S. and local distributor's name and phone number.

END OF SECTION

(NOTE TO DESIGNER: These Specifications are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer.)

SECTION 27 05 43
UNDERGROUND DUCTS AND RACEWAYS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of exterior telecommunications pathways as called for in these specifications and related drawings.

B. This section includes minimum requirements and installation methods for the following:
   1. Cutting and Patching Asphalt and Concrete
   2. Trenching and Excavation
   3. Underground Conduit Systems
   4. Cable Routing Hardware
   5. Horizontal Directional Drilling – Also commonly referred to as Directional Boring or Guided Horizontal Boring

1.2 SUMMARY *(Designer to provide a detailed summary of all work to be performed; examples below.)*

A. Incoming Service Duct-bank: The connection point for telecommunications services is an existing maintenance hole located northwest of the project site. The project shall provide four (7) 4” PVC Schedule 40 conduits, with pull-rope in each PVC conduit, direct-buried from the Community Center MDF to the existing telecommunications service maintenance hole. (Refer to the Telecom Site Plan for details).

B. Primary Duct-bank: The primary telecommunications duct-bank will consist of ten (10) 4” PVC Schedule 40 conduits from the Community Center MDF to a series of five (5) telecommunications maintenance holes located throughout the site. Each PVC conduit shall include pull-rope. (Refer to the Telecom Site Plan for details).

C. Feeder Duct-bank: Each residential building shall be fed from the nearest telecommunications maintenance hole via two (2) 4" PVC Schedule 40 conduits. Each PVC conduit shall include pull-rope. (Refer to the Telecom Site Plan for details).

D. Innerduct: Install three (3) - 3x3” Multi-cell flexible innerduct into each of the 4” conduits. All pull cords shall be secured at each end to prevent accidental removal.

1.3 RELATED DOCUMENTS

A. Section 01 10 00 - Summary: Contract descriptions, description of alterations work, work by others, future work, occupancy conditions, use of site and premises, work sequence.

B. Section 01 20 00 - Price and Payment Procedures: Applications for payment, Schedule of Values, modifications procedures, closeout procedures.

C. Section 01 30 00 - Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.

D. Section 01 35 15 - LEED Certification Procedures.

E. Section 01 40 00 - Quality Requirements: Procedures for testing, inspection, mock-ups, reports, certificates; use of reference standards.

F. Section 01 57 13 - Temporary Erosion and Sedimentation Control.

G. Section 01 57 21 - Indoor Air Quality Controls: Procedures and testing; smoking room testing; LEED requirements.

H. Section 01 60 00 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

I. Section 01 70 00 - Execution Requirements: Examination, preparation, and general installation procedures; pre-installation meetings; cutting and patching; cleaning and protection; starting of systems; demonstration and instruction; closeout procedures except payment procedures; requirements for alterations work.

J. See Section 01 74 19 - Construction Waste Management and Disposal.

K. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance (O&M) data, warranties and bonds.

L. Section 01 79 00 - Demonstration and Training: Detailed requirements.

M. Section 01 91 13 - General Commissioning Requirements.

N. Section 27 05 00 Basic Communications Requirements.

O. Section 27 05 26 Grounding and Bonding for Communications Systems.

P. Section 27 05 28 Pathways for Communications Systems.

Q. Section 27 05 53 Identification for Communications Systems.

R. Section 27 13 00 Backbone Cabling Requirements

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.5 QUALITY ASSURANCE

A. All installation work for the new exterior telecommunications pathways shall be performed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated shall be subject to the control of Owner.

B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval based on submittals provided.

C. Materials and work specified herein shall comply with the applicable requirements of:
   1. ANSI/NFPA 70 – National Electrical Code including, but not limited to, the following articles:
      a. 314 – Outlet, Device, Pull-Boxes; Conduit Bodies; Fittings; and Vaults
      b. 344 – Rigid Metal Conduit: Type RMC
      c. 352 – Rigid Nonmetallic Conduit: Type RNC
      d. 358 – Electrical Metallic Tubing: Type EMT
      e. 384 – Strut-Type Channel Raceway
   2. IEEE/NESC – National Electrical Safety Code
   3. NEMA Standards including, but not limited to:
      a. NEMA, RN1, 1986 PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
      b. NEMA, TC3, 1982 PVC Fittings for use with Rigid PVC Conduit and Tubing.
      c. NEMA, TC6, 1983 PVC and ABS Plastic Utilities Duct for Underground Installation.
      d. NEMA, TC8, 1983 Extra Strength PVC Plastic Utilities Duct for Underground

Installation.

e. NEMA, TC9, 1983 Fitting for ABS and OVC Plastic Utilities Duct and Fittings for Underground Installation.
f. NEMA, TC10, 1983 PVC and ABS Plastic Communications Duct and Fittings for Underground Installation.

4. UL Standards including, but not limited to:
   a. UL 6, 1981 Rigid Metal Electrical Conduit
   b. UL 651 1981 Schedule 40 and 80 PVC Conduit
5. ANSI-C80.2, 1983 Specification for Rigid Steel Conduit, Enameled
6. ANSI/TIA/EIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces.
7. ANSI/TIA/EIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications
8. ANSI/TIA/EIA-758-A – Customer Owned Outside Plant Telecommunications Cabling Standard (including all applicable addenda)
9. BICSI Telecommunications Distribution Methods Manual
10. BICSI Customer-Owned Outside Plant Manual

D. For horizontal directional drilling, the Contractor shall follow all procedural precautions necessary to ensure that the essential aspects of proper directional bore installation are adequately controlled.

E. Personnel for horizontal directional drilling shall be fully trained in safety and their respective duties as part of the directional drilling crew.

1.6 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 – PRODUCTS

2.1 TRENCH/BACKFILL MATERIALS

A. Trenching and Excavation Backfill: Select fill materials as specified in Section 01 57 13.

B. Concrete Slurry: Select Flow Fill as specified in Section 01 10 00

C. Concrete Pavement: Select concrete paving materials as specified in Section 01 60 00

D. Asphalt Pavement: Select asphaltic paving materials as specified in Section 01 60 00

2.2 CONDUIT SYSTEM

A. Non-Metallic Conduit:
   1. PVC plastic pipe, ASTM D1785, Schedule 40, Type PVC 1120.
   2. Tone Tape, Arnco DL WP12LC Tone Tape, or equivalent.

B. Conduit Joint Couplings:
   1. PVC non-metallic fittings must be installed with solvent applied couplings.
   2. An approved transition coupling shall be used to connect metal to plastic (PVC) conduits.
   3. Couplings may be threaded and / or glued to provide watertight seal at conduit junctions.

C. Electrical Metallic Tubing (EMT): Electro-galvanized steel tubing 3/4” and larger diameter per project requirements.
   1. Conduit joint couplings and connectors: steel double set screw indenter fittings.
   2. Metal bushings for 3/4” and 1” conduit.
   3. Insulated metallic bushings for 1-1/4” and larger conduit.
   4. Insulated metallic bushings with grounding lugs as required.
   5. Conduit sweeps: minimum 10 times the conduit inside diameter.
   6. Include required conduit straps, and hangers, heavy-duty malleable iron or steel.

Perforated pipe strap or wire hangers are not permitted.

D. Inside Pull-Boxes: Reference Section 27 05 28 for inside pull-boxes for conduit entering building.

E. Outside Pull-Box: Minimum 14 gauge galvanized steel with weatherproof locking cover and hardware for surface mounting as required for project. Dimensions as required for project.

F. Test mandrel shall be ¼" smaller than inside conduit diameter and not less than 12 inches long.

G. Pull-rope: 1/4" Nylon pull rope.

H. Core Drill Seals for Outside Building Walls: Link-Seal waterproof assembly or equal. Manufactured by PSI/Thunderline/Link-Seal, 6525 Goforth Street, Houston, TX 77021.

I. Conduit Caulking Compound: Compounds for sealing conduit ducts shall have putty-like consistency workable with the hands at temperatures as low as 35 degrees Fahrenheit, shall not slump at a temperature of 300 degrees Fahrenheit, and shall not harden materially when exposed to the air. Compounds shall readily caulk or adhere to clean surfaces of plastic conduit, metallic conduits, or conduit coatings; concrete, masonry; any cable sheaths, jackets, covers, or insulation material, and the common metals. Compounds shall form a seal without dissolving, noticeable changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect on the hands of workers or upon materials.

J. Underground Plastic Line marker: Manufacturer's standard permanent, continuous-printed polyethylene film tape with metallic core, intended for direct burial service; not less than 3" wide x 4 mils thick. Provide orange tape with black printing reading, "CAUTION TELEPHONE/DATA CABLE BELOW," or similar.

K. Ground Wire: Bare Copper # 6

L. Tracer Box: NEMA-3 4" x 4" weatherproof box

M. Spacers for 4" Conduit: Carlon S289NJN Intermediate Spacer and S288NJN Base Spacer

N. Precast Concrete Vault:
   1. General: Provide precast concrete communications vault as detailed on the Drawings and as required for installation of new duct-bank systems and connection to existing duct-bank systems at locations shown on the Drawings. Provide 4'-0"x 8'-0" x 6'-0" deep precast.
   2. Design: Vaults shall be steel reinforced and the complete vault assembly shall be designed for H-20-44 bridge loading. Submittals shall clearly indicate all dimensions and reinforcing steel.
   3. Concrete: Vaults shall be constructed using concrete with a 4500 psi 28 day strength. Concrete mix shall be designed in accordance with ASTM standards.
   4. Reinforcing Steel: Steel shall be intermediate or hard grade billet steel conforming to ASTM A15, deformed in accordance with ASTM A305.
   5. Vaults: Vault and pull box covers for all non-traffic areas shall be made of ductile iron cover, covers in parking and traffic areas shall be cast iron and rated for heavy vehicular traffic. Mount covers in a 30" Type "B" or "WRM" frame. The frame and neck shall be doweled into the vault to prevent movement away from the opening. Voice and Data communications vaults and pull box covers shall be marked "TELECOMMUNICATIONS".
   6. Conduit Entry: Plastic conduits shall include a bell end inside the vault or pull box, mounted flush and grouted to seal openings. Precast fiber type terminators shall be provided for each duct-bank entry.
   7. Grounding: A #4/0 bare copper ground wire shall penetrate the side wall in the bottom section of each vault and pull box and extend 48" inside and outside of the vault pull box.
   8. Accessories: Knockouts, cable racks, sumps, steps, joint seals and other accessories shown on the Drawings or required for a complete installation shall be provided.

O. Duct Plug 4": General Machine Products (GMP) 6668R16

P. End Bell 4": Carlon E297N

Q. Squeegee is moistened pea-sized gravel and sand mixture.

R. Multi-cell Fabric Mesh Duct:
1. All fabric mesh duct shall be installed per manufacturer's requirements.
2. Only manufacturer's fittings, transition adapters, terminators, accessories and installation kits shall be used.
3. All fabric mesh duct shall be populated with a measured pull tape.
4. Manufacturer: MaxCell.

2.3 CABLE ROUTING HARDWARE

A. Cable Rack with Support Hardware as Required (or comparable):
1. 18 Hole: Condux 08380200, Chance C203-1126
2. Other Sizes as Required: Condux, Chance

B. Cable Rack Steps/Hooks:
1. 4": Condux 08380600, Chance C203-1131
2. Other Sizes as Required: Condux, Chance

C. "S" Rack Supports: Condux, Chance

D. Step Lock Wedge: Panduit CHW-C20

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which the new exterior telecommunications pathways are to be installed. Provide notification, in writing, of conditions detrimental to proper completion of the work.

B. Verify field measurements and pathway routing conditions are as shown on drawings. Provide notification, in writing, of conditions deviating from drawings.

C. Beginning of telecommunications pathway installation indicates Contractor acceptance of existing conditions.

3.2 EXCAVATING, TRENCHING AND BACKFILLING:

A. General: The work hereunder includes whatever excavating and backfilling is necessary to install the voice and data communications work. Coordinate the voice and data communications work with other work in the same area, including excavating and backfilling, dewatering, floor protection provisions, other temporary facilities, other underground services (existing and new), landscape development, paving, structural foundations, and floor slabs on grade. Coordinate with weather conditions and provide temporary facilities needed for protection and proper performance of excavating and backfilling.

B. Standards: Except as otherwise indicated, comply with the applicable provisions of Division 2 for voice and data communications work excavating and backfilling. Refer instances of uncertain applicability to the Architect/ Engineer for resolution before proceeding with the Work.

C. Coordinate excavating, trenching and backfilling with Landscaping, Civil, Mechanical, Plumbing and Electrical drawings. Voice and Data Communications duct-banks shall be independent of any other systems.

D. Refer to Civil contract documents for information regarding required depths, slope and grade and additional information regarding trenches. Where these documents and the civil documents differ, bring any such differences to the attention of the engineer prior to construction. The bottom of the trench shall be accurately excavated to provide firm, uniform bearing for the

bottom of the raceways and duct-banks. Where mud or unstable soil is encountered in bottom of trench, it shall be removed to firm bearing and the trench shall be backfilled with bedding sand to proper grade and tamped to provide uniform firm support.

E. The bottom of trenches shall be accurately graded to provide proper fall and uniform bearing and support for each section of the conduit on undisturbed soil or 2" of sand fill at every point along its entire length. In general, grading for voice and data communications duct-banks and conduits shall be from building to vault, and from a high point between vaults to each vault.

F. Exercise care not to excavate below required depth, leaving a flat bed of undisturbed earth, firm and secure, before laying conduit. In the event rock is encountered, excavate 6" below required depth and backfill to required depth with bedding sand, and compact to minimum 95% compaction.

G. All grading in the vicinity of excavation shall be controlled to prevent surface ground water from flowing into the excavations. Any water accumulated in the excavations shall be removed by pumping or other acceptable method. During excavation, material suitable for backfilling shall be stacked in an orderly manner a sufficient distance back from edges of trenches to avoid overloading and prevent slides or cave-ins. Material unsuitable for backfilling shall be wasted and removed from the site and properly disposed of.

H. The Contractor shall be fully responsible for the safety of persons, materials and equipment in or near trenches or other excavations and provide all required sloping, shoring, railings and other protective provisions. The Contractor shall provide a trench shoring plan and design which is sealed by a registered professional engineer. Refer to Divisions 1 and 2 for additional requirements.

I. If any unknown and/or uncharted utilities are encountered during excavation, promptly notify Architect/ Engineer and wait for his instructions before proceeding.

J. If such unknown utilities are encountered and work is continued without contacting the Architect/ Engineer for instructions, and damage is caused to said utilities, the Contractor shall repair at his own expense, such damage to the satisfaction of the owner or utility company concerned.

K. Trenches shall not be backfilled until all required tests have been made by the Contractor and approved by the Architect/Engineer and any local authorities having jurisdiction.

L. Backfill shall be cement stabilized sand up to 6" above the top of conduit or duct-bank as required by code. Backfill up to grade shall be in maximum 6" lifts with minimum 95% compaction of lifts. Refer to Division 2 or elsewhere in Contract Documents for additional trenching and backfill requirements.

M. Opening and Re-closing Pavement, Landscape Areas and Lawns: Where excavation requires the opening of existing walks, street, drives, other existing pavement or lawns, such surfaces shall be cut as required to install new conduit and to make new connections to existing conduits. The sizes of the cut shall be held to a minimum, consistent with the work to be accomplished. After the installation of the new work is completed and the excavation has been backfilled and flooded, the area shall be patched or replaced, using materials to match those cut out or removed. Patches shall thoroughly bond with the original surfaces, shall be level with them, and shall meet all the requirements established by the authorities having jurisdiction over such areas. All removed work shall be replaced by craftsman who regularly installs the types of work being replaced.

N. Excavation in Vicinity of Trees: All trees including low hanging limbs within the immediate area of construction shall be adequately protected to a height of at least 5’ to prevent damage from the construction operations and/or equipment. All excavation within the outermost limb radius of all trees shall be accomplished with extreme care. All roots located within this outermost limb

radius shall be brought to the attention of the Architect before they are cut or damaged in any way. The Architect will give immediate instructions for the disposition of same. All stumps and roots encountered in the excavation, which are not within the outermost limb radius of existing trees, shall be cut back to a distance of not less than 18" from the outside of any concrete structure or pipeline. No chips, parts of stumps, or loose rock shall be left in the excavation. Where stumps and roots have been cut out of the excavation, clean compacted dry bank sand shall be backfilled and tamped.

O. Perform all trenching and backfill for new underground conduit system placement as shown on the project drawings.

P. Perform pavement marking as required as specified in Section 02 58 00.

Q. All utilities to be located by contractor and exposed, if necessary, prior to construction.

3.3 CONDUIT SYSTEM PLACEMENT

A. Place new conduit system including maintenance holes as shown on the project drawings.

B. Twelve inch (12”) clearance from all utilities to be maintained. If not possible, conduit to be encased in concrete slurry (flow fill) where proper distance cannot be obtained.

C. Cross telecommunications conduit ducts below gas piping.

D. All conduits shall be thoroughly cleaned before laying or using.

E. During construction the ends of the conduits shall be plugged to prevent water washing mud into the conduits, vaults, or buildings. Particular care shall be taken to keep the conduits clean of concrete, dirt or any other substance during the course of construction.

F. New and reopened trenches under asphalt roadways and parking lots must have concrete cap or be encased in concrete as required.

H. Support multiple conduits on preformed nonmetallic separators to provide not less than 1” spacing between exterior surfaces of conduit (Type 5). Spacing between separators shall be close enough to prevent sagging of conduits or breaking of couplings and watertight seals.

I. Squeegee is to be placed in the trench for 20’ on each side of the vaults (Type 4).

K. Conduits shall be securely anchored in place with nylon tie-downs to prevent movement during the placement of concrete slurry (flow fill), squeegee, and other backfill materials. Wire tie-downs are prohibited.

L. Seal all conduit junctions and fittings watertight prior to pour of concrete slurry (flow fill). Conduit couplings shall be made in accordance with the manufacturer’s recommendation for the particular type of conduit and coupling selected and as approved.

M. Unless otherwise noted on drawings, a minimum two foot (24”) depth of cover is required above the top of all conduits.

N. Provide communication drain box in conduit six feet (6’) from building outside wall penetrations as shown in project drawings. Conduit inside drain box shall be perforated to allow water and gas to escape.

O. Transition to PVC coated GRC conduit five feet (5’) from building outside wall penetrations.

P. For all offsets and sweep bends, provide fiberglass or PVC coated GRC.

Q. All conduit bends are to be minimum 3’ radius or larger as noted on drawings.

R. Bury underground plastic line marker one foot (12”) above the telecommunications conduit.

S. Cast into concrete a #6 bare copper ground wire directly above the telecommunications conduit

and extend 4” into each vault space. Extend 6” of tracer wire into tracer box on outside wall of building directly above conduit entry point.

T. Provide plastic conduit bell ends at each PVC conduit termination and for all conduit entering vaults.

U. Do not bore under concrete sidewalks, remove and replace sidewalks as necessary.

V. The new conduit shall extend through the wall into the building, tunnel, or crawl space a minimum of 4 inches.

W. Building, tunnel, and vault core drills must be sealed around conduits with approved waterproof plugging compound.
   1. Seal openings around conduits that pass through inside building wall core drills with UL listed foamed silicone elastomeric compound.
   2. Seal openings around conduits that pass through outside building walls with a complete Link-Seal assembly or equal for a waterproof seal. Slope conduit away from building.
   3. Seal openings around conduits that pass through vault walls with foundation foam on the interior of the core and silicone sealer on the inside and outside of the core for a waterproof seal.

X. Maintenance Holes (MH) shall be placed with the long dimension in line with the main conduit run. The conduit shall enter opposite ends of the MH on the short sides so that the MH shall not be used as a 90 degree bend in cable installations.

Y. The ends of the metallic conduit shall be reamed and bushed using:
   1. Insulated metallic bushings for 1-1/4” conduit and larger
   2. Insulated metallic bushings with grounding lugs for conduit entering TRs and ERs

Z.. After conduit duct installation has been completed and concrete has set, pull “D” test mandrel through all new conduit ducts to verify duct integrity and insure smooth interior surfaces free from burrs or obstructions that might damage cable sheaths.

AA. Following mandrel testing, draw cylindrical wire brush with stiff bristles through each conduit to clean the conduit and remove any concrete, dirt or other obstructions.

BB. Stub out conduits into ERs, TRs, and cabinets only enough to attach connector and bushings with grounding lugs except conduits shall rise a minimum of 6 inches above the finished floor.

CC. Install new pull rope in all new conduit and extending three feet into each building space.

DD. Plug ends of the new conduit with watertight rubber conduit plugs, conduit caulking compound, or conduit caps to ensure foreign matter does not enter the buildings.

EE. Refer to Owner prior to cutting or drilling any surface.

3. 4 CABLE ROUTING HARDWARE

A. Place new cable routing hardware in the tunnels and in crawl spaces beneath the building as required for the project and as shown on the drawings.

B. Perform installation of routing hardware as specified in Section 270526 including anchoring and supports, grounding and bonding, etc.

C. Place new ladder, pulling-in irons, cable racks, “S” rack supports, steps in new and existing vaults as required for backbone cable routing.

3.5 HORIZONTAL DIRECTIONAL DRILLING

A. Owner shall be notified 48 hours in advance of starting horizontal directional drilling work. The directional drilling shall not begin until Owner is present at the job site and agrees that proper

preparations for the operation have been made.

B. No work shall commence until Traffic Control and Construction Permits from Owner and/or the City are in place as applicable for the specific project.

C. Site Preparation
   1. Prior to any alterations to work site, the entry and exit points shall be marked.
   2. No alterations to the work site beyond what is required for operations shall be made.
   3. All activities shall be confined to designated work areas.

D. Drill Path Survey
   1. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings.
   2. If a magnetic guidance system is being used, the drill path will be surveyed for any surface geomagnetic variations or anomalies.

E. All applicable environmental regulations shall be adhered to.

F. Following drilling operations, the equipment will be de-mobilized and the worksite restored to its original condition. All excavations will be backfilled and compacted to 95% of original density. Landscaping will be restored to original site conditions.

3.6 SAFETY

A. The contractor must comply with Owner regulations for asbestos, lead, and confined spaces.

B. All applicable state, federal and local safety regulations shall be adhered to and all operations shall be conducted in a safe manner.

C. Guard vault openings per NESC C-2-1997, 423.A:
   1. When covers of maintenance holes are removed, the opening shall be promptly protected with a barrier, temporary cover, or other suitable guard.

D. Test for gas in vaults and unventilated vaults per NESC C2-1997, 423.B and C, including, but not limited to:
   1. The atmosphere shall be tested for combustible or flammable gases before entry.
   2. Where combustible or flammable gases are detected, the work area shall be ventilated and made safe before entry.
   3. Unless forced continuous ventilation is provided, a test shall also be made for oxygen deficiency.
   4. Provision shall be made for adequate continuous supply of air. Note: The term adequate includes evaluation of both the quantity and quality of the air.
   5. Employees shall not smoke in vaults.
   6. Where open flames must be used in vaults or vaults, extra precautions shall be taken to ensure adequate ventilation.

3.7 AS-BUILT DRAWINGS

A. Mark the project drawings with notations reflecting any variations from the base specifications and drawings including as-built conduit routing.

B. Comply with Construction Drawings As-Built Requirements attached to Section 01 78 00 Closeout Submittals.

END OF SECTION

(NOTE TO DESIGNER: These Specifications are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer.)

SECTION 27 05 53
IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Documentation practices and requirements of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, Telecommunications Rooms, and other telecommunications spaces.

1.2 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. University of Houston Information Technology Telecommunication Infrastructure Standards (latest edition).

1.3 SUMMARY

A. This Section specifies the requirements for the Identification for Communications Systems for the University of Houston [Project Name]. [Insert Project Description].

B. Work covered by this Section shall consist of furnishing labor, equipment and materials necessary for the labeling of the telecommunications infrastructure as described on the Drawings and/or required by these specifications.

1.4 QUALITY ASSURANCE

A. Identification and administration work specified herein shall comply with the latest applicable requirements of:
   1. ANSI/TIA/EIA - 606-A Administration Standards.
   2. ANSI/TIA/EIA - 569 Pathway and Spaces
   3. ANSI/TIA/EIA - 568-B Telecommunications Cabling Standard.
   4. BICSI Telecommunications Distribution Methods Manual.
   5. UL 969.
   6. University of Houston Information Technology Telecommunication Infrastructure Standards (latest edition)

1.5 TELECOMMUNICATIONS ADMINISTRATION

A. Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, Telecommunications Rooms, and other telecommunications spaces. All UH facilities shall apply and maintain a system for documenting and administering the telecommunications infrastructure.

B. UH maintains a campus wide labeling scheme for voice and data outlets and patch panels.

C. Refer to the University of Houston Information Technology Telecommunications Infrastructure Standards Manual for Labeling Standards and Conventions.

D. Telecommunications Infrastructure Records must be maintained in a computer spreadsheet, or in a computer database. Paper records are encouraged, but are optional. A cable record is prepared for each backbone cable. The record will show the cable name, and must describe the origin point and

destination point of the cable. The cable record will record what services and/or connections are assigned to each cable pair or strand. An equipment record is prepared for services distributed from a certain piece of equipment, such as a router, or a system such as the telephone system PBX.

E. Installer shall maintain accurate, up-to-date Installation or Construction Drawings. At a minimum, the Installation Drawings shall show pathway locations and routing, configuration of telecommunications spaces including backboard and equipment rack configurations, and wiring details including identifier assignments.

F. Installer shall provide a complete and accurate set of as-built drawings. The as-built drawings shall record the identifiers for major infrastructure components including; the pathways, spaces, and wiring portions of the infrastructure which may each may have separate drawings if warranted by the complexity of the installation, or the scale of the drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Panduit
B. Brady Corporation
C. Equivalent

2.2 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.

C. Where insert type labels are used provide clear plastic cover over label.

D. Outside plant labels shall be totally waterproof even when submerged.

E. Equipment Room Copper, Fiber, and Coax Backbone Cable Labels
1. Panduit Part#LS7-75NL-1 or Brady#WML-1231-292

F. Equipment Room Copper, Fiber, and Coax Horizontal Cable Labels
1. Panduit Part#LS7-75NL-1 or Brady#WML-317-292

G. Work Area Copper, Fiber, and Coax Riser Cable Labels
1. Panduit Part#LS7-75NL-1 or Brady #WML-317-292

H. Patch Panel Labels
1. Panduit Part #LS7-38-1 or Brady #CL-111-619

PART 3 - EXECUTION

3.1 IDENTIFICATION & LABELING

A. The size, color, and contrast of all labels should be selected to ensure that the identifiers are easily read. Labels should be visible during the installation of and normal maintenance of the infrastructure.

B. Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light), and should have a design life equal to or greater than that of the labeled component.

C. All labels shall be printed or generated by a mechanical device.

3.2 TELECOMMUNICATION IDENTIFIERS

A. Refer to the University of Houston Information Technology Telecommunications Infrastructure Standards

Manual for labeling practices.

B. Outside Plant cabling shall be clearly marked using permanent means. Outside plant shall use the following system of numbering and labeling:

1. Fiber Optic:
   a. Identify: far-end building name, building number, fiber-type and strand-count
   b. Label at entrance and exit points of tunnel system and at conduit entry points between 12 inches and 36 inches from the conduit or at closet point that is clearly visible, and long cable length in tunnel at 200 foot intervals.
   c. Label at termination panels at both ends.

2. Copper:
   a. Identify: far-end building name, building number and strand-count
   b. Label at entrance and exit points of tunnel system and at conduit entry points between 12 inches and 36 inches from the conduit or at closet point that is clearly visible, and long cable length in tunnel at 200 foot intervals.

C. Riser cabling shall be clearly marked using permanent means. Riser cabling shall use the following system of numbering and labeling:
1. Fiber Optic:
   a. Identify: far-end EF / ER / TR, fiber-type and strand-count .
   b. When small facilities are fed from a primary location and treated as an ER, riser shall be labeled similar to Outside Plant Fiber Optic.
2. Copper:
   a. Identify: far-end EF / ER / TR and pair-count
   b. Termination points shall be labeled as to actual pair at every fifth (5th) pair-point.

3.3 LABELING PROCEDURES
A. To be consistent with ANSI/TIA/EIA standards and industry practices, it is important that both labeling and color coding be applied to all telecommunications infrastructure components. Labeling with the unique identifier will identify a particular component. Proper color coding will quickly identify how that component is used in the overall telecommunications infrastructure of the facility.
B. Visibility and durability
1. The size, color, and contrast of all labels should be selected to ensure that the identifiers are easily read. Labels should be visible during the installation of and normal maintenance of the infrastructure.
2. Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light), and should have a design life equal to or greater than that of the labeled component.
3. Labels are generally of either the adhesive or insert type. All labels must be legible, resistant to defacement, and maintain adhesion to the application surface.
4. Outside plant labels shall be totally waterproof, even when submerged.
5. Labels applied directly to a cable shall have a clear vinyl wrapping applied over the label and around the cable to permanently affix the label.
6. Other types of labels, such as tie-on labels, may be used. However, the label must be appropriate for the environment in which it is used, and must be used in the manner intended by the manufacturer.
C. Mechanical generation
1. All labels shall be printed or generated by a mechanical device.

END OF SECTION

(NOTE TO DESIGNER: These Specifications are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer.)

SECTION 27 11 00
COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Equipment room fittings for ER/MDF and TR/IDF facilities.

1.2 RELATED SECTIONS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 27 05 00 – Communications Common Work Results

C. University of Houston Information Technology Telecommunications Infrastructure Standards (latest edition).

1.3 SUMMARY

A. This Section specifies the requirements for the Communications Equipment Room Fittings for University of Houston *[Project Name and Description.]*

B. Communications Equipment Room Fittings
   1. The communications service entrance pathway will consist of a minimum of four (4) 4” conduits from the Building Entrance Point to the ER/MDF.
   2. Space for new outside plant copper and fiber optic cable and terminating hardware mounted in contractor provided 19” racks will be provided in the ER/MDF.
   3. ER and TR facilities shall include the following:
      a. ER/MDF Room: Shall not be less than the following size depending on the total building area being served. Note: Special purpose rooms, such as laboratories, computer rooms and certain instructional spaces, may have higher than average density of communications outlets. The size of the ER/TR serving these rooms shall increase accordingly, as determined by ITNO.
         1) <10,000 sq. ft.: 8' X 10'
         2) <20,000 sq. ft.: 10' X 15'
         3) <30,000 sq. ft.: 15' X 15'
         4) <40,000 sq. ft.: 17' X 17'
         5) <50,000 sq. ft.: 19' X 19'
      b. TR/IDF Room: Shall not be less than the following size depending on the total building area being served.
         1) <5,000 sq. ft.: 4.5' X 4.5'
         2) >5,000 < 8000 sq. ft.: 10' X 7'
         3) <8,000 sq. ft.: 10' X 9'
         4) <10,000 sq. ft.: 10' X 11'
      c. 24/7 environmental controls - 18 °C to 24 °C (64 °F to 75 °F). The humidity range should be 30% to 55% relative humidity.
      d. Ceiling height a minimum of 9 ft 6 inches (9’ 6”) above finished floor (AFF)
      e. No false ceilings or water pipe within the room’s interior or running horizontally on the floor above.
      f. Light fixture height a minimum of 8.5 ft AFF, with a minimum equivalent of 500 lux (50 foot candles) measured 3' AFF, with 30% emergency light fixtures, if available. Fluorescent lighting is

prohibited.

g. Dedicated Telecom Room power panels fed from UPS distribution, if available.
h. Convenience electrical outlets shall be installed on a side wall to allow for power cables to be run along relay racks, minimizing possibility of tripping hazards.
i. A minimum of one (1) duplex convenience outlet shall be placed at 6 foot intervals around perimeter walls immediately to the left and right of the door for general purpose use. Duplex utility outlets shall be placed at a 18 inches AFF.
j. At a minimum, one 240 volt 30 AMP dedicated circuit with a NEMA L6-30R receptacle and one 240 volt 20 AMP dedicated circuit with a NEMA L6-20R receptacle shall be installed at a height of seven (7) feet AFF. Both conduit and outlets shall be connected to the outside of the basket tray facing rear of the relay racks.
k. At a minimum, there shall be four (4) 120 volt 20 AMP dedicated outlets with each pair on a dedicated circuit with emergency generator back-up. These outlets are to be located at a height of seven (7) feet AFF and both conduit and outlets shall be connected to the outside of the basket tray facing the rear of the equipment racks. Final design and layout approval on the number, type and location of the outlets shall be provided by ITNO.
l. At a minimum, there shall be one (1) 20-amp 120-volt single phase circuit per rack. All telecommunication circuits shall be clearly labeled on circuit breaker panels with the circuit identification number located on the faceplate of the outlet in the telecommunications room.
m. ¾ “void-free” AC-grade marine plywood on all walls, 8 ft high, painted with at least two coats of light colored fire retardant paint. Fire Marshall to inspect and approve before painting. Paint should be equivalent to: Flame Control Coatings, LLC. Flame Control NO. 20-20A. Fire Hazard Classification, ASTM E-84 (NFPA 255) Class “A”.
n. A Telecommunications Main Grounding Bus Bar (TMGB) in the MER and Telecommunications Grounding Bus Bar (TGB) in the TR and a Bonding Conductor for Telecommunications (BCT) that bonds the TMGB to the electrical power ground compliant with ANSI J STD-607 A Standards
o. Equipment racks and overhead runway (ladder rack) system as shown in T-drawings.
p. 4” riser sleeves between stacked ER/TRs as shown in T-drawings.
q. Building Entrance stub-ups as shown in T-drawings.
r. Cage covered fire suppression elements
s. A floor rating greater than 50 lbf/ft2 distributed loading
t. Fully-opening, secured, lockable, solid-core doors that are at least 3 ft wide and 6.7 ft [80 in]) tall and open outwards from the room.
u. Door locking mechanisms shall be cored with a campus-standard BEST system to accept the Telecommunication Room standard keying of 3IL119 as provided by the University of Houston Lock Shop. Keys for ER’s will be available from ITNO Project Managers as needed.
v. Rooms shall not provide for pass-through or over-head conduits serving plumbing, HVAC or electrical services, except for sprinkler systems.
w. No panels for electrical or other services shall be contained in a TR/ER.
x. Rooms shall be located to maintain compliance with TIA/EIA distance limitations and stacked vertically whenever possible.
y. Conduits entering room shall be located within 4” of wall and conduit outer diameter and stubbed 2” into room.
z. An additional two conduits, sleeved cores or cable tray, over and above the current requirements shall be included for future growth.
aa. Appropriately sized UPS shall be installed in every Telecommunication Room and in Equipment Rooms having rack-mounted equipment/hardware. ITNO will determine appropriate UPS devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Equipment Racks – Heavy duty aluminum 7’ floor mounted racks with cable management channels on

both sides and mounting rails for 19” equipment are required.

1. Chatsworth Products Inc.
   a. Relay Rack - 55053-703
   b. Grounding Bar – 13622-012

B. Vertical Cable Management
   1. Chatsworth Products Inc.
      a. Combination Cabling Section - 30162-703
   2. Uniprise
      a. 6 in. Wide 7FT Double Sided Black W/ Doors - VCM-DS-84-6B 760072785
      b. 8 in. Wide 7FT Double Sided Black W/ Doors - VCM-DS-84-8B 760089359
      c. 10 in. Wide 7FT Double Sided Black W/ Doors - VCM-DS-84-10B 760089367
      d. 12 in. Wide 7FT Double Sided Black W/ Doors - VCM-DS-84-12B 760089375

C. Horizontal Cable Management
   1. Panduit Products
      a. 1U - NCMHF1
      b. 2U - NCMHF2

D. Basket Cable Tray
   1. Cablofil
      a. 12” x 2” – CF54 /300 EZ
      b. 12” X 4” – CF105 / 300 EZ

2.1 RELAY RACKS

A. Equipment racks shall be capable of accepting 19” equipment, self-supporting and manufactured from high-strength aluminum with two top brackets included for additional strength.

B. Finish color shall be black. Mounting holes shall be drilled and tapped each side at 5/8”-5/8”-1/2” patterns compatible with EIA 1-1/4”-5/8” alternating patterns.

C. The rack shall include base flanges with mounting holes drilled through for securing the rack to the floor. Each mounting hole must be at least 5/8” in diameter.

D. Where the rack is to be mounted to VCT flooring or bare concrete, an insulating pad must be used, and care must be taken that anchors, used to secure the rack to the floor, do not come in contact with any reinforcing steel embedded in the concrete slab.

E. In the Telecommunications and Equipment Rooms a minimum of six (6) rack mount spaces are reserved at the top of each rack for fiber enclosures.

2.3 CABLE MANAGEMENT

A. Vertical cable management shall be double-sided and narrow or wide depending upon application requirements. Each manager section shall have a black finish. Lockable latching sections and protective edge guards shall be included.

B. Horizontal cable management shall be capable of attachment to a 19” rack, maximum 6” deep and maximum 2.8” high. Each manager shall have a black finish.

2.4 CABLE RUNWAY

A. Subject to compliance with these specifications, cable runway shall be as manufactured by Chatsworth Products, Inc. Cable runway (ladder rack) is required within the ER/TR's to provide a suitable pathway to route all cabling into and out of termination equipment, mounted in equipment racks or on backboards attached to walls, and pathway spaces beyond the ER/TR.

B. Runway: Provide UL classified cable runway and components. Such products are to be UL classified as to

its suitability as an equipment-grounding conductor. Cable runway and components are to have rounded edges and smooth surfaces in compliance with applicable standards, and with the following additional construction features:

1. Dimension: The cross sectional area of the side rail shall be greater than 0.20 square inches. The height of the side rail must remain at 1-1/2 inches.
2. Material and Finish: All cable runway and components shall be made of tubular steel and finished with flat black powder coat paint or gold chem film over zinc plating.
3. Construction: Cable runway is a prefabricated metal structure consisting of two longitudinal side rails connected by individual transverse members. Cable runway shall be constructed of 1-1/2" x 3/8" x .065" rectangular steel tubing. Cross members shall be a single continuous rectangular tube ½" x 1' x .065" with radiused corners. Cross members shall be welded to stringers at 9" intervals with ends finished to protect installers and cables.
4. Cable runway width shall be 12 inches except as otherwise shown on the Telecommunications Drawings.
5. Cross members shall be spaced every 9 inches at a minimum.

C. UL Classified Runway Butt-Splice Kit: Consists of 4 splice plates, U-shaped. Overall, 5" by 5/8" by 11/16" thick. Provided with 7/16" by 3/8" cutout for insertion of trimmed head bolt. Bolt measures 3/8" diameter by 2-1/2" long provided with hex nut and lock washer.

D. UL Classified Runway Junction Splice Kit: L-shaped splice angles. Overall, 2" x 2" by 1-1/2", 3/16" thick. Secured to cable runway by 3/8" diameter by 1-1/2" hex bolts, nuts and lock washers.

E. UL Classified 90 Degree Runway Splice Kit: Outside Clamp - Overall, 5-3/4" x ¾" by 5/8", minimum 0.10 thick. Provided with 7/16" by 7/16" cutout for insertion of trimmed head bolt. Bolt measures 3/8" diameter by 3-1/4" long. Provided with hex nut and lock washer. Inside Edge Clamp - Overall, 2-9/16" x 15/16" x 5/8", minimum 0.10 thick. Provided with 7/16" x 7/16" cutout for insertion of trimmed head bolt.

F. UL Classified 45 Degree Runway Splice Kit: Outside Clamp - Overall, 4-7/16" x 5/8" x ¾", minimum 0.10" thick. Provided with 7/16" x 7/16" cutout for insertion of trimmed head bolt. Bolt measures 3/8" diameter by 2-11/16" long provided with hex nut and lock washer. Inside Edge Clamp - Overall, 2-9/16" x 15/16" x 5/8" minimum 0.10" thick. Provided with 7/16" x 7/16" cutout for insertion of trimmed head bolts.

PART 3 - EXECUTION

3.1 GENERAL

A. ER / TR

1. Cabling within Racks and Enclosures: provide adequate length of cabling. Train conductors to termination terminal points that follow manufactures installation procedures for maintaining cable performance specifications. Provide lacing/mounting bars to restrain cables, to prevent straining connections, and to stop bending cables to smaller radii than minimums recommended by manufacturer.
2. Equipment Racks: Provide 19" wide x 7'-0" tall racks with number of vertical rack sections as required to allow space for termination of all fiber and data/voice cabling plus mounting space for multi-port concentrators (Hub/Switches) required to cross-connect all data jacks.
3. Locate/space racks and enclosures according to EIA/TIA guidelines for front and around access.
4. Vertical wire management: double-sided vertical rack cabling sections. Reference T. Drawings
5. Entrance: Arrange and coordinate locations of distribution frames, patch panels, cross-connections in communication rooms and racks to optimize space requirements of any service provider requirements, telephone system and LAN equipment.
6. Provide cable runway in equipment room above all racks and up to runway/conduits/sleeve's entering room from corridors to form a complete runway system connecting all hardware installations. Attach grounding lugs to each rack/cable raceway, conduit, etc. Refer to 'T' drawings

for details.

7. Install trays overhead along the equipment rows, leading to the cross-connects. Coordinate tray locations with lighting, air-handling systems, and fire extinguishing systems so that fully loaded trays will not obstruct or impede their operation. In the United States, NEC Article 392 provides requirements for cable trays.
8. Provide horizontal cable runways. Equip each 19" rack with overhead ladder style cable runway installed between the wall and horizontal/equipment racks. Refer to COMMUNICATIONS "T" drawings for proposed locations and sizing of each runway. Securely attach to wall studs with support brackets (and racks if applicable), in accordance with manufacturer written instructions.
9. Provide ground lug for each 19" rack. Racks shall be grounded to wall mounted ground bus bar using #6 AWG stranded, green jacketed, insulated copper conductor. Furnish all required bonding material and hardware, and bond to building grounding electrode subsystem TMGB in ER. If crimp connectors are used to bond the #6 AWG wire, follow NEC bonding procedures/specifications.
10. An inert dielectric material shall separate dissimilar metals apt to corrode through electrolysis under the environmental operating conditions specified.

END OF SECTION

(NOTE TO DESIGNER: These Specifications are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer.)

SECTION 27 13 00
COMMUNICATIONS BACKBONE CABLING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections apply to this Section.

1.2 SECTION INCLUDES

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing in performing the following operations recognized as necessary for the installation, termination, and labeling of copper and fiber backbone infrastructure as described on the Drawings and/or required by these Specifications.

B. Products

C. Installation Requirements

D. The building backbone riser system connects Telecommunication Rooms to each other, to the Main Service Entrance Room and to the Equipment Room. UH specifies separate cable systems to provide data, video and voice needs. The backbone riser system consists of plenum-rated, multi-pair twisted pair copper cables, coaxial, and single mode fiber cables along with associated termination systems.

1.3 RELATED SECTIONS

A. 27 05 00 Common Work Results for Communications

B. 27 05 53 Identification for Communication Systems

1.4 COORDINATION

A. New cable plant requiring connection to, or disconnection from, the University of Houston campus networks shall be performed by personnel designated by Information Technology Network Operations. Campus networks include; telephone, local and wide area, video, cable television, and fiber optic networks.

B. Contractor shall coordinate the work specified in this Section with the work in other parts of the Contract documents.

B. Plans in general are diagrammatic. It is the full responsibility of the Contractor to be familiar with the location of equipment involved under the work of other trades to eliminate conflicts between the fiber and copper cable installation and the work of other trades.

C. All questions and issues with regard to coordination shall be directed to the Owner.

1.4 SUBMITTALS

A. Manufacturer’s data, including part numbers, cut sheets and detailed descriptions, for all proposed equipment.

B. Cable inventory data shall be submitted for all fiber, copper, and coaxial cabling and termination equipment. Submit data electronically on CD-Rom disc in "Microsoft Excel 2007" format, listing products furnished, including:

1. Manufacturer's name.
2. Manufacturer's part numbers and com code numbers.
3. Cable numbers utilizing the UH Information Technology Network Operations' cable numbering standard.
4. Location and riser assignments.
5. This requirement applies to copper cable, fiber optic cable, and all termination equipment.

C. Record Drawings: Furnish CAD drawings of completed work including cable numbers. Refer to item Section 27 05 53 for labeling conventions. Contractor's on-site Building Industry Consulting Services International (BICSI) Registered Communications Distribution Designer (RCDD) supervisor shall review, approve and stamp all shop drawings, coordination drawings and record drawings.

D. Cable Testing Reports.
1. Submit Testing Plan prior to beginning cable testing.
2. Submit certified test reports of Contractor-performed tests in accordance with this document.
3. Electronic and hardcopy versions of test reports shall be submitted together and clearly identified with cable identification.
4. Test reports shall be reviewed, approved and stamped by the Contractor's on-site RCDD.

E. Product data for all termination and test equipment to be used by Contractor to perform work.
1. Equipment shall be calibrated with traceability to National Institute of Standards and Technology (NIST) requirements.
2. Contractor shall include copy of calibration and certification that equipment calibration meets NIST standards and has been calibrated at least once in the previous calendar year.
3. Test equipment data shall be reviewed, approved and stamped by the Contractor's on-site RCDD prior to submitting.

F. Submit Cable Pulling Plan, as follows:
1. Indicate the installed backbone conduit layout in schematic format, including junction boxes and distances between junction boxes.
2. Indicate contents of each conduit.
3. Indicate the cable pulling calculations, conduit fill ratios and actual cable runs and tensions.
4. Cable Pulling Plan shall be reviewed, approved and stamped by the Contractor's on-site RCDD prior to submittal.
5. Installation of cabling shall not commence prior to approval of the pulling plan and calculations by the Architect/Engineer.

G. The Contractor shall submit installation plan indicating:
1. Equipment and personnel
2. Materials and staging area
3. Start and completion dates
4. Locations, including floor, room and building
5. Installation plan shall be reviewed, approved and stamped by the Contractor's on-site RCDD prior to submitting.

H. The Contractor shall submit a copper cable pulling plan for all multi-pair copper cables with a pair count of 25 pairs or greater, that includes, but is not limited to, the following:
1. Each cable run and route.
2. Date and duration of the pull.
3. Pulling methodology and equipment setups.
4. Pulling tension calculations for each pull in the run.
5. Safety issues and precautions to be taken.

I. Cable Splicing Submittals
   1. Fiber fusion splicing method and procedures.
   2. Schedules of copper and fiber cables to be spliced.
   3. Copper splicing method and procedures.
   4. Certification documents for all splicing personnel.
   5. Cut sheets, showing accurately scaled components, of fiber and copper splice closures, accessories, clamps, brackets, hangers, splice connectors, splice joint assemblies and fittings.

J. Shop Drawing Submittals to include:
   1. Room penetration plan / drawing
   2. Communication extension pathway plan / drawing
   3. Riser conduit anchoring plan / drawing
   4. Conduit chase plan / drawing
   5. Communication pathway plan / drawing
   6. Junction box, gutter and pull box labeling plan / drawing
   7. Cabinet / rack elevation drawing
   8. Floor plan drawing for all ER / TR rooms
   9. Wall elevation drawings for all ER / TR rooms

K. All submittals for substitutions or modifications shall be made to the ITNO for approval prior to start of work.

1.5 QUALITY ASSURANCE

A. Verification: The Owner shall maintain inspection personnel on the job site. It is incumbent upon the Contractor to verify that the installation and material used has been inspected before it is enclosed within building features, or otherwise hidden from view. The Contractor shall bear costs associated with uncovering or exposing installations or features that have not been inspected.

B. Equipment: The Contractor is to use equipment and rigs designed for pulling, placement and termination of multi-pair copper cable; including reel trucks, mechanical mules, sheaves, shoes, anchors etc., and equipment for drilling masonry, installing anchors, etc., to install support and cable management hardware.

.

PART 2 - PRODUCTS

2.1 COPPER CABLE

A. Substitutions for products specified are not permitted without express written approval of Information Technology Network Operations.

B. Solid Copper Backbone/Tie Copper Cable: 24 AWG, UTP, Category 3, OSP Backbone Cables with an overall metallic shield. Manufacturer: Berk-Tek - Part Number: 10032113

C. Voice backbone cables installed in underground conduits or the tunnel shall be gel-filled PIC cable to a termination point within the ER. The backbone cable shall then be cross-connected to the protector blocks.

D. All splice cases used in the multi pair voice backbone shall be waterproof.

E. Building entrance protection for copper cabling shall be installed utilizing a two (2) foot fuse link between outside plant cable plant splice and the protector module with IDC-type input and output terminals, 100 pair-pair capacity and female mounting base, equipped with 230 volt solid state protector modules. Sufficient protector modules shall be provided to completely populate all building entrance terminals.

F. The shield of all inter-building backbone cables must be bonded to the ground lug on the primary protector panel. The protector panel must be bonded to the Telecommunications Main Grounding Busbar. The shield of all intra-building backbone cables must be bonded to the Telecommunications Main Grounding Busbar.

G. Voice backbone cables shall have a minimum 10-foot service loop when terminated in the ER and TR, and at any splice points in telecommunications manholes.

2.2 PROTECTOR PANELS

A. Entrance Terminals - CIRCA 188OECA1-100G

B. Protector Modules – CIRCA Gas Protector Unit – 3BIE

2.3 COPPER TERMINATION HARDWARE

A. Main Cross Connect (MC)
   1. 5 Pair – Panduit P110KB1005
   2. 5 Pair – CommScope UNK-110-WB-5M-100PR
   3. 4 Pair – Panduit P110KB1004
   4. 4 Pair – CommScope UNK-110-WB-4M-100PR

B. Entrance Facility (EF)
   1. 5 Pair – Panduit P110KB1005
   2. 5 Pair – CommScope UNK-110-WB-5M-100PR
   3. 4 Pair – Panduit P110KB1004
   4. 4 Pair – CommScope UNK-110-WB-4M-100PR

C. 48 Port Angled Patch Panels, filled and terminated with appropriate number of black RJ-45 jacks.
   1. Panduit – UICMPPA48BL
   2. CommScope – M2000A-48

2.4 OUTSIDE PLANT FIBER OPTIC CABLE

A. 48-strand 9/125 micron single-mode outside plant rated fiber optic cable: CommScope

B. 12-strands 62.5/125 micron multi-mode outside plant rated fiber optic cable (MM OSP cable used only for fire alarm system): CommScope

C. All fiber optic cable with loose tube construction installed underground shall be gel filled or be constructed of appropriate waterproofing compounds.

D. A minimum of two (2) complete fiber optic loops in each manhole shall be installed in manholes between buildings.

E. No splicing is allowed in fiber optic cables between buildings.

F. Cable runs shall be installed in one continuous length from bulkhead connector to bulkhead connector without splices; including service loops, and repairs unless required by standard, otherwise written approval must be received from ITNO Management.

G. All newly installed fiber optic cable shall be placed inside fiber optic innerduct when not in conduit or utility tunnel cable tray. A pull string must be run in addition to the cable in order to provide access for future growth.

H. Fiber optic cables shall always have minimum 20-foot service loop at the terminating ends and all approved splice points. Place service loops with large bend radii neatly bundled on walls or on the attached to the bottom side of ladder trays in ‘figure-8’ configuration.

2.5 INSIDE PLANT FIBER OPTIC CABLE

A. 12-strands Plenum-rated 9/125 micron Singlemode fiber optic cable: Manufacturer - CommScope

B. 6-strands Plenum-rated 62.5/125 micron Multimode fiber optic cable: CommScope

2.6 FIBER TERMINATION HARDWARE

A. Rack-mounted Fiber Distribution Units for ER: CommScope #RFE-FXD-EMT-BK/4U

B. Rack-mounted Fiber Distribution Units for TRs: CommScope #RFE-SLG-EMT/2U

C. ST fiber connectors

2.7 FIBER PATCH CABLES

A. Fiber Optic Patch Cords with ST connectors for both SM and MM Cable: Panduit
   1. Yellow for single-mode
   2. Orange for multi-mode

B. One duplex patch cable for every fiber optic strand terminated.

B. Patch cables to be of like type and connector to fiber cable.

C. Length shall be adequate to reach owner provided electronic equipment mounted in lower section of relay rack.

PART 3 – EXECUTION

3.1 CABLE INSTALLATION – OUTSIDE PLANT

A. Fiber optic cable installed in manholes between buildings shall be a minimum of two (2) complete loops in each manhole.

B. Splicing of fiber optic cable is not allowed between buildings.

C. All fiber shall be installed in innerduct. Innerduct shall be spliced according to manufacturer approved methods.

D. At a minimum, 48-strand, single-mode fiber of size 9/125 micron shall be installed. Final strand counts to be approved by ITNO. Single-mode fiber size shall be 9/125 micron. All Single-mode cables are not to exceed 1 dB plus .0008 dB per foot end to end attenuation at 1310nm.

E. The average/maximum fiber splice loss for single-mode fusion splices shall be 0.05/0.3 dB and 0.10/0.3 dB for mechanical splices.

F. Contractor shall submit the cable pulling plan to the Owner prior to commencement of the operation.

G. The fiber shall be pulled in inner-duct inside the manhole to prevent damage to the cable. No splicing is allowed in fiber cables between buildings.

H. All inner-duct shall be spliced according to manufacturer approved methods.

I. The route of multi-pair copper cable installation is as described herein or as shown on the Drawings.

J. The Contractor shall ensure the cables are pulled into the ducts in a manner observing the bend radii and tension restrictions of the cable.

K. The Contractor shall use appropriate shoes, guides, wheels and lubricants to prevent damage to the cable jacket and sheath during installation.

L. Install shield bond connectors to the shields of all cables terminated at the Protector Panels.

M. The Contractor shall apply an appropriate amount of damming compound over the end of filled

copper cables in indoor or dry environments to prevent seepage of cable filling compounds where encapsulant shall not be used.

N. Prior to closure assembly in dry or indoor installations, all exposed cable pairs shall have the filling compound thoroughly cleaned off the cable insulation using appropriate cleaning solvents.

O. All pairs spliced shall be tested and all splice-related faults cleared prior to sealing the closure assembly.

3.2 BACKBONE CABLE TESTING

A. Complete end-to-end test results for all copper UTP and fiber optic lines installed is required.

B. All fiber optic cable must be visually inspected and optically tested on the reel upon delivery to the installation site. Using an Optical Time Domain Reflectometer (OTDR), an access jumper with like fiber, a pigtail, and a mechanical splice, all fibers shall be tested for continuity and attenuation. Testing for continuity and attenuation on the reel must confirm factory specifications to ensure that the fiber optic cable was not damaged during shipment. The test results must match the results of the factory-attached tag on the reel, or the fiber shall not be used. Reel data sheet must be provided showing test results.

C. End to end (bi-directional) test measurements shall be provided for singlemode and multimode fibers (2 wavelengths per test are required). Test results must be submitted for review as part of the installation inspection requirements. Test results shall be in paper form and electronic form, and must contain the names and signatures of the technicians performing the tests.

D. Testing shall be performed on 100% of the fibers in the completed end-to-end system. ANSI/TIA/EIA-568-A, Annex H, provides the technical criteria and formulae to be used in fiber optic testing. Note however, that all UH fiber must be tested, rated and guaranteed for Ethernet GigaSPEED 1000B-X performance. Additionally, all fiber optic cable links must pass all installation and performance tests both recommended and mandated by the cable manufacturer.

E. All multi-pair copper cable pairs installed shall be tested to TIA/EIA 568A, Category 3 or Category 6 equivalent performance specifications. In addition, provide loop resistance measurements in ohms and dB loss at 1KHz, 8KHz, and 256KHz.

F. The Owner is to be notified at least 24 hours prior to testing to allow observation at the Owner's discretion. If the Owner confirms his intention to observe, a reasonable starting time shall be agreed upon. Should the Owner not be present at the scheduled commencement time, the Contractor may begin testing as scheduled.

G. 100% of all pairs in backbone copper cables shall be tested for continuity and wire-map.

H. Format: Test Results must be submitted in two (2) formats. First, must be original file(s) down loaded from tester. Second, the file must be cohesively placed in Excel format with the following fields: ER/TR RM # / RM # of drop / Port # / all relevant test information in as many fields as necessary.

I. Care, with reference to above format criteria, should be taken when recording the information in the tester, proper consistency with port identification is required.

J. As- Built drawings must be submitted with .dgn or .dwg file extensions.

K. Delivery: Test Results may be electronically submitted to the ITNO Department. Contact information shall be provided after contract is awarded and before project completion

L. All test results are to be recorded and turned over to the Owner for checking.

3.2 CABLE AND TERMINATION PANEL LABELING

A. Label the installed cables in accordance with Section 27 05 53

3.3 CABLE SUPPORT

A. Provide cable supports and clamps to attach cables to backboards and walls.
   1. Attach horizontal and vertical backbone cables at 2 foot intervals using Owner approved supports; such as D-rings or jumper troughs utilized for wire management.

B. Attach cables to manhole racks using Owner approved methods

3.3 AS-BUILT DRAWINGS

A. Provide three (3) copies of E and three (3) copies of C size prints along with CADD files in .dwg or .dgn formats showing floor plans with room numbers and actual backbone cabling and pathway locations and labeling. The deliverable is required within 5 business days of final cable testing.

B. Red Line Drawings: Contract must kept one (1) E size set of floor plans on site during work hours with installation progress marked and backbone cable labels noted. Contractor may be asked to produce these drawings for examination during construction meetings or field inspections.

END OF SECTION

(NOTE TO DESIGNER: These Specifications are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer.)

SECTION 27 15 00
COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Horizontal communications cabling materials and installation methods

B. Copper connectivity equipment.

C. Horizontal cable testing methods.

1.2 RELATED DOCUMENTS

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

B. Related Division 27 Sections include:
1. 27 05 00 Common Work Results for Communications

C. University of Houston Information Technology Telecommunication Infrastructure Standards (latest ed.)

1.3 SUMMARY

A. This Section specifies the requirements for Communications Horizontal Cabling for the University of Houston [Project Name]. [Insert Project description.].

B. All voice and data horizontal cables shall consist of plenum-rated, solid copper, 24 AWG, 100 balanced twisted-pair (UTP) Category 6 cables with four individually twisted-pairs, which meet or exceed the mechanical and transmission performance specifications in ANSI/TIA/EIA-568B.2.

C. Horizontal cabling shall be terminated in the ER/TRs on 48-port, 8-pin modular insulation displacement connector (IDC) meeting Category 6 performance standards, and pinned to T 568B standards. Category 6 patch panels shall be mounted in an approved 19 inch relay rack. 100 percent of the horizontal cabling shall be terminated on patch panels in the telecommunications room.

D. The maximum horizontal distance shall be 295 feet.

E. All information outlets will be flush-type mounted into conduits and boxes. Typical outlets will be used in the offices and consist of two voice and two data cables with 568B outlet configurations.

F. Each horizontal cable must be tested with documentation provided.

G. Contractor shall keep updated redline drawings and provide as-built documentation in both print and electronic formats.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cable
1. Twisted Pair
   a. CommScope - 6504 – Cable Jacket Color shall be Blue.
2. Coaxial
   a. CommScope – 2275 V

B. Angled Patch Panels

1. Panduit – UICMPPA48BL
2. CommScope – M2000A-48

C. Faceplates
1. Panduit – CFPE4IW
2. CommScope – UNF-MFM-4P-WH

D. Telecommunication Outlets: 8-pin modular Category 6, un-keyed, pinned T568B standards to be fully terminated. Single-gang mounting plate with four (4) openings which shall include one or more of the following devices:
1. Panduit
   a. Telecommunications Outlet – Color: Red– CJ688 TP RD
   b. Wireless Outlet – Color: Yellow – CJ688 TP YL
   c. Security Camera/Intrusion Alarm Outlet – Color: Purple-CJ688 TP
   d. EMECS Systems- Color: Green – CJ688 TP GN
   e. Blank – CMBIW-X
2. CommScope
   a. Telecommunications Outlet – Color: Red – UNJ600-RD
   b. Wireless Outlet – Color: Yellow – UNJ600-YL
   c. Security Camera/Intrusion Alarm Outlet – Color: Purple
   d. EMECS Systems- Color: Green
   e. Blank – UNDC-WH

PART 3 - EXECUTION

3.1 GENERAL

A. Follow manufacturer's installation guidelines and UH Information Technology Telecommunication Infrastructure Standards.

B. All voice and data cabling and terminations and termination hardware shall be TIA/EIA wiring configuration T568B.

C. All voice and data cabling shall be continuous from the nearest telecommunications room to the telecommunications outlet. Splicing of cable is not allowed.

D. The length of each individual run of horizontal cable from the administration subsystem (Telecommunications Room) to the Telecommunication Outlet shall not exceed 295 ft.

E. The 4 pair UTP cable shall be Underwriter's Laboratories (UL) listed type CMP.

F. Strict attention shall be paid to the manufacturer's guidelines on bend radii and maximum pulling tension during installation. Notice that the recommended minimum bend radius for a cable during installation is typically greater than the recommended bend radius after the cable is installed. This is to minimize tension and deformation as the cables pass around corners during installation. The maximum pull-force guideline for 4-pair horizontal balanced twisted pair cables is 110 N (25 lbf).

G. UTP Cabling:
1. Provide a minimum of 3-foot service loop (for re-termination) for horizontal cables. Locate service loop where horizontal cable run transitions to cable tray. Place at least 12” of service loop in outlet box.
2. The horizontal distance is the cable length from the mechanical termination of the media at the horizontal cross-connect in the telecommunications room to the telecommunications outlet/connector in the work area. The maximum horizontal distance shall be 295 ft, independent of media type. The length of the cross-connect jumpers and patch cords in the cross-connect facilities, including horizontal cross-connects, jumpers, and patch cords that connect horizontal cabling with equipment or backbone cabling, should not exceed 5 m (16 ft) in length. For each horizontal channel, the total length allowed for cords in the work area plus patch cords or jumpers

plus equipment cables or cords in the telecommunications room shall not exceed 10 m (33 ft).

3. Cable and components shall be visually inspected for proper installation. Cable stress, such as that caused by tension in suspended cable runs and tightly cinched bundles, shall be minimized. Plenum rated Velcro ties used to bundle cables should be applied loosely to allow the Velcro tie to slide around the cable bundle. The vector ties should not be cinched so tightly as to deform the cable sheath. Cable placement should not deform the cable sheath.
4. Minimum bend radius: The minimum bend radius for cable will vary depending on the condition of the cable during installation (tensile load) and after installation when the cable is at rest (no-load).
5. The minimum bend radius, under no-load conditions, for 4-pair unshielded twisted-pair (UTP) cable shall be four times the cable diameter.
6. Copper cable splicing or bridge tapping is unacceptable.
7. Cables should be terminated with connecting hardware of the same category or higher. To maintain the cable geometry, remove the cable sheath only as much as necessary to terminate the cable pairs on the connecting hardware. The connecting hardware manufacturer's instructions for cable sheath strip-back shall be followed. When terminating Category 6 and higher cables, the cable pair twists shall be maintained to within 13 mm (0.5 in) from the point of termination. For best performance when terminating cable on connecting hardware, the cable pair twists should be maintained as close as possible to the point of termination.
8. The Cable Contractor shall install 4-pair Category 6 plenum rated UTP cables from the appropriate TR to each outlet location as indicated on the telecommunications drawings.

3.2 SITE QUALITY CONTROL

A. Site Testing and Inspection Agency Qualifications

1. Every cabling link in the installation shall be tested in accordance with the field test specifications defined in ANSI/TIA/EIA-568-B.2-1 “Transmission Performance Specifications for 4-pair, 100 Ohm, Category 6 Cabling”. This document will be referred to as the “TIA Cat 6 Standard.”
2. The installed twisted-pair horizontal links shall be tested from the patch panel in the telecommunications room to the telecommunication wall outlet in the work area against the “Permanent Link” performance limits specification as defined in the TIA CAT 6 Standard.
3. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals).
4. The test equipment shall comply with the accuracy requirements for level III field testers as defined in ANSI/TIA/EIA 568B.2-1. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table B.2 of Annex B of in ANSI/TIA/EIA 568B.2-1. (Table B.3 in this TIA document specifies the accuracy requirements for the Channel configuration.)
5. The test plug shall fall within the values specified in E.3.2.2 Modular test plug NEXT loss requirements of the in ANSI/TIA/EIA 568B.2-1.
6. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
7. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The Cable Contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
8. One hundred percent of the installed cabling links must be tested and must pass the requirements

of the standards in this section. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with the Test Result Documentation as listed below.

B. Site Testing, Inspection and Acceptance
   1. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.
   2. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks.
   3. A representative of the design team shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing commences.
   4. At the conclusion of field testing, at a time scheduled by the owner's representative, the owner's representative will select a random sample (up to 10%) of the installed links in each wiring closet. The Cable Contractor, under supervision of the owner's representative, shall test these randomly selected links and the results are to be stored in accordance with the prescriptions in Test Result Documentation as listed below.
   5. The results obtained shall be compared to the data originally provided by the Cable Contractor. If any (one or more) of the sample test reports displays a fail or fail* result, the Cable Contractor shall resolve any conditions causing the failed test and under supervision of the owner’s representative shall repeat 100% of the testing and the cost shall be borne by the Cable Contractor.

C. Performance Test Parameters
   1. The test parameters for CAT 6 are defined in TIA CAT 6 standard, which refers to the ANSI/TIA/EIA-568-B.2 standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test all measurements (at each frequency in the range from 1 MHz through 250 MHz) must meet or exceed the limit value determined in the above-mentioned standard.
      a. Wire Map
      b. Length
      c. Insertion Loss (Attenuation)
      d. NEXT Loss
      e. PSNEXT Loss
      f. ELFEXT Loss, pair-to-pair
      g. PSELFEXT Loss
      h. Return Loss
      i. ACR (Attenuation to crosstalk ratio)
      j. PSACR
      k. Propagation Delay
      l. Delay Skew [as defined in TIA/EIA-568-B.1; Section 11.2.4.11]

D. Test Result Documentation
   1. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test.
   2. The test results records saved by the tester shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test and that these results cannot be modified at a later time.

Superior protection in this regard is offered by testers that transfer the numeric measurement data from the tester to the PC in a non-printable format.

3. The database for the completed job shall be stored and delivered on CD-ROM including the software tools required to view, inspect, and print any selection of test reports.
4. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
    a. The identification of the link in accordance with the naming convention defined in the overall system documentation.
    b. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number.
    c. The date and time the test results were saved in the memory of the tester.
5. General Information to be provided in the electronic data base with the test results information for each link:
    a. The identification of the customer site as specified by the end-user.
    b. The identification of the link in accordance with the naming convention defined in the overall system documentation.
    c. The overall Pass/Fail evaluation of the link-under-test.
    d. The name of the standard selected to execute the stored test results.
    e. The cable type and the value of NVP used for length calculations.
    f. The date and time the test results were saved in the memory of the tester.
    g. The brand name, model and serial number of the tester.
    h. The identification of the tester interface.
    i. The revision of the tester software and the revision of the test standards database in the tester.
    j. The test results information must contain information on each of the required test parameters.
6. The detailed test results data to be provided in the electronic database for each tested link must contain the following information:
    a. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. In this case, the PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
        1) Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m (1ft) and the test limit value.
        2) Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value.
        3) Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value.
        4) Attenuation: Minimum test results for the worst pair.
        5) Return Loss: Minimum test results for the worst pair as measured from each end of the link.
        6) NEXT, ELFEXT, ACR: Minimum test results documentation as explained in Section I.B for the worst pair combination as measured from each end of the link.
        7) PSNEXT, PSELFEXT, and PSACR: Minimum test results documentation for the worst pair as measured from each end of the link.

E. As-built drawings
    1. Provide three (3) copies of E and three (3) copies of C size prints along with CAD files in .dwg or .dgn formats showing floor plans with room numbers and actual outlet locations and labeling. The deliverable is required within 5 business days of final cable testing.

2. Red Line Drawings: Contract must kept one (1) E size set of floor plans on site during work hours with installation progress marked and outlet labels noted. Contractor may be asked to produce these drawings for examination during construction meetings or field inspections.

END OF SECTION 27 15 00

(NOTE TO DESIGNER: These Specifications are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer.)

SECTION 27 16 19
PATCH CORDS, STATION CORDS AND CROSS-CONNECT WIRE

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Copper and fiber optic patch cables.

1.2 RELATED DOCUMENTS

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

B. Related Division 27 Sections include:

1. 27 05 00 Common Work Results for Communications

C. University of Houston Information Technology Telecommunication Infrastructure Standards

1.3 SUMMARY

A. This Section specifies the requirements for the Patch Cords, Station Cords, and Cross-Connect Wire for the University of Houston [Project Name]. [Insert Project description.].

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Panduit

B. CommScope

2.2 COPPER PATCH CABLES

A. Two (2) Category 6 copper patch cables shall be furnished and installed for each horizontal cable installed as follows:
1. 50% - 5 feet in length;
2. 50% - 15 feet in length.

B. Field terminated patch cables are strictly prohibited.

C. At minimum, every horizontal cabling permanent link in the installation shall meet or exceed performance characteristics of the field test specifications defined in ANSI/TIA/EIA-568-B.2-1 “Transmission Performance Specifications for 4-pair 100 ohm Category 6 Cabling”.

D. Copper patch cables shall be labeled with the switch and port number on the patch panel end, and the patch panel and port number on the switch end.

E. Patch cables color corresponds to the following:
1. Red for Data;
2. Yellow for Wireless Access Points;
3. Purple for Security Applications;
4. Green for Building Energy Management and Environmental Controls Systems.

2.3 FIBER OPTIC PATCH CABLES

A. Furnish and install one duplex LC Fiber optic patch cable for each fiber optic termination. Length to be determined and included in submittal documents.

B. Fiber optic patch cables types shall coincide with terminated fiber optic type (ie. Singlemode or 50 µm Multimode)

C. Fiber Optic Patch Cable Color:
   1. Single-mode - Yellow
   2. Multi-mode - Orange

D. Field terminated patch cords are strictly prohibited

E. Patch cord shall be labeled on each end specifying the source and destination of the cable.

PART 3 - EXECUTION

3.1 PATCH CABLES

A. Cable Contractor shall fully cooperate and coordinate with Owner's Voice and Data Communications Equipment providers as required to ensure proper integration and connectivity between systems.

B. Care shall be taken to protect the minimum bend radius of 4 times the cable diameter on all copper patch cables.

C. Cable Contractor shall furnish labeled floor plan and Microsoft Excel run sheet to Owner's Voice and Data Communications Equipment providers two weeks prior to occupancy.

D. Cable Contractor shall furnish and install all patch cords in conjunction with Owner's Voice and Data Communications Equipment providers.

E. Cable Contractor shall provide adequate technician support when Owner's Voice and Data Communications Equipment providers are planning and installing new voice and data equipment installation and connectivity.

END OF SECTION

(NOTE TO DESIGNER: These Specifications are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer.)

SECTION 27 20 00
DATA COMMUNICATIONS EQUIPMENT

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Data Communications Equipment.

1.2 RELATED DOCUMENTS

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

B. Related Division 27 Sections include:
   1. 27 05 00 Common Work Results for Communications

C. University of Houston Information Technology Telecommunication Infrastructure Standards

1.3 SUMMARY

A. This Section specifies the requirements for the Data Communications Equipment for the University of Houston [Project Name]. [Insert Project description.].

B. Data Communications Equipment
   1. Data Communications Equipment includes customer owned routers, servers, Ethernet switches, personal computers, printers, wireless access points, etc. required to connect the Academic Wing to the rest of the campus, the internet and the public switched telephone network (PSTN).
   2. Data Communications Equipment at UH is provided by Owner.
   3. Data Communications Equipment will be Owner Furnished Owner Installed (OFOI).
   4. Cable Contractor shall fully cooperate and coordinate with Owner as required to ensure proper integration and connectivity between systems.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 COORDINATION

A. Cable Contractor shall fully cooperate and coordinate with Owner as required to ensure proper integration and connectivity between systems.

B. Cable Contractor shall furnish labeled floor plan and excel run sheet to Owner two weeks prior to occupancy.

C. Cable Contractor shall furnish and install all patch cords in conjunction with Owner.

D. Cable Contractor shall provide adequate technical support to Owner during planning, installation and connectivity of new voice and data equipment.

E. Cable Contractor shall provide adequate technician support first business day after data equipment installation and connectivity.

END OF SECTION

(NOTE TO DESIGNER: These Specifications are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer.)

SECTION 27 30 00
VOICE COMMUNICATIONS EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Division 27 Sections include:
   1. 27 05 00 Common Work Results for Communications

C. University of Houston Information Technology Telecommunication Infrastructure Standards

1.2 SUMMARY

A. This Section specifies the requirements for the Voice Communications Equipment for the University of Houston [Project Name]. [Insert Project description.].

B. Voice Communications Equipment
   1. Voice Communications Equipment includes customer owned phones, faxes, etc. required to connect the [Project Name] to the rest of the campus and the public switched telephone network (PSTN).
   2. Voice Communications Equipment at the University of Houston is provided by Owner.
   3. Voice Communications Equipment will be Owner Furnished Owner Installed (OFOI).

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 Coordination

A. Cable Contractor shall fully coordinate with Owner's Voice Communications Equipment provider as required to ensure proper integration and connectivity between systems.

B. Cable Contractor shall furnish labeled floor plan and excel run sheet to Owner's Voice Communications Equipment provider two weeks prior to occupancy.

C. Cable Contractor shall furnish and install all patch cords in conjunction with Owner's Voice Communications Equipment provider.

D. Cable Contractor shall provide adequate technician support when Owner's Voice Communications Equipment provider are planning and installing new voice and data equipment installation and connectivity.

E. Cable Contractor shall provide adequate technician support first business day after Voice equipment installation and connectivity.

END OF SECTION 27 30 00