HARVARD
UNIVERSITY

Information Technology

Harvard University Information Technology Standards

Master Format Division 270000

DIVISION 270000 COMMUNICATIONS
TABLE OF CONTENTS

VERSION CONTROL

VERSION #	IMPLEMENTED BY	REVISION DATE	APPROVED BY	APPROVAL DATE	REVISIONS/COMMENTS
1.0	Bala Consulting Engineers	04.15.2020	Mark O'Brien	04.15.2020	Initial Release
1.1	Bala Consulting Engineers	08.11.2022	Mark Bond	08.11.2022	Updated manhole requirements.

SECTION 27 00 00 COMMUNICATIONS GENERAL CONDITIONS

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA-568.0-D Commercial Building Telecommunications Standard.

B. All telecommunication outlets shall be T568-B wiring configuration.

C. All UTP cabling shall meet or exceed all requirements in this specification, ANSI/TIA -568.2-D and ANSI/ICEA S-80-576 that are applicable to four-pair inside wiring cable for plenum space within a building.

D. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.

2. Electrical contract documents.

3. Mechanical equipment.

E. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer

2. Local Exchange Carrier (LEC)

3. Internet Service Provider(s)

F. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

G. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

H. Materials and workmanship

1. Work shall be executed in workmanlike manner and shall present neat, plumb, and perpendicular to building structure and parallel to electronic devices and cabling. Mechanical appearance when completed must adhere to the standards as set forth today (see section 1.02 for applicable standards). Maintain maximum headroom at all times. Do not run work exposed unless shown exposed on drawings. Material and equipment shall be new and installed according to manufacturer's recommended best practice so that completed installation shall operate neatly, safely and efficiently.

2. Completely remove temporary materials, facilities and equipment when their use is no longer required. Clean and repair damage caused by temporary installations.

3. Contractor shall ensure that excess materials are removed from the job site upon completion and acceptance of project work. Excess materials removed from the job site shall be credited to the Owner. Additionally, upon completion of the project, all Contractor equipment will be removed.

1.02 RELATED DOCUMENTS

A. Materials and equipment shall be manufactured, installed and tested as specified in the latest editions of applicable publications, standards, rulings and determinations of:

B. Insulated Cable Engineers Association (ICEA)

1. ANSI/ICEA S-80-576-2002, Category 1 & 2 Individually Unshielded Twisted-Pair Indoor Cables for Use in Communications Wiring Systems, 2002.

2. ANSI/ICEA S-84-608-2002, Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor, 2002.

3. ANSI/ICEA S-90-661-2002, Category 3, 5, & 5e Individually Unshielded Twisted-Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems, 2002.

4. ICEA S-102-700-2004, ICEA Standard for Category 6 Individually Unshielded Twisted-Pair Indoor Cables for Use in LAN Communication Wiring Systems Technical Requirements, 2004

C. National Fire Protection Association (NFPA)

1. NFPA 70, National Electrical Code® (NEC®), Latest Approved Edition.

2. NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces, 2004

3. NFPA 72, National Fire Alarm Code®, 2007

4. NFPA 75, Standard for the Protection of Electronic Computer/Data Processing Equipment, 2009

5. NFPA 76, Recommended Practice for the Fire Protection of Telecommunications Facilities, 2009

6. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, 2009

7. NFPA 101, Life Safety Code®, 2006

8. NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials, 2006

9. NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces, 2007

10. NFPA 780, Standard for the Installation of Lightning Protection Systems, 2004

11. NFPA 5000™, Building Construction and Safety Code, 2006

D. Telecommunications Industry Association (TIA)

1. ANSI X3T9.5, Requirements for UTP at 100 Mbps

2. TIA TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse-Pair Positioning, 2001

3. TIA TSB-140, Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems (2004)

4. TIA-526-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7

5. T-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – SFSTP-14

6. ANSI /TIA-568.0-D, “Generic Telecommunications Cabling for Customer Premises”, December 2015

7. ANSI/TIA-568.1-D, “Commercial Building Cabling Standard, Part 1, General Requirements”, September 2015.

8. ANSI/TIA-568.2-D, "Balanced Twisted Pair Telecommunications Cabling and Components Standard", June 2018

9. ANSI/TIA -568.3-D, "Optical Fiber Cabling and Components Standard", October 2016

10. ANSI/TIA 569.D, “Commercial Building Standards for Telecommunications Pathways & Spaces”, April 2016

11. ANSI/TIA-598-D, Optical Fiber Cable Color Coding, 2014

12. ANSI/TIA-604.2-A, FOCIS 2—Fiber Optic Connector Intermateablility Standard, 2003

13. ANSI/TIA 606-C, “Labeling and Administration Standards for Telecommunications Cabling in Commercial Buildings”, June 2017

14. ANSI/TIA 607-D, “Bonding and Grounding for Telecommunications Cabling and Equipment in Commercial Buildings”, July 2019

15. ANSI/TIA-758-B, Customer-Owned Outside Plant Telecommunications Infrastructure Standard, March 2012

16. ANSI/TIA-854, A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling, 2001

17. ANSI/TIA-862-B Building Automation Systems Cabling for Commercial Buildings, February 2016

18. ANSI/TIA-942-B, Telecommunications Infrastructure Standard for Data Centers, July 2017

E. Other Reference Materials

1. ANSI/NECA/GICSI-568-2006, Standard, Installing Commercial Building Telecommunications Cabling

2. BICSI Outside Plant Design Reference Manual (COOSP), current edition.

3. BICSI Electronic Safety and Security Reference Manual (ESS), current edition

4. BICSI Information Transport Systems Installation Methods Manual (ITSIM), current edition

5. BICSI Network Design Reference Manual (NDRM), current edition

6. BICSI Telecommunications Distribution Methods Manual (TDMM), current edition

7. BICSI Wireless Design Reference Manual (WDRM), current edition

8. Institute of Electrical and Electronic Engineers (IEEE)

9. National Electrical Manufacturers Association (NEMA)

10. Underwriters Laboratories (UL) Cable Certification and Follow Up Program

11. All other required Federal, State, and Local codes and regulations.

1.03 WORK INCLUDED

A. Perform work and provide material and equipment as shown on Drawings and/or as specified and/or indicated in this Specification(s). Completely coordinate work of this Section with work of other trades and provide a complete and fully functional installation.

B. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

C. Give notices, file plans, obtain permits and licenses, pay fees and back charges, and obtain necessary approvals from authorities that have jurisdiction as required to

perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

D. Harvard University Information Technology (HUIT) can provide departments with the following assistance to ensure all wire and cable is installed in a thorough and professional manner. HUIT will work with departments during the entire installation process to make sure all work meets the department's needs.

1. Provide Design Assistance.

2. Conduct a needs assessment.

3. Assist in preparing a floor plan detailing specific station locations to be wired and the location of wiring closets.

4. Develop a comprehensive design recommendation using University standards.

5. Present design, time-line, and work descriptions.

6. Present a thorough financial analysis of the intended work.

7. Identify special construction requirements that are the department's responsibility.

8. Identify special events that would affect the time-line.

9. Obtain approval of the plan from the department.

E. Develop Implementation Plan

1. A HUIT consultant will work with the customer representative to develop an orderly implementation plan. This includes assigning responsibilities for site preparation and preparatory work as well as the actual installation of required components. The HUIT consultant will bring together the team members and ensure that they understand the assignment. The implementation plan will describe the scope of work and include target dates.

F. Provide Project Management

1. The HUIT consultant will:

a. Initiate the work order and begin work (all changes must be requested through the HUIT consultant).

b. Oversee site preparation, including the equipment room and power requirements.

c. Conduct status agreed-upon specifications meetings to ensure implementation is progressing as planned, oversee the completion of wire and cable work, including testing, according to the specification.

G. Conduct a Performance Evaluation

1. The HUIT consultant will:

    a. Conduct a walk-through to inspect the work with customer and vendor representatives, send a letter to the customer itemizing work performed, dates, and billing information, negotiate a plan to resolve any discrepancies with the customer and contractor, and sign an acceptance agreement for the work.

H. Administer Data Base

1. The HUIT consultant will arrange to bill the customer when work is accepted, and to update the University Network database to reflect the changes.

I. Coordinate Moves, Adds, Changes

1. HUIT will retain responsibility for installing new telephone lines. The University Network's management features allow HUIT to perform many moves, adds and changes for departments. For example, HUIT is able to:

2. Configure lines and sets for an electronic key system.

3. Move telephones/lines to a new room.

J. Perform work and provide material and equipment as shown on Drawings and/or as specified and/or indicated in this Specification(s). Completely coordinate work of this Section with work of other trades and provide a complete and fully functional installation.

K. Work shall include, but shall not be limited to, the following:

1. Installer to provide telecommunication racks, ladder rack systems, and cable supports in the Main Distribution Frame (MDF) and each Telecommunications Room (TR). All telecommunication racks and rack systems shall be bonded to the telecommunication ground. The telecommunication ground shall be bonded to the electrical ground. Electrical ground provided by others.

2. Installer shall conduct proper testing procedures for all elements of the scope of work described. Both soft and hard copy test result submissions are required for both the owner and Architect/Engineer team.

3. Installer required to provide shop drawings and submittals for approval by Owner and Architect/Engineer team.

4. Installer is responsible for firestopping all sleeves, cores or penetrations to return them to their original F & T rating.

5. The Vendor shall give full cooperation to other trades and shall furnish (in writing, with copies to Designers) any information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.

6. Of primary importance is the supervision of the project to ensure an expeditious installation of the telephone system and other systems. The

Vendor must identify and provide an on-site project manager who will supervise the daily activities of the project and who will be the conduit of communication with other contractors, the General Contractor, the University and other vendors. The project manager may be required to attend periodic project meetings called by the Harvard Project Manager and/or the General Contractor.

7. After completion of the work, the Vendor shall remove all waste, rubbish and other materials left as a result of his operations and leave the premises in clean condition. Any painted surfaces, which have been scratched, dented or marred, shall be repainted or patched by the Vendor. All work shall conform to the latest edition of the National Electrical Code, the Building Code, and all local codes and ordinances, as applicable. TIA Documents 568-D.0, D.1, D.2 and 569-D and all addendums shall be adhered to during all installation activities. Methodologies outlined in the latest edition of the BICSI Telecommunications Distributions Methods Manual shall also be used during all installation activities. Should conflicts exist with the foregoing, the HUIT Project Manager will have responsibility for making interpretation.

8. The active phone system and network associated with this work will not be taken off-line or removed from service during working hours. Arrangements must be made by the Vendor to coordinate any such activities.

L. Work not included:

1. Peripherals connected to the data-cabling infrastructure (servers, workstations, printers, etc.), shall be provided by others.

2. Electronic backbone equipment (Hubs, switch, routers, etc.) shall be provided by others.

3. All voice equipment connected to telephone cabling infrastructure (phones, faxes, PBX, etc.) shall be provided by others.

4. All line/equipment cords connecting voice equipment to the telephone- cabling infrastructure shall be provided by others.

5. All cross wiring associated with the Centrex shall be by the telecommunications contractor.

6. Patch cords (copper & fiber) shall be provided by Harvard.

1.04 NOTIFY VERIZON OF FACILITIES

A. HUIT will coordinate efforts with Verizon to provide outside plant cable to each building to accommodate the number of stations in the building and allow for a 20% growth in the number of stations.

1.05 QUALIFICATION

A. The successful bidder shall be thoroughly familiar with the cabling methods set forth in the latest release of the BICSI TDMM's (Building Industry Consulting Services

International Telecommunications Distribution Methods Manuals) and unless otherwise specified, shall supervise the installation in accordance with the recommendations and practices outlined in the latest release of the BICSI Telecommunications Cabling Installation Manual.

B. Installer shall be a SYSTIMAX PartnerPRO and provide a twenty (25) year manufacturers' extended product warranty and application assurance warranty for the Category 6 and 6A copper systems and fiber optic cabling. If alternate fiber optic systems and solutions are proposed by the installed, and accepted by Harvard, the installer shall be a certified vendor/installer capable of providing the manufactures 25-year extended warranty. Proof of participation in these warranty programs shall be provided as part of the installer's bid response.

C. The successful bidder shall have at least five (5) years' experience installing and servicing Telecommunication Systems, and shall provide a list of completed projects equivalent in size and complexity to this project, with contact names and telephone numbers.

D. The successful bidder shall submit in writing a list of qualified technicians assigned to this project, including relevant manufacturers training programs completed by each, and years of related experience of each.

1. The successful bidder shall maintain an office or competent technical presence with appropriate testing equipment and replacement parts within 2 hours drive time from this project.

1.06 SUBMITTALS

A. Material and equipment requiring shop drawings submittals shall include, but not be limited to, the following telecommunication components:

1. Faceplates
2. Data Modular Inserts (Category 6 and 6A)
3. Data Horizontal Cable (Category 6 and 6A)
4. Data Patch Panels (Category 6 and 6A)
5. UTP Line/Patch (Category 6 and 6A)
6. Fiber Optic Backbone Cable
7. Fiber Optic Line/Patch Cables
8. Fiber Optic Termination Hardware
9. Inner Duct
10. Wall Telephone Faceplate (Category 6 and 6A)
11. Voice Modular Inserts (Category 6 and 6A)

12. Voice Horizontal Cable (Category 6 and 6A)

13. Voice Termination Blocks

14. Voice Patch Panels (Category 6 and 6A)

15. Copper Backbone Cable

16. Telecommunications Enclosures/Racks

17. Cable Supports and Management

18. Cable Runway/Ladder Rack

19. Firestopping Material

B. Submittal Requirements

1. Provide HUIT with product data for all equipment shown on drawings or schedules, prepared by manufacturers, suppliers and vendors.

2. Submittals shall contain information specific to systems, equipment and materials required by Contract Documents for this Project only. Do not submit catalogs that describe products, models, options or accessories other than those required, unless irrelevant information is marked out or unless relevant information is highlighted clearly.

C. Required Use of Acceptable Manufacturers on this Project:

1. Substitution of products other than those of the Acceptable Manufacturers specified herein shall not be made. Only the specified items or the comparable product by one of the specified Alternate Manufacturers shall be submitted. Products by other manufacturers shall not be used on this project. Use of acceptable manufacturers shall meet or exceed this scheduled or designed product.

D. Deviations

1. Concerning deviations other than substitutions, proposed deviations from Contract Documents shall be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of Shop Drawings which flags the deviation to the attention of the Harvard/HUIT representative or their designate.

2. Without letters flagging the deviation to the Harvard representative or their designate, it is possible that the Harvard representative or their designate may not notice such deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Harvard representative or their designate, the contractor shall hold the Harvard representative or their designate and his consultants harmless for any and all adverse consequences resulting from the deviations being implemented. This shall apply regardless of whether the Harvard representative or their designate has reviewed or approved shop drawings containing the deviation, and will be strictly enforced.

E. Schedule: Incorporate shop drawing review period into construction schedule so that work is not delayed. Contractor shall assume full responsibility for delays caused by not incorporating the following shop drawing review time requirements into his project schedule. Working days listed reference the time in the Harvard representative or their designates office. It does not include transmittal or review time of Contractor or Harvard representative or their designate. Allow at least 10 working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted.

F. Submittal Cover Sheet

1. Shop drawings shall be submitted according to specification section with a separate cover sheet completed for each product, rather than one cover sheet for multiple products, whether or not supplied by one manufacturer or vendor.

G. Communications

1. At the completion of the construction, the Contractor shall provide the following to Harvard.

2. "As Built" drawings of each floor plan documenting the location and labeling of each telecommunication outlet and the approved Harvard labeling scheme. These drawings shall be provided in AutoCAD-2013 and PDF format (electronic media).

    a. In addition – telecommunications contractor shall provide wireless access point outlet numbering list to HUIT minimum 30 days prior to access point installation in field.

3. Electronic drawings documenting the rack and wall field elevations in the MDF and IDFs.

4. Test results of all the telecommunication systems called out in Part 3 Execution of this specification.

5. Prior to the start of the following tasks, work shall be reviewed and approved by designated representative of HUIT:

    a. Start of MDF and IDF layout

    b. Start of vertical riser cable installation

    c. Start of station cable installation

    d. Start of station cable termination

    e. Start of outlet device termination/labeling

    f. Start of installation testing

    g. Start of final inspection process

1.07 TERMS AND GLOSSARY

ANSI: American National Standards Institute

Administration: correct and consistent use of color, labeling, and numbering when preparing and maintaining records of wire and cable work.

Access Point (AP): The central or control point in a wireless cell that acts as a bridge for traffic to and from wireless devices in the cell. The AP also connects wireless devices to the wired portion of the LAN.

Americans with Disabilities Act (ADA): U.S. Department of Justice regulations and guidelines under civil rights law that ensure individuals with disabilities have access to, or may use, public entities and government buildings.

American Wire Gauge (AWG): The standard gauge for measuring the diameter of copper, aluminum, and other conductors.

Approved Ground: A ground that has been approved for use by the authority having jurisdiction.

As-built: Documentation that indicates cable routing, connections, systems, and blueprint attributes upon job completion that reflects changes from the planned to the finished state

Attenuation: The effect of signal dwindling, experienced with accumulating line length or distance of radio transmission.

Authority having jurisdiction (AHJ): The building official, electrical inspector, fire marshal, or other individuals or entities responsible for interpretation and enforcement of local building and electrical codes.

Backbone(s): The part of a premises distribution system that included a main cable route and facilities for supporting the cable from the equipment room to the upper floors or along the same floor to the wiring closets.

Backboards: fire-treated 3/4 inch plywood panels used to mount termination blocks at the IDF and MDF.

Basic rate interface (BRI): The simplest form of network access available on (BRI) the ISDN (integrated services digital network). The BRI comprises 2B + D channels for carriage of signaling and user information.

Bend Radius: The radius of curvature that fiber or copper can bend without breaking or causing excessive loss.

Buffer tube: Loose-fitting cover over the optical fibers in loose-tube construction, used for protection and isolation.

Building distribution: horizontal and vertical wiring that comprise the Riser System and the horizontal distribution used to connect the station outlets through the IDF's and back to the building's MDF.

Building Entrance Facility: A facility that provides all necessary mechanical and electrical services, that complies with all relevant regulations, for the entry of telecommunications cables into a building.

Cable Fill: The ratio of cable installed into a conduit against the theoretical maximum capacity of the conduit.

Cabling: A system of telecommunications cables, cords and connecting hardware that can support the connection of information technology equipment.

Campus wiring: general plan for connecting Harvard buildings via buried conduit and steam tunnels. Campus wiring enables the copper (or fiber optic) cables to connect Harvard buildings to each other and back to the main switch.

Category 5e: This is an enhanced version of Category 5, with additional parameters specified to enable parallel transmission with full duplex across the four pairs. Enhanced Category 5 specifications for cable and connecting hardware products with transmission characteristics specified to 100 MHz, intended to support digital transmission of 1000 Mb/s.

Category 6: For cable and connecting hardware products with transmission characteristics specified to 250 MHz, used to support digital transmission of 1 Gbp/s and above.

Category 6A: For cable and connecting hardware products with transmission characteristics specified to 500 MHz, used to support digital transmission of 10 Gbp/s and above.

Ceiling distribution: Distribution system that uses the space between the false or suspended ceiling and the structural ceiling for housing horizontal cable routes.

Channel: The end-to-end transmission path connecting any two pieces of application-specific equipment. Equipment cables and work area cables are included in the channel.

Cladding: The low refractive index material that surrounds the core of an optical fiber, usually pure silica.

Conduit: heavy-duty casing used to enclose and conceal wire and provide additional protection for wires. Conduits should be sized for all potential voice and data communication needs.

Coaxial (Ethernet) cable: 2-conductor cable with a copper wire center conductor and another tubular conductor of braided wire or copper tubing.

Cords: A short length of copper wire or fiber optic cable with connectors on each end. Used to connect equipment to cabling or to connect cabling segments.

Coring: drilling between floors of a building when IDF closets are aligned vertically. Also, drilling through a building's external wall to provide access for a 4-inch conduit that terminates in the basement MDF.

Cross-Connect: action of joining wires (vertical and horizontal) at the IDFs and MDF to provide service for the station outlet back from the main switch. Cross-connects are performed using standard tools and are labeled at each location according to the specifications described in this document.

Crosstalk: An electromagnetic coupling between two physically isolated circuits in a system. This coupling causes a signal on one circuit to induce a noise voltage on adjacent circuits. Thereby causing interference.

Customer premises equipment (CPE): Customer owned equipment used to terminate or process information for the public network.

CMR: fire rating approved by the National Fire Protection Association (NFPA) for riser cable.

CMP: fire rating approved by NFPA for plenum cable.

Decibel (dB): A unit used to measure relative increase or decrease in power, voltage or current, using a logarithmic scale.

Decibel/kilometer (dB/km): A unit of measurement for fiber optic attenuation.

Demarcation point (DP): A point where the operational control or ownership changes. This point is usually where the access provider's facilities stop and the customer-owned structured cabling begins.

Distribution media: types of wire used to link Network equipment (telephone, PC, terminal) to the main Intellipath system or local area network (LAN). Various types of media may be used in one Distribution System.

TIA: Telecommunications Industry Standard. Used for testing Category 5E, Category 6 and Category 6A UTP.

Equal Level Far End Crosstalk (ELFEXT): Is the same as FEXT, except that the coupled signal at the remote end is relative to the attenuated signal at the remote end on the pair the signal was applied to at the local end.

Equipment (Telephone) room: space (usually in the basement of a building) where dial tone or transmission service is brought into the building, campus wiring is terminated, and wiring is distributed throughout the building.

Far End Crosstalk (FEXT): Refers to the undesired coupling of signals from the transmit pair onto the receive pair at the other (=far) end. FEXT isolation is also expressed in dB. For some applications this is an important parameter, for most applications however, the NEXT values are more important.

FDDI: Fiber Distributed Data Interface. An American National Standards Institute (ANSI) standard for fiber-based token ring physical and data link protocol that operates at 100Mbps data transfer rate.

Fiber optic cable: thin glass filaments that transmit signals as very high-frequency light pulses.

Firestop: A material, device, or assembly of parts in an architectural barrier to prevent vertical or horizontal passage of flame, smoke, water, or gases through the rated barrier.

Firestop system: A specific construction consisting of the material(s) (firestop penetration seals) that fill the opening in the wall or floor assembly, and around and between any items that penetrate the wall or floor (e.g., cables, cable trays, conduit, ducts, pipes), and any termination devices (e.g., electrical outlet boxes), along with their means of support.

Firestopping: The process of installing specialty materials into penetrations of fire-rated barriers to re-establish the integrity of the barrier.

Firewall: 1. A wall that helps prevent fire spreading from one fire zone or area to another, and that runs from structural floor to structural ceiling. 2. One or more security mechanisms designed for access control and authentication to prevent, detect, suppress, and/or contain unauthorized access to a network. Firewalls are designed to keep unwanted and unauthorized traffic from a protected network.

Fishtape: A tool or device that can be extended from the beginning of a pathway to the other end to assist in installing a pull line or to pull in a cable.

Harvard University Network (HUN): an integrated communication transport system, which provides voice and data services to the University, composed of Intellipath, High-speed Data Network (HSDN), TFMS, and wire and cable.

Horizontal distribution (also called station wiring): wires connecting the station outlet (jack) to the IDF.

High-speed Data Network (HSDN): fiber optic backbone and associated media and equipment used to provide mainframe-to-mainframe, mini-to-mini, LAN-to-station, or LAN-to-LAN connectivity within and outside Harvard, as well as access to national networks.

Hub: A concentrator or repeater in a star topology at which node connections meet.

Hybrid cable: An assembly of two or more different types of cable units, cables or categories covered by an overall sheath, It may be covered by an overall shield.

IDF (Intermediate Distribution Frame): area, or one of the areas in a building, housing the riser cable terminations for the floor on which it is located, and from which the service is distributed to the station locations via the horizontal distribution system.

Integrated services digital network (ISDN): Integrated voice and data network based on digital communications technology and standards interfaces.

Intellipath: digital Centrex used at Harvard to provide voice and data services. Control and switching modules are housed Verizon, 10 Ware Street, Cambridge

Inter-building wire and cable: support network of copper and fiber optic cable providing high-speed and low-speed data transport between locations.

Interference: A signal impairment caused by the interaction of another unwanted signal.

Jack (also called station outlet): wire termination assembly that allows network equipment to connect to University Network voice and data services.

J-hook: A supporting device for horizontal cables that is shaped like a J. It is attached to some building structures. Horizontal cables are laid in the opening formed by the J to provide support for the cables.

LAN (local area network): association of personal computer or workstation users who share information and communicate via the University Network's distribution system, inter-building cable, and related network server equipment. LAN users may access the HSDN (High-speed Data Network) for high speed access to file servers, data bases, and other LANs both within and outside the University.

Link: A transmission path between two points, not including terminal equipment, work area cables, and equipment cables

Megabits per second (Mb/s): A unit of measure used to express the data transfer rate of a system, device, or communications channel.

Megahertz (MHz): A unit of frequency equal to one million cycles per second (hertz).

MDF (Main Distribution Frame also called equipment room): usually located in a building's basement, where dial tone and optical fiber is brought into the building, campus wire is terminated, and wire is distributed through the building.

Mule string - pull string in a conduit to allow for future access for pulling more cable trough exiting conduit.

Multimode fiber: Optical fibers that have a large core and that permit nonaxial rays or modes to propagate through the core. 50 micron (OM4) is the common standard core size for premises cabling systems.

National Electrical Code (NEC): A nationally recognized safety standard for the design, construction, and maintenance of electrical circuits. The NEC, sponsored by the National Fire protection Association (NFPA), generally covers electrical power wiring within buildings.

Network components: individual systems (TFMS, Intellipath, wire and cable, and HSDN) that function together to operate, manage, and support the Harvard University Network.

Network equipment: terminals or other equipment located at the station, connected to the Network via a jack, or connected to the Network through the wiring closet. This equipment may include a personal computer, terminal, telephone, fax machine or modem.

Near End Crosstalk (NEXT): Refers to the undesired coupling of signals from the transmit pair onto the receive pair on the same (=near) end. NEXT isolation is

expressed in dB and is a measure of how well the pairs in a cable are isolated from each other.

NFPA: National Fire Protection Association.

Noise: The term used for spurious signals produced in a conductor by sources other than the transmitter to which it is connected. Noise can affect a legitimate signal to the extent that it is inaccurate or indecipherable when it reaches the receiver. The higher the speed of data transmission, the worse the effects of noise become.

110 Hardware: type of termination block used to cross-connect vertical and horizontal distribution at IDF and MDF locations.

Optical fiber: A transmission medium consisting of a core of glass or plastic surrounded by a protective cladding. Signals are transmitted as light pulses introduced into the fiber by a light transmitter i.e. Laser or an LED.

OT: Operational Technologies

Outlets: A term used to describe the sockets provided in the work location of a structured cabling system. These are usually 8-pin modular sockets which can support a variety of services e.g. voice, video and data.

Patch cord(s): Flexible cable unit or element with connector(s), used to establish connections on a patch panel.

Patch panel(s): Termination and administration hardware designed to accommodate the use of patch cords. It facilitates administration for moves and changes.

Pathway(s): Designated cable routes and/or support structures in a false floor or ceiling.

Permanent link: The transmission path between two mated interfaces of generic cabling, excluding equipment cables, work area cables and cross-connections.

Plenum: A designated area used for transport of environmental air as part of the air distribution system. Because it is part of the air distribution system, cables installed in this space require a higher fire rating.

Plenum cable: A cable with flammability and smoke characteristics that meet the safety requirements of the National Electrical Code® (NEC®) that allow it to be routed in a plenum area without being enclosed in a conduit.

Plenum rated: Meeting flammability and smoke requirements for the purpose of fire, life, and safety as described by the National Electrical Code® (NEC®).

POE – Power over Ethernet or PoE - describes any of several standard or ad hoc systems which pass electric power along with data on twisted pair Ethernet cabling. This allows a single cable to provide both data connection and electric power to devices such as wireless access points, IP cameras, and VoIP phones.

Point of demarcation (DP): A point at which two services may interface and identify the division of responsibility (e.g., the point inside a commercial building where the location service provider stops and the customer's cabling begins).

Poke-thru: A penetration through the fire-resistive floor structure to permit the installation of electrical and/or communications cables

Pre-wiring: Wiring installed before walls are enclosed or finished.

PVC (Poly-vinyl chloride): type of cable used in areas with non-plenum ceilings. The minimum type of PVC required is: UL-listed CMR/CMP semi-rigid PVC.

Proprietary networks: Networks that are not designed or installed to standard based guidelines and do not relate specifically to any relevant standard.

Raceway system: system for distribution of media and equipment, including trays, conduit, and wire mold that can carry concealed wire between non-aligned telephone closets and may, in some situations, extend to the station location.

Radio Node: are high-capacity, power-over-Ethernet (PoE) capable, small cells. In any deployment, multiple RNs are deployed inside an enterprise or venue, and are connected to the Services Node using standard Ethernet LAN infrastructure.

Riser system (also called vertical distribution): how media is distributed among floors of a multi-story building.

Router(s): An intermediate system between two or more networks capable of forwarding data packets at the network layer (layer 3.)

Server(s): Host computer(s.)

Single-mode: Optical fiber with a small core diameter in which only a single-mode is capable of propagation. 8.3 micron is the common standard core size.

Sleeve (SL): A short section of conduit, either metallic or non-metallic, lining an opening in the wall or floor for cables to pass through.

Splice: A joining of conductors or fibers, generally from separate cables.

Standards: set of guidelines used as a framework for installing wire and cable for voice and data transmission at Harvard.

Station (STA): Telecommunications end-user location. Usually dedicated to a single-user location and function (e.g., a telephone or computer hookup work area outlet).

Station wiring (also called horizontal distribution): describes wires that connect station outlets (jacks) to the IDF.

Structured cabling: Flexible cabling scheme which allows rapid reconfiguration for office moves through patching.

Systimax SCS: Brand name of Commscope structured cabling system.

Telecommunications closet: An enclosed space for housing telecommunications equipment, cable terminations, and cross-connect cabling. The telecommunications closet is a recognized cross-connect point between the backbone and horizontal cabling subsystems.

Telecommunications bonding backbone (TBB): A conductor that interconnects the telecommunications main grounding busbar (TMGB) to the telecommunications grounding busbar (TGB).

Telecommunications bonding backbone interconnecting bonding conductor (TBBIBC): A conductor utilized to interconnect two or more telecommunications bonding backbones.

Telecommunications bonding equipment conductor (TBEC): Should be installed from each piece of equipment to the telecommunications grounding busbar or telecommunications main grounding busbar.

Telecommunications grounding busbar (TGB): A common point of connection for telecommunications system and equipment bonding to ground; located in the telecommunications room or equipment room.

Telecommunications main grounding busbar (TMGB): A busbar placed in a convenient and accessible location and bonded, by means of the bonding conductor for telecommunications, to the building service equipment (power) ground.

Telecommunications outlet (TO): A socket where the horizontal cable terminates. The telecommunications outlet provides the interface to the work area cabling.

Terminal equipment: telephones, data communication equipment, and peripherals used at station locations.

Terminal wiring: wires connecting network equipment (PC, telephone, or terminal) to the jack on the wall.

Termination blocks: location of the cross-connect fields used to connect and administer station wire. The standard required at Harvard is the 110A (AT&T) Termination block.

Teflon: material required as a casing for cables in areas with plenum ceilings.

Twisted pair: two insulated copper wires twisted together, with a 4-pair total sharing a common outer insulation or sheath; 23 gauge.

UL: Underwriters Laboratory.

Unshielded twisted pair cable (UTP): An electrically conducting cable comprising one or more pairs none of which is shielded.

Wire and cable: media system using copper twisted pair, fiber optic cable, and/or coaxial used to distribute voice and data services throughout the University. Its two principle components are media (the type of wire used by each station to

transmit voice and data) and distribution (the elements needed to link the stations to the media switch or LAN).

Wireless LAN: Local area network that communicates using radio technology.

Work area: A building space where the occupants interact with telecommunications terminal equipment. A user's work area, which is typically 9 sq. meters or 100 sq. feet.

UNITS OF MEASURE

A	Ampere
°C	degrees Celsius
°F	degrees Fahrenheit
ft	feet, foot
Gb/s	gigabit per second
Hz	hertz
in	inch
kb/s	kilobit per second
kHz	kilohertz
m	meter
Mb/s	megabit per second
MHz	megahertz
mm	millimeter
V	volt
W	Watt

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.01 GENERAL

A. Contractor shall use cable tray (which could be provided by others) as primary cable pathway and shall distribute from the cable tray to each TO via conduit or acceptable methods. See electrical drawings for cable tray routing.

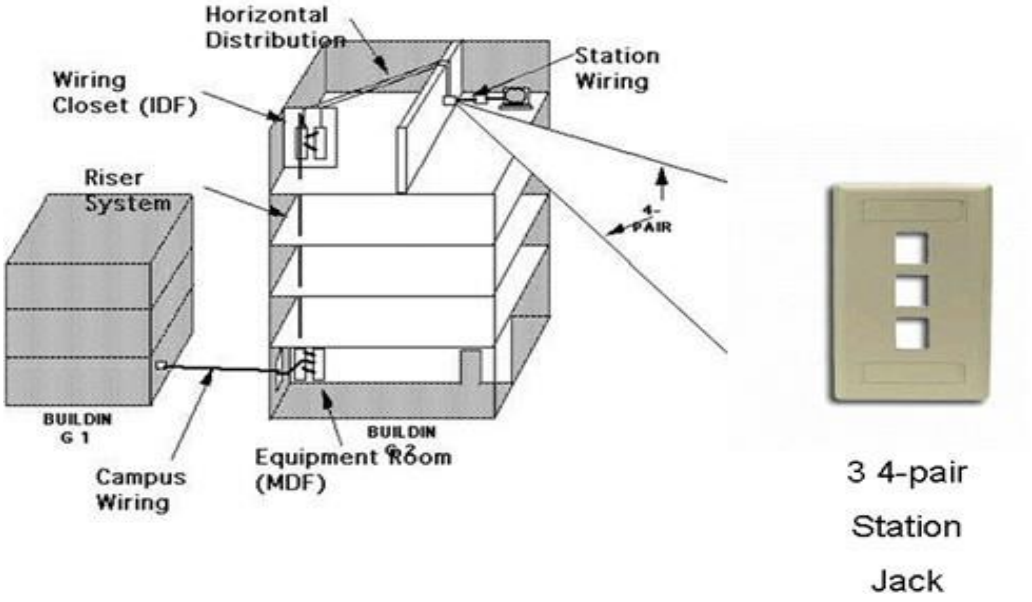
B. All penetrations, cores and sleeves shall be provided by the general contractor with installation practices adhering to local codes and industry accepted methodology.

C. Firestop penetration seals shall be provided by Cabling Installer using methods and materials which are FM-approved and UL-listed as applicable and approved by the authorities having jurisdiction. During the construction phase, fire-stopping pillows are required. If pillows are approved as a permanent solution either by the Fire Marshal or local jurisdiction, they may remain as a permanent firestop. If pillows are not approved as a permanent solution, Cabling Contractor will seal all Tel/Data penetrations with an approved firestopping solution.

D. Electrical Installer to leave pull string in all conduits to allow future access for pulling more cables through existing conduit.

PART 4 - DIAGRAMS

4.01 CABLING DISTRIBUTION



4.02 SYSTEM VAR'S

Name	Address	Main Contact	Main	Fax	Union
LCN (E.G. Sawyer Co.)	260 Libbey Parkway Weymouth, MA 02189	Mike O'Neill	781 340-1400	781 340-1444	IBEW
Spectrum Integrated Technologies	267 Amory St. Jamaica Plain, MA 02130	Lou Whittemore	617 522-8800	617 522-8150	IBEW
Sullivan & McLaughlin Companies, Inc.	74 Lawley St. Boston, MA 02122	David Donegan	617 474-0500	617 474-0505	IBEW

Name	Address	Main Contact	Main	Fax	Union
LAN-TEL	1400 Providence Hwy Norwood, MA 02062	Bill Sands	617 413-8995	781 551-8667	IBEW

END OF SECTION

SECTION 27 02 00 TELECOMMUNICATIONS EQUIPMENT SPACES

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-B Commercial Building Telecommunications Standard.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.
2. Electrical contract documents.
3. Mechanical equipment.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer
2. Local Exchange Carrier (LEC)

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

PART 2 - PRODUCTS (SECTION NOT USED)

PART 3 - EXECUTION

3.01 SPACE REQUIREMENTS

A. Minimum sizes for Telephone/data rooms in new buildings shall be as shown in Appendix B.

B. Rooms in older facilities shall conform to Appendix B requirements unless not feasible. Room sizes shall be coordinated with HUIT.

C. Rooms must be kept clean and dust free at all times.

D. Rooms will not be used for any purpose except telecommunications support.

E. The recommended height of the finished ceiling to the finished floor in a tel/data room is 8 ft. 6 inch.

F. Because Electromagnetic Interference (EMI) causes severe problems with electronic equipment, telecommunication rooms must not be shared with electrical feeders, branch circuits or transformers.

G. No housekeeping or other materials shall be stored in these rooms.

H. Space for plywood (covered with fire-retardant paint) installed a minimum of 6” above finished floor (AFF) in both the MDF and IDF.

I. Two 19” wide telecommunications equipment racks will be provided in locations specified by HUIT personnel.

1. Racks shall be secured to the floor and ladder rack.

2. Racks shall contain adequate cable management to accommodate all patch cables.

J. Rooms should be stacked to provide for ease in running the riser, in a straight vertical line from the basement MDF running to the IDFs.

K. Locate the TRs in the center of the area to be cabled to minimize the length of cable runs.

L. Floors, walls, and ceiling shall be sealed, painted, or constructed of a material to minimize dust. Finishes should be light in color to enhance room lighting. Floors shall have anti-static properties as per IEC 61000-4-2.

M. Carpet is prohibited.

N. Telecommunication rooms shall be located above any threat of flooding. Rooms located in basements shall have drains with positive drainage, otherwise sump pumps must be provided. When sump pumps are required, they shall be connected to an emergency power supply and a water detection system that shall notify HUIT SOC Operations in the event of a water problem.

O. Services that are not communications related are prohibited in these rooms. This includes, but is not limited to supply storage, janitorial services, etc.

3.02 ELECTRICAL REQUIREMENTS

A. Main Distribution Frame (MDF)

1. Each MDF shall be furnished with its own dedicated electrical panel. The panel for each room shall be wired to a panel that is fed from a UPS system that is connected to the Emergency generator for the building.

2. A minimum of two, non-switchable, 20AMP, 208 (NEMA L6-20) Volt alternating current nominal twist-lock receptacles, each on separate branch circuits, shall be provided for equipment power. In addition, each space shall have a minimum of 2 non-switchable 20 Amp (NEMA 5-20), 120 volt alternating current quad receptacles.

3. Proper lighting that produces 50 foot-candles positioned between rows of racks and/or cabinets, not directly over the top of the rack.

4. The grounding busbar is provided by others, but grounding of the conduit and cable tray is the responsibility of the telecommunications contractor.

B. Work area (WA)

1. Two duplex electrical outlets with every outlet.

3.03 HVAC REQUIREMENTS

A. Coordinate electronic equipment BTU output with HUIT for proper cooling requirements to maintain 41^{o} – 95^{o} F temperature and 30% min –60% max. relative humidity.

B. Maintain positive pressure with a minimum of 1 air change per hour.

C. No plumbing, HVAC or electrical conduit shall pass through or be directly above the telecommunications room.

1. If approved by HUIT project manager, where HVAC equipment must be installed in MDF/IDF rooms - HVAC contractor shall provide drip trays under HVAC equipment.

2. All drip trays shall be piped to condensate drain.

3. All drip trays shall be provided with lead detection devices and shall be connected to local audible alarm as well as building management system.

D. HVAC shall be provided on a 24 hours-per-day, 365 days-per-year basis. If the building system cannot assure continuous operation, a stand-alone unit shall be provided.

3.04 WIRE REMOVAL

A. NEC 2008 Article 770.25 for optical fiber and Article 800.25 for communications cabling states that all accessible abandoned cable, unless marked for future use, must be removed.

B. The building owner is responsible for removing old abandoned cabling. HUIT is available to help coordinate this effort.

3.05 ASBESTOS ABATEMENT

A. The building owner is responsible for asbestos abatement. HUIT is available to help coordinate this effort.

3.06 FIRESTOPPING

A. Provide fireproof seals in accordance with the National Fire Protection Association (NFPA) and the National Electric Code (NEC), Article 200-221 and TIA 569 standards.

B. Firestop all penetrations in accordance with the current edition of the National Electrical Code.

C. Do not use concrete for firestopping on cable trays, wireways or conduit. Contractors who use this method will be required to replace all cables affected.

3.07 TELECOMMUNICATION ROOMS SECURITY

A. All Telecommunication Rooms shall be secured with either swipe card or lock and key entry only and keyed the same.

B. Access to communications facilities shall be restricted to HUIT NOC, FAS NOC and HUIT Telecom personnel.

C. Access by HUIT personnel shall be available on a 7x24x365 basis.

D. All telephone and data locations within the location served by the telephone/data room should also be accessible by the HUIT and FAS personnel.

E. Required building security or building management arrangements necessary to assure NOC personnel access will be made by the customer.

3.08 FIRE ALARM SYSTEMS

A. Cabling to fire alarm panel is not required – all fire alarm panels connect using radio. Coordinate individual project requirements with HUIT.

B. The telephone line that is used in the elevator is a standard Centrex.

3.09 PLUMBING SYSTEMS

A. No water or drain piping should be routed through a Tele/data room that is not associated with Tele/data equipment. Should water or drain piping be routed within a Tele/data room it should be either encased or provided with a leak protection jacket and a leak detection system shall be provided to notify HUIT SOC Operations in the event of a water problems.

3.10 HANDHELD FIRE EXTINGUISHERS

A. A clean agent fire extinguisher is recommended for the Tele/data room as it avoids the dry chemical powder of ordinary ABC fire extinguishers, which can impact associated equipment. SP-3-0092 (to become TIA–942). See NFPA 75 for guidance regarding handheld fire extinguishers.

3.11 DOORS

A. Doors of the Tele/data room shall be a minimum of 1 m (3 ft) wide and 2.13 m (7 ft) high, without doorsill, hinged to open outward (code permitting) or slide side-to-side, or be removable. Doors shall be fitted with a lock and have either no center post or a removable center post to facilitate access for large equipment.

PART 4 - DIAGRAMS

4.01 MDF ROOM LAYOUT – SEE APPENDIX B FOR HUIT MDF LAYOUT

4.02 IDF ROOM LAYOUT – SEE APPENDIX B FOR HUIT IDF LAYOUT

END OF SECTION

SECTION 27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-D Series Commercial Building Telecommunications Standard and ANSI/TIA 607-D, “Bonding and Grounding for Telecommunications Cabling and Equipment in Commercial Buildings”.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.

2. Electrical contract documents.

3. Mechanical equipment.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard’s Installer

2. Local Exchange Carrier (LEC)

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

PART 2 - PRODUCTS

2.01 GROUNDING AND BONDING

A. Provide a suitable telecommunications ground for equipment as required per ANSI/TIA/ -607-D (telecommunications grounding), IEEE Emerald Green book and NEC requirements.

1. The Telecommunication Main Grounding Busbar (TMGB) installed in the MDF shall be 20 inches long and 4 inches wide by ¼ inch thick with predrilled NEMA bolt hole sizing and spacing, Chatsworth Products, Inc. part number 40153-020.

2. The Telecommunication Grounding Busbar (TGB) installed in the IDF shall be 10 inches long and 2 inches wide by ¼ inch thick with predrilled NEMA bolt hole sizing and spacing, Chatsworth Products, Inc. part number 13622-010.

B. All cable tray, ladder rack, access floors and Telecommunications Room (TR) racks and/or cabinets contained within the MDF and the telecommunications room shall be grounded/ bonded together with #6 AWG, and then bonded/grounded with minimum

#6 AWG to the Telecommunications Grounding Busbar (TGB). The grounding busbar shall be provided by the Electrical Installer.

C. Grounding Conductor Sizing Chart

LENGTH (IN FEET)	CONDUCTOR SIZE (AWG)
0 - 13	6
14 - 20	4
21 - 26	3
27 - 33	2
34 - 41	1
42 - 52	1/0
53 - 66	2/0
67 - 84	3/0
85 - 105	4/0
106 - 125	250 KCMIL
126 - 150	300 KCMIL
151 - 175	350 KCMIL
176 - 250	500 KCMIL
251 - 300	600 KCMIL
GREATER THAN 300	750 KCMIL

PART 3 - EXECUTION

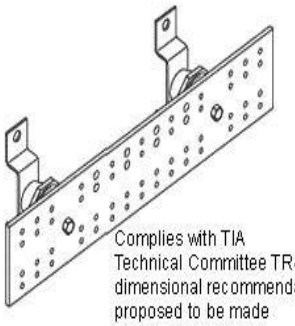
3.01 GROUNDING AND BONDING

A. All aforementioned telecommunications devices shall be grounded/bonded to the TGB using minimum solid 6 copper (AWG wire) with green insulation. The size of the grounding conductor is dependent upon the length of the conductor, and shall be sized based upon the Grounding Conductor Sizing Cart shown above. Coordinate exact grounding locations for each component with the Electrical Installer.

PART 4 - DIAGRAMS

4.01 TELECOMMUNICATIONS GROUNDING DIAGRAM

All telecommunications rooms shall have a grounding bar that shall be 20 inches long and 4 inches wide by ¼ inch thick with pre drilled NEMA bolthole sizing and spacing. Each distribution point shall be grounded to the main building ground, NEC and EIA/TIA 607 requirement shall be followed.



Complies with TIA Technical Committee TR41 dimensional recommendations proposed to be made to ANSI/TIA/EIA-607

Stand-Off Insulator Specifications:
Dielectric Strength: 19,000-21,000 volts S.T.
UL 94V-O Flame Resistant
Finish Color: Red
Insert Size & Material: 3/8-16 x 5/8"D UNC-2B Aluminum
Dimensions: 2.5"W x 2.5"D

Grounding Busbar (TGB) Specifications:
Provides 3.75" stand-off from backboard.
The 20" busbar (13622-020) has both .25"D and .375"D

END OF SECTION

SECTION 27 05 28 PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.
2. Electrical contract documents.
3. Mechanical equipment.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer
2. Local Exchange Carrier (LEC)

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

F. Materials and workmanship:

1. Work shall be executed in workmanlike manner and shall present neat, plumb, and perpendicular to building structure and parallel to electronic devices and cabling. Mechanical appearance when completed must adhere to the standards as set forth today (see section 1.1 for applicable standards). Maintain maximum headroom at all times. Do not run work exposed unless shown exposed on drawings. Material and equipment shall be new and installed according to manufacturer's recommended best practice so that completed installation shall operate neatly, safely and efficiently.
2. Completely remove temporary materials, facilities and equipment when their use is no longer required. Clean and repair damage caused by temporary installations.
3. Contractor shall ensure that excess materials are removed from the job site upon completion and acceptance of project work. Excess materials removed from the job site shall be credited to the Owner. Additionally, upon completion of the project, all Contractor equipment will be removed.

G. Contractor shall use cable tray (which could be provided by others) as primary cable pathway and shall distribute from the cable tray to each TO via conduit or acceptable methods. See electrical drawings for cable tray routing.

H. All penetrations, cores and sleeves shall be provided by the general contractor with installation practices adhering to local codes and industry accepted methodology.

I. Firestop penetration seals shall be provided by Cabling Installer using methods and materials which are FM-approved and UL-listed as applicable and approved by the authorities having jurisdiction. During the construction phase, fire-stopping pillows are required. If pillows are approved as a permanent solution either by the Fire Marshal or local jurisdiction, they may remain as a permanent firestop. If pillows are not approved as a permanent solution, Cabling Contractor will firestop and seal all penetrations through rated walls made by the tele/data contractors with an approved firestopping solution.

J. Electrical Installer to leave pull string in all conduits to allow future access for pulling more cables through existing conduit.

PART 2 - PRODUCTS

2.01 INNER DUCT

A. Flexible, Plenum rated 1-inch duct shall be Carlon p/n CF4X1-XXX.

B. Flexible, Riser rated 1-inch inner duct shall be Carlon p/n DF4X1-XXX

C. All fiber optic cables shall be installed in inner duct.

D. Provide and install quantity of inner duct to protect the quantity and lengths of optical fiber furnished in this project.

E. Refer to Contract Documents for quantities, pathways and locations.

2.02 FLOOR BOX

A. 2 port 106 style mounting frame shall be SYSTIMAX P/N M106FR2-262, Material ID 106622251.

B. 4 port 106 style mounting frame shall be SYSTIMAX P/N M106FR4-262, Material ID 106622285.

2.03 RACEWAY

A. End plates (1 pair per baseplate) for labeling shall be Wiremold P/N AC-EPL.

B. One port insert shall be Wiremold P/N 2A-U1ATT.

C. Two port insert shall be Wiremold P/N 2A-U2ATT.

D. Blank insert shall be Wiremold P/N 2A-BL.

PART 3 - EXECUTION

3.01 GENERAL

A. Pull Rope

1. Pull rope shall be ¼ inch wide nylon or equivalent with a minimum pull strength of 1250 PSI. Pull rope shall be installed in the innerduct prior to delivery to the construction site. The pull rope shall extend 6 feet beyond the termination at each end.

B. Conduit and innerduct plugs

1. The conduit plugs around innerduct will be Hilti filler foam CF124 or equivalent.

2. Solid telephone duct plugs shall be 4 inches in diameter and have the following characteristics:

a. Corrosion proof, no metallic parts.

b. Water, air and gas tight seal.

c. Ring for attachment of existing pull tape inside the 4-inch telephone duct.

d. Sealing capacity of 22 psi minimum.

e. Joslyson conduit plug, Hilti filler foam CF124 or equivalent.

3.02 PATHWAYS

A. Note: Coordinate all pathways and raceways with Electrical Engineer.

3.03 CONDUIT FILL RATIO CHART

A. The table below shows the conduit fill ratio based on the area and the minimum bend radius. Apply these fill percentages to straight runs with nominal offsets equivalent to no more than two 90 degree bends.

PART 4 - DIAGRAMS

4.01 SYSTIMAX UTP CATEGORY 6 2071E (0.231" OD) 40% CABLE FILL RATIO IN EMT CONDUIT

Conduit - Trade Size					
Trade Size		Conduit I.D. (in)	Conduit Area	Fill Area	# Cables
1/2	(16mm)	0.622	0.30	0.12	2
3/4	(21mm)	0.824	0.53	0.21	5
1	(27mm)	1.049	0.86	0.35	8
1-1/4	(35mm)	1.380	1.49	0.60	14
1-1/2	(41mm)	1.610	2.03	0.81	19
2	(53mm)	2.067	3.35	1.34	32
2-1/2	(63mm)	2.731	5.85	2.34	55
3	(78mm)	3.356	8.84	3.54	84
3-1/2	(91mm)	3.834	11.54	4.62	110
4	(103mm)	4.334	14.75	5.90	140

4.02 SYSTIMAX UTP CATEGORY 6A 2091B (0.285" OD) 40% CABLE FILL RATIO IN EMT CONDUIT

Conduit - Trade Size					
Trade Size		Conduit I.D. (in)	Conduit Area	Fill Area	# Cables
1/2	(16mm)	0.622	0.30	0.12	1
3/4	(21mm)	0.824	0.53	0.21	3
1	(27mm)	1.049	0.86	0.35	5
1-1/4	(35mm)	1.380	1.49	0.60	9
1-1/2	(41mm)	1.610	2.03	0.81	12
2	(53mm)	2.067	3.35	1.34	21
2-1/2	(63mm)	2.731	5.85	2.34	36
3	(78mm)	3.356	8.84	3.54	55
3-1/2	(91mm)	3.834	11.54	4.62	72
4	(103mm)	4.334	14.75	5.90	92

END OF SECTION

SECTION 27 05 43 UNDERGROUND DUCTS AND RACEWAYS FOR OUTSIDE PLANT – MANHOLE & CONDUIT SYSTEMS

PART 1 - GENERAL

1.01 GENERAL

A. The General Conditions shall be considered as forming a part of the specifications and shall be carefully examined before proposals for any work are submitted. Unless the specifications contain statements, which are more definitive or more restrictive than those contained in the General Conditions, the specifications shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions.

B. This Section shall be used in conjunction with the following to establish the total requirements for underground telecommunications manhole and conduit systems.

1. Excavation Support Systems
2. Excavation and Backfilling
3. Concrete Formwork
4. Concrete Reinforcement and Embedded Materials
5. Division 16 Section - Basic Electrical Requirements
6. Division 16 Section - Basic Electrical Materials and Methods
7. Division 16 Section – Raceway, Conduit, and Boxes

C. If any duplicates or conflicts with other specification sections should occur, the item of higher standard shall dictate.

D. All work related to the manhole and underground conduit systems shall be coordinated with the Civil Engineer and the Harvard University HUIT representative.

E. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard and ANSI/TIA 758-B, “Customer-Owned Outside Plant Telecommunications Infrastructure Standard, March 2012.

F. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.
2. Electrical contract documents.
3. Mechanical equipment.

G. Coordinate all work with on-site installers including, but not limited to:

1. Harvard’s Installer

2. Local Exchange Carrier (LEC)

H. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

I. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

1.02 SCOPE OF WORK

A. This specification defines the pathway systems required for the placement of outside plant telecommunications cabling systems.

B. The provisioning and installation of all underground manholes and conduit systems for telecommunications use shall be performed by the electrical contractor and/or the general contractor.

1.03 CODES, PERMITS AND INSPECTIONS

A. All work shall meet or exceed the latest requirements of all national, state, county, municipal, and other authorities exercising jurisdiction over the manhole and ductbank work and the project.

B. All required permits and inspection certificates shall be obtained, paid for, and made available by the contractor.

C. In the event the authority having jurisdiction does not require a permit for this scope of work, Contractor must obtain that information, in writing, from the AHJ and provide to Owner, prior to the start of the work.

D. Installation procedures, methods and conditions shall comply with the latest requirements of the Federal Occupational Safety and Health Administration (OSHA).

E. The contractor shall be responsible to obtain all applicable permits and Rights of Way to perform the required scope of work.

1.04 WARRANTY

A. The contractor shall provide a two-year, minimum, service warranty on all materials and labor involved with the scope of work. Any fulfillment of the warranty shall be at no cost to the owner.

B. The warranty shall commence from the date of acceptance by the owner.

1.05 DEFINITIONS AND INTERPRETATIONS

A. Certain non-technical words shall be understood to have specific meanings as follows regardless of indications to the contrary in the General Conditions or other documents governing the telecommunications work.

1. "Furnish"— Purchase and deliver to the project site complete with every necessary appurtenance and support. Purchasing shall include payment of all sales taxes and other surcharges as may be required to assure that purchased items are free of all liens, claims or encumbrances. Payment of sales taxes is, however, specifically excluded.

2. "Install"— Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project.

3. "Provide" — "Furnish" and "install."

4. "New" — Manufactured within the past two years and never before used.

B. Regardless of their usage in codes or other industry standards, certain words used in the specifications shall be understood to have the specific meanings ascribed to them in the following list:

1. "Backfill" — Earth material used specifically for filling and grading excavations back to a finished state. Backfill is placed on top of the bedding surrounding encased ductbanks and direct-buried conduits.

2. "Base" — Earth material used specifically to level and grade an excavation's subgrade for the subsequent placement of encased ductbanks, direct-buried conduit, maintenance holes and handholes. Base material is placed on top of the subgrade and beneath the bedding surrounding encased ductbanks, conduits, maintenance holes or handholes.

3. "Bedding" — Earth material used specifically for filling excavations. Bedding is placed around encased ductbank, conduits, maintenance holes or handholes. Bedding is placed on top of the base and beneath the backfill.

4. "Fill" — The collective term for base, bedding, and backfill.

5. "Handhole (HH)" - A structure similar to a small maintenance hole through which cable can be pulled, but not large enough for a person to fully enter to perform work.

6. "Maintenance Hole or Manhole (MH)" - A vault located in the ground or earth as part of an underground conduit system and used to facilitate placing, connectorization, and maintenance of cables as well as the placing of associated equipment, in which it is expected that a person will enter to perform work.

7. "RNC" — Rigid Non-Metallic Conduit (PVC)

1.06 FIELD INVESTIGATION

A. Even if route documentation is provided by the owner, the Contractor shall perform a field investigation for the entire route. Any discrepancies or possible interference with existing utilities shall be brought to the attention of the Owner.

B. Prior to the field investigations, the Contractor shall contact Dig Safe in order to locate all existing utilities.

C. When necessary, the Contractor will be required to dig test poles (or potholes) to verify the locations of existing utilities and take exact measurements.

D. During field investigations, if it is determined that joint trenching is feasible, the contractor shall discuss it with the Owner prior to any work. Refer to the National Electric Safety Code for proper separation of utilities ductbanks.

1.07 RECORD DRAWINGS

A. As part of the required work, a complete set of "as-built" or record drawings shall be made up and delivered to the Owner.

B. The drawings shall show:

1. All conduit types, quantities, routing, lengths and ductbank depths.

2. All manhole sizes and conduit penetrations (butterfly diagram shall be provided for each manhole).

3. All manhole labeling.

C. The as-built drawings shall be produced using AutoCAD 2013 (or later version) design package.

D. Another CAD program may be utilized as the as-built drawing package of choice subject to review and approval by the Owner as to the specific package, version, etc., to be used.

E. The quantity of design drawings which are made available represents the minimum number of drawings to be included in the record drawing set and shall in no way be interpreted as setting a maximum limit to the number of drawings necessary to show the required "as-built" information.

F. Any and all costs for document conversion (if necessary), printing, etc., are the responsibility of the contractor.

G. Prior to developing any "as-built" drawings, the contractor shall coordinate with the Owner the layering structure, colors, etc., of CAD drawings.

H. "As-built" information shall be submitted to the Owner and Engineer at the conclusion of the project and shall be in the approved format as specified in the project's General Conditions. The Contractor shall keep all documentation current throughout the installation and build-out process. If changes occur which affect any documentation, the Contractor shall formally re-issue the affected documentation to the Owner or his representatives.

I. All manufacturer's product data and warrantees including specifications and manuals will be provided to the Owner upon acceptance of the system by the Owner.

1.08 SUBMITTALS

A. Prior to purchasing any materials, a list of their manufacturers shall be submitted for review.

B. The following shall be submitted for review, as a minimum:

1. Catalog information, factory assembly drawings and field installation drawings as required for a complete explanation and description of all items.

2. Submit for approval one sample of each of the following:

a. Each type of pre-cast manhole or handhole.

b. Each type of conduit.

c. Each type of conduit fitting.

d. Each type of concrete to be used.

e. Each type of manhole or handhole racking.

f. Each type of manhole or handhole grounding rod.

g. Each type of rebar.

h. Other items as requested.

3. Issue all pre-construction submittals as a single package.

4. Quality Assurance Submittals: Contractor shall submit a copy of each concrete delivery receipt. The submittal shall include the date, strength ordered and location used.

C. Documents will not be accepted for review unless:

1. They include complete information pertaining to appurtenances and accessories.

2. They are submitted as a package where they pertain to related items.

3. They are properly marked with specific service or function, and intended location of use within the project.

4. They are clearly identified or highlighted to indicate all items that are applicable.

5. They indicate the project name and address along with the Contractor’s name, address and phone number.

6. They are properly marked with external connection identification as related to the project where they consist of standard factory assembly or field installation drawings.

D. The contractor shall not order any materials until all of the submittals are return as “Approved” by the Owner. The contractor shall issue the submittals such that the Owner has a minimum of 2 weeks to return the submittals with no impact to the project schedule.

1.09 COORDINATION

A. Contractor shall coordinate locations of all manholes/handholes and ductbanks with the Owner, General Contractor, other trades and all utility companies located in the areas affected by the scope of work.

B. The Contractor is responsible to review all other trades coordination drawings and issue a set of coordination drawings of their scope of work to all other trades.

1.10 “PROTECT IN PLACE” FOR TELECOMMUNICATIONS CABLING DURING CAMPUS CONSTRUCTION AND RENOVATION PROJECTS.

A. HUIT Engineering and Maintenance will handle locating HUIT telecommunication cables and coordination with Verizon and Comcast to locate their cables. Once identified HUIT or a HUIT contractor will provide a split inner duct or PVC conduit to cover the existing cables and wrap highly visible caution tape around the protective covering. We will also provide snap and directional tags along the cable route. Once cables are protected and tagged the project will then be responsible for maintaining these cables throughout the construction activity and will be responsible for the replacement or repair cost if the cables are damaged.

B. The cable repairs or replacement will be handled by the utility owning the cable.

C. Location of cabling, utility coordination and work required to protect, repair or replace the cables are billable to the project.

D. Construction Impact

1. HUIT will coordinate with University stakeholders, Harvard Planning Groups, and Contractors to determine if “Protect in Place” is sufficient to mitigate the impact of the construction or renovation project. HUIT will coordinate with all parties to determine if alternatives, relocation, or new cabling is a requirement for the project.

1.11 REFERENCES

A. General:

1. National Electrical Code (NEC)

2. National Electrical Safety Code (NESC)

3. Occupational Safety and Health Act (OSHA)

B. Communications:

1. ANSI/TIA-758-B, Customer-Owned Outside Plant Telecommunications Infrastructure Standard, March 2012

2. BICSI-CO-OSP Customer-Owned Outside Plant

C. Concrete:

1. Reinforcement:

a. ACI 301: Structural Concrete for Buildings

b. ACI SP-66: American Concrete Institute - Detailing Manual

c. ANSI/ASTM A82: Cold Drawn Steel Wire for Concrete Reinforcement

d. ANSI/AWS D1.4: Structural Welding Code for Reinforcing Steel

e. ANSI/AWS D12.1: Reinforcing Steel Welding Code

f. ASTM A615: Deformed and Plain Billet Steel Bars for Concrete Reinforcement

g. AWS D12: Welding Reinforcement Steel, Metal Inserts and Connections in

2. Reinforced Concrete Construction

a. ASTM A 615: Deformed and Plain Carbon Steel Bars for Concrete Reinforcement

3. Cast-in-Place:

a. ACI 212.3R: Chemical Admixtures for Concrete

b. ACI 301: Structural Concrete for Buildings

c. ACI 304: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete

d. ACI 305R: Hot Weather Concreting

e. ACI 306R: Cold Weather Concreting

f. ASTM C33: Concrete Aggregates

g. ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

h. ASTM C94: Ready-Mixed Concrete

i. ASTM C150: Portland Cement

j. ASTM C143: Standard Test Method for Slump of Hydraulic Cement Concrete

k. ASTM C173: Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

l. ASTM C231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

m. ASTM C260: Air Entraining Admixtures for Concrete

n. ASTM C309: Standard Specifications for Liquid Membrane Forming Compound for Curing Concrete

o. ASTM C494: Chemical Admixtures for Concrete

p. ASTM C 31: Standards Practice for Making and Curing Concrete Test Specimens in the Field

q. ASTM C 39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

r. ASTM C 172: Standards Practice for Sampling Freshly Mixed Concrete

s. ACI 301: Structural Concrete

4. Pre-Cast:

a. ASTM C478: Standard Specification for Precast Reinforced Concrete Manholes Sections

b. ASTM C857: Standard Practice for Minimum Structural Design Loading for Underground Precast Utility Structures

c. ASTM C858: Standard Specification for Underground Precast Concrete Utility Structures

d. ASTM C891: Standard Practice for Installation of Underground Precast Concrete Utility Structures

e. ASTM C1037: Standard Practice for Inspection of Underground Precast Concrete Utility Structures

f. ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

5. Trenching and Backfill:

a. ASTM D 698: Standard Test Methods for laboratory Compaction Characteristics of Soil Using Standard Effort

b. ASTM D1557: Test Method for Laboratory Compaction Characteristics Using Modified Effort

6. Conduits:

a. NEMA TC 6 & 8: Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations

b. NEMA TC 9: Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations

PART 2 - PRODUCTS

2.01 CONDUITS AND FITTINGS

A. Conduits: UL Listed, NEMA TC6 Schedule 40 or 80 rigid PVC.

B. Fittings: UL Listed, NEMA TC9, match to conduit and material.

C. Ductbank Spacers: High density plastic interlocking spacers.

D. Sweeps: Factory manufactured with a 15 foot radius, minimum.

E. End caps: Factory manufactured, water-tight. Tape is not an acceptable method for capping conduits.

F. Warning Tape: 6” wide, metallic, orange in color.

G. Pull rope: Polypropylene with a minimum tensile strength of 200 pounds.

2.02 CAST-IN-PLACE CONCRETE

A. Forms shall be metal, plywood or gypsum board in good condition.

B. Cement shall be of a single type and from the same manufacturer. Cement shall comply with ASTM C150-7, type 1. Aggregate shall comply with ASTM C33-71. Water shall be fresh, potable normal weight, air-entrained with a 28 day strength of 2500 psi per ASTM C39.

C. Concrete shall have a maximum slump of 4 inches per ASTM C143 tested for each nine cubic yards of concrete placed.

D. Cylinder Tests: Make four cylinder tests from each pouring operation and not less than four cylinders for each 18 cubic yards not less than once a day nor less than once for each concreting operation. Samples shall be taken at point of placement and shall conform to ASTM C172 and ASTM C31.

1. Test two (2) cylinders at 7 days.

2. Test two (2) cylinders at 28 days.

3. Tests conform to ASTM C39.

E. All ductbanks shall be constructed with reinforcement bars. Reinforcement steel shall be uncoated, free from rust and dirt, and shall conform with ASTM A615, Grade 40.

F. Concrete shall be protected from damage caused by frost or low temperatures as per ACI 306R. Concrete mixture shall not drop below 50º F and not be more than 80º F.

G. Concrete shall be protected from damage caused high temperatures as per ACI 305R. Concrete mixture shall not be more than 90º F. Reinforcement shall not exceed ambient temperature. If reinforcement steel gets too hot, it shall be covered with water-soaked burlap before concrete is placed around it.

2.03 MANHOLES AND HANDHOLES

A. Manholes shall have the following characteristics:

1. Shall be pre-cast concrete and shall comply with ASTM C478. The manhole shall have grade 60 reinforcement of H20 loading and 4,500 psi concrete.

2. Shall have minimum dimensions of 5’-0”W x 9’-0”L x 7’-0”H.

3. Shall have pre-cast end bell type terminators shall be provided for each ductbank entry.

4. Shall have pulling eyes located opposite each set of duct openings.

5. Galvanized, C-channel racking hardware.

6. Shall include a 30 inch frame and cover suitable for vehicular traffic and appropriately marked “HARVARD COMM.”

7. Shall have a 4/0 bare copper ground wire penetrating the side wall in the bottom section of the manhole and extending 48 inches inside and outside the manhole. The exterior end of the grounding wire shall be connected to a ¾ inch diameter 10-foot long grounding rod. The interior end of the grounding wire shall be connected to a copper grounding plate. The cable racks and conduits shall be connected to the grounding plate via a grounding tree. The grounding rod shall not penetrate the manhole wall.

8. A 12” sump shall be included in the bottom of the manhole.

9. No permanent ladder shall be installed. Any utility or vendor requiring access to manhole shall provide their own temporary use ladder.

B. Handholes shall have the following characteristics:

1. Shall be pre-cast concrete and shall comply with ASTM C478. The manhole shall have grade 60 reinforcement of H20 loading and 4,500 psi concrete.

2. Shall have minimum dimensions of 4’-0”W x 4’-0”L x 4’-0”H.

3. Shall have pre-cast end bell type terminators shall be provided for each ductbank entry.

4. Shall have pulling eyes located at each corner (4 total).

5. Galvanized, C-channel racking hardware.

6. Shall include a rectangular diamond plate cover suitable for vehicular traffic and appropriately marked “HARVARD COMMUNICATIONS.”

7. Shall have a 4/0 bare copper ground wire penetrating the side wall in the bottom section of the manhole and extending 48 inches inside and outside the manhole. The exterior end of the grounding wire shall be connected to a ¾ inch diameter 10-foot long grounding rod. The interior end of the grounding wire shall be connected to a copper grounding plate. The cable racks and conduits shall be connected to the grounding plate via a grounding tree. The grounding rod shall not penetrate the manhole wall.

8. A 12” sump shall be included in the bottom of the handhole.

9. Joint Sealant: Continuous extrusion of asphaltic butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand the maximum hydrostatic pressures at the installation location with the ground water level at grade.

10. Source Quality Control: Inspect structures according to ASTM C 1037.

2.04 FIRESTOPPING MATERIAL

A. Shall conform to both Flame and Temperature ratings as per local building codes. Material shall be tested in a configuration that is representative of the actual field conditions as per ASTM E814 and UL 1479.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall be responsible for the safety of the public and workers in accordance with all applicable rules, regulations, and local codes.

B. All work shall comply with all applicable OSHA safety rules and regulations. All work shall also comply with the requirements of the NESC, NEC and/or local codes and regulations, wherever there is question on code variances, the more stringent shall govern.

C. The Contractor shall replace and/or repair to original (or better) condition any existing structures, materials, equipment, etc. inadvertently demolished or damaged by the Contractor during the course of construction at no additional cost to the Owner.

3.02 EXCAVATING, TRENCHING AND FILL

A. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 deg F.

B. The Contractor shall stake out the intended trench and review with the Owner prior to any trenching. Once the trenching is completed, the Contractor shall have the owner inspect it prior to the placement of any conduits.

C. Where crossing of concrete or asphalt is required, saw cut and remove surface material prior to excavating. Remove concrete in complete sections from control joint to control joint regardless of the width of the excavation. Restore concrete and asphalt surfaces following excavation to match existing depth, strength, color, and type of material.

D. Provide all necessary bracing and bridging to maintain traffic flow during construction through all areas interrupted by trenching. Provide construction signage, traffic barriers, and warning notices throughout the construction period.

E. Protect excavations at the end of the work shift. Cover with steel sheets and barricade prior to leaving the job site, in accordance with all applicable rules, regulations, building codes, and ordinances.

F. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.

2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

G. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.

2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

H. Provide a minimum of six (6) inches clearance around each side of the structure.

I. Excavation for ductbank trenches shall be to a sufficient depth to provide a minimum of twenty-four (24) inches cover over the ductbank. Provide a minimum of six (6) inches to each side of the ductbank formation.

J. Level the subgrade bed using sand for trenches and gravel for Manholes/Handholes so that an even base is formed. A minimum of 6” of material shall be used to level the base.

K. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.

1. Do not exceed 4” depth of bedding lifts/layers before compacting. Do not exceed 6” depth of backfill lifts/layers before compacting.

2. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well- defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

    a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches (300 mm) of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.

    b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.

    c. Other Areas: Compact top 6 inches (150 mm) of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.

3. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.

L. Install sediment and erosion control measures in accordance with local codes and ordinances.

M. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation.

N. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.

1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches (750 mm) below finished grade elevation.

3.03 CAST-IN-PLACE CONCRETE

A. Formwork construction tolerances shall complying with ACI 347. Surfaces shall be formed in true planes within ¼ inch in 10 feet. Clean forms and remove debris prior to pouring concrete. Formwork shall be readily removable without impact, shock, or damage to concrete surfaces and adjacent materials.

B. Verify that any required reinforcement is installed prior to commencing placement of concrete. Construct reinforcement in accordance with ACI SP-6. Weld reinforcement in accordance with ANSI/AWS D1.4 or ANSI/AWS D12.1. Bond and Ground reinforcement rods to the nearest grounding bar.

C. Build expansion joints into form, premolded ½" thick, and conforming to ASTM D1751. Seal the top ½" of expansion joints with an approved joint sealer.

D. Do not remove forms until concrete has cured for 7 days or after concrete has attained a compressive strength of 2000 psi.

E. Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.

F. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

G. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions or low temperatures.

H. When air temperature has fallen to or is expected to fall below 40 F (4 C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 F (10 C) and not more than 80 F (27 C) at point of placement.

I. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

J. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

3.04 CONDUITS AND DUCTBANKS

A. Install nonmetallic conduit and duct as indicated according to manufacturer's written instructions.

B. Slope: Install conduit such that a slope exists at all points to allow for proper drainage and prevent the accumulation of water. The slope shall always run towards the manhole/handhole of no less than 1% grade. Slope ducts from a high point in runs between 2 manholes to drain in both directions. Always slope conduits away from building entrances.

C. Curves and Bends: Use manufactured long sweep bends with a minimum radius of 15 feet. The number of bends between pull points (manholes/handholes and/or building entrances) shall not exceed 180 degrees of total bend.

D. Make joints in ducts and fittings watertight according to manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

E. Duct Entrances to Manholes and Handholes: Provide bell ends where conduits enter manholes/handholes. Change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances. Main conduit formations should enter Manholes/Handholes approximately halfway between the floor and ceiling. If the number of conduits is less than the capacity of the manhole/handhole wall, the conduits shall enter at the lowest extent possible. The upper space shall be reserved for future conduits.

F. Building Entrances: Transition from underground duct to conduit 10 feet (3 m) minimum outside the building wall. Use fittings manufactured for the purpose. Follow appropriate installation instructions below.

1. Concrete-Encased Ducts: Install reinforcing in duct banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall.

G. Clearances: Maintain the minimum separations between telecommunications ductbanks and the following outside surfaces of foreign structures:

1. Electric light, power or other conduits – 6 inches

2. When crossing pipes (gas, water, oil, etc.) – 6 inches

3. When parallel to pipes (gas, water, oil, etc.) – 12 inches

H. Concrete-Encased Nonmetallic Ducts: Support on plastic separators coordinated with duct size and required duct spacing, and install according to the following:

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, and secure separators to the earth and to ducts to prevent floating during concreting. Do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

2. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not use power-driven agitating equipment unless specifically designed for duct bank application. Pour each run of envelope between manholes or other terminations in 1 continuous operation. When more than one pour is necessary, terminate each pour in a vertical plane and install ¾-inch (18 mm) reinforcing rod dowels extending 18 inches (450 mm) into the concrete on both sides of joint near the corners of the envelope.

3. Reinforcing: Reinforce duct banks where they cross disturbed earth, where they cross over or under underground utilities or other obstructions and where indicated.

4. Minimum Clearances Between Ducts: 2 inches between ducts and exterior envelope wall, 1 inch between ducts for like services.

5. Depth: Except as otherwise indicated, install top of duct bank at least 24 inches below finished grade. Increase cover where required by field conditions.

I. Provide end caps on conduit ends throughout construction to prevent

J. the intrusion of water or debris. Leave end caps in place upon final completion of the work. Seal conduit terminations in buildings until used for cable.

K. Main, straight conduit runs between manholes/handholes shall not exceed 600 feet in length.

L. A metallic Warning Tape shall be run the entire length of the ductbank at 12" above the top of the ductbank. The tape shall be orange in color and state "Caution Telecommunications Conduits" every 20 feet.

M. A pull rope shall be installed in each conduit after it is cleaned and mandreled. Leave a minimum of 10 feet of slack in each manhole/handhole and tie off the rope at each end.

N. Place a ground wire along the entire ductbank run and bond to the manhole/handhole grounding electrode or building service ground.

3.05 UNDERGROUND SPACES

A. Elevation: Install manholes with roof top at least 15 inches (375 mm) below finished grade. Install handholes with depth as indicated.

B. Where indicated, cast handhole cover frame directly into roof of handhole and set roof surface 1 inch (25 mm) above grade.

C. Access: Install cast-iron frame and cover. For manholes, use 30-inch (750 mm) cover except as indicated. Use 30-inch (750 mm) cover for handholes, except use 24-inch (600 mm) covers for 24-inch (600 mm) by 24-inch (600 mm) handholes. Install brick chimney to support frame and cover and to connect cover with roof opening. Provide moisture- tight masonry joints and waterproof grouting for cast-iron frame to chimney. Provide lock down bolts. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch (25 mm) above finished grade. Taper pavement to meet flush with rim.

D. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cable.

E. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches (96 mm) for anchor bolts installed in the field. Use a minimum of 2 anchors for each cable stanchion.

F. Grounding: Provide a 4/0 bare copper ground wire penetrating the side wall in the bottom section of the manhole and extending 48 inches inside and outside the manhole. The exterior end of the grounding wire shall be connected to a ¾ inch diameter 10-foot long grounding rod. The interior end of the grounding wire shall be

connected to a copper grounding plate. The grounding rod shall not penetrate the manhole wall. Seal the floor opening against water penetration with waterproof non-shrink grout. Ground exposed metal components and hardware with bare copper ground conductor. Train conductors neatly around corners. Install on walls and roof using cable clamps secured with expansion anchors.

G. Precast Concrete Underground Structure Installation:

1. Precast maintenance holes and handholes shall be free from damaged joint surfaces, cracks, or other damage that would permit infiltration. Repair of defects is not acceptable. Manholes/Handholes and associated equipment (such as cable racking brackets and supports) shall be supplied by a single manufacturer.

2. Install according to manufacturer's written instructions and ASTM C 891.

3. Install units plumb and level and with orientation and depth coordinated with arrangement of connecting ducts to minimize bends and deflections required for proper entrances.

H. Remove water from excavation and properly install bedding material prior to setting the Manhole/Handhole.

I. Open conduit entry knockouts with care preserving the sidewalls. Adhere the conduits entering the vault to the opened knockouts with PVC cement.

3.06 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements upon completion of installation of underground duct and utility structures.

1. Grounding: Test manhole grounding to ensure electrical continuity of bonding and grounding connections. Measure ground resistance at each ground rod and report results. Use an instrument specifically designed for ground-resistance measurements.

2. Duct Integrity: Rod ducts with a mandrel ¼ inch (6 mm) smaller in diameter than internal diameter of ducts. The conduits shall be rodded after backfilling but prior to the replacement of landscaping. Where rodding indicates obstructions in ducts, remove the obstructions and retest. Any conduit that does not prove out shall be dug up and replaced at no cost to the Owner.

3. Water Tightness: Make internal inspection of manholes 3 months after completion of construction for indications of water ingress. Where leakage is noted, remove water and seal leak sources. Reinspect after 2 months and reseal remaining leak sources. Repeat process at 2 month intervals until leaks are corrected.

B. Inspect installed components for damage and faulty work, including the following:

1. Concrete for underground conduit runs.

2. Excavation for underground conduit runs.

C. Correct installations where possible, and retest to demonstrate compliance. Otherwise, remove and replace defective products and retest at no cost to the Owner.

3.07 CLEANING

A. Swab with clean rags until the rag comes out of the conduit clean and dry. Swab away from buildings for conduit sections connected to buildings.

B. Clean internal surfaces of manholes including sump. Remove foreign material.

C. The Contractor shall leave the site in a clean and orderly manner and shall properly dispose of any material.

END OF SECTION

SECTION 27 05 53 IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard and ANSI/TIA 606-C, “Labeling and Administration Standards for Telecommunications Cabling in Commercial Buildings”.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.

2. Electrical contract documents.

3. Mechanical equipment.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard’s Installer

2. Local Exchange Carrier (LEC)

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Labels:

1. Panduit

2. Brady Worldwide.

3. Brother International.

B. Labelling Software:

1. Panduit

2. Brady Worldwide.

3. Brother International.

PART 3 - EXECUTION

3.01 LABELING AND IDENTIFICATION

A. Provide labeling as required.

1. Confirm labeling scheme with Harvard's HUIT groups.

2. Labeling scheme example:

a. 4023D1-B3

b. 4 represents the floor

c. 023 represents the outlet number

d. D1 represents the multi data jack identifier.

e. B3 represents the IDF or MDF

B. Provide and install labeling at the wall outlet according to Owner provided labeling scheme.

C. All locations will be clearly marked with a machine-made label with a unique identifying number at both the station location and the DF location. Cabling will also have jack labeling at both the station location and the DF location.

3.02 COLOR CODING

A. Originating and terminating points of a group of wire pairs will be connected to color-coded hardware. The Harvard University Network uses the following color codes:

1. ORANGE: Demarcation Point (i.e., central office terminations)

2. GREEN: leads from central office (Network Interface)

3. PURPLE: leads from common equipment ports (KSU)

4. YELLOW: leads from auxiliary equipment (e.g. NT1's and low voltage)

5. WHITE: 1st level Backbone

6. GRAY: 2nd level Backbone

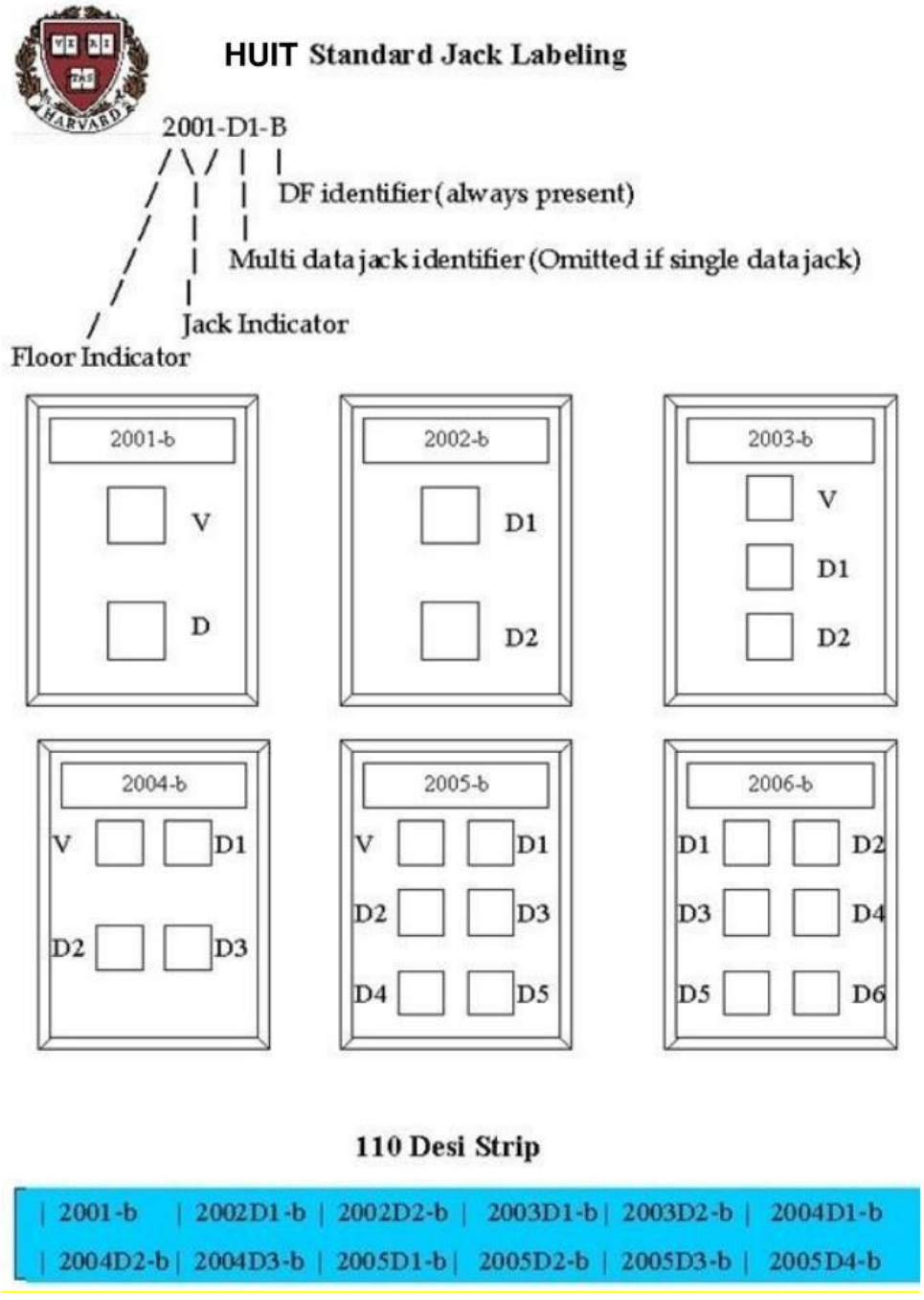
7. BLUE: leads from station outlet.

8. RED: Key Telephone Systems

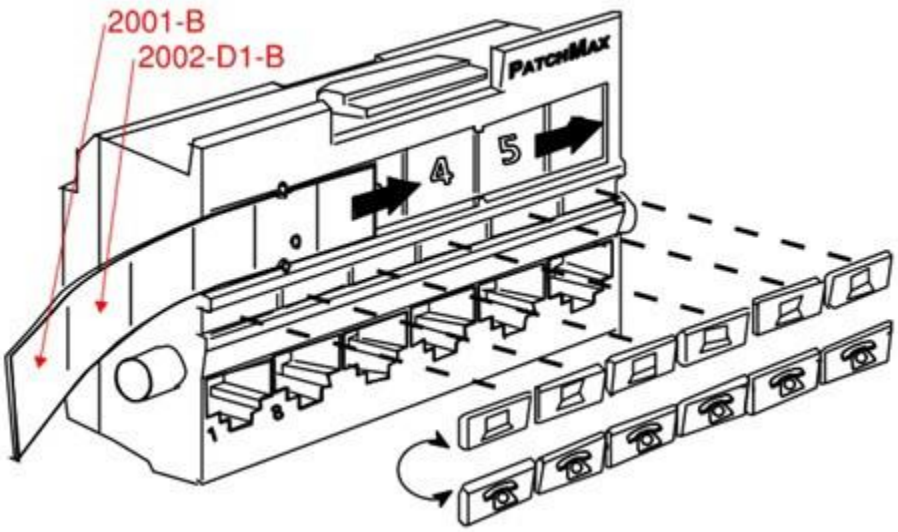
B. Communications and data conduit are to be clearly identified, at every junction box, via a painted section or by use of conduit stickers indicating each conduit run. Green shall be used for computer, data and telephone and Orange shall be used for fiber optic.

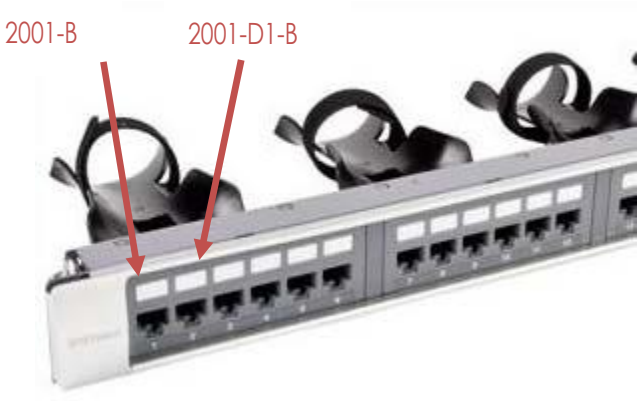
PART 4 - DIAGRAMS

4.01 HUIT STANDARD JACK LABELING



4.02 PATCH PANEL DESI STRIP





END OF SECTION

SECTION 27 08 00 COMMISSIONING FOR COMMUNICATIONS

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.
2. Electrical contract documents.
3. Mechanical equipment.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer
2. Local Exchange Carrier (LEC)

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.01 CABLE TESTING

A. All cables (UTP, Fiber Optic) shall be tested as noted below.

B. Provide a hard copy of all test results. Handwritten test results will not be accepted.

C. All testing shall be completed after all communication face plates, patch panels, fiber optic termination hardware and wiring blocks have been secured in their final position and are properly labeled per this specification.

D. Building must be operational (i.e. Building lighting and power must be energized).

E. Provide the Owner with individual binders representing each MDF and TR containing the following documentation and test results for all cables. Testing and Documentation shall include but not limited to:

1. Fiber Optic Cables

a. Using an optical power meter, measure end-to-end attenuation for all installed cables, including: all splices, terminated fiber; all connector, and patch panels. The total loss shall be measured and reported for each cable at the appropriate operation wavelengths, 850 nm and 1300 nm for multimode fiber and 1310 nm and 1550 nm for Single-mode Fiber. Optical attenuation measurements are to be done from one direction.

b. Multimode Link Measurement:

1) Test at 850 or 1300 nm in 1 direction according to ANSI/TIA-526-14-A, Method B, One Reference Jumper.

2) Before beginning testing, the contractor shall submit a design fiber optic loss budget for the segment to be tested, based upon the length of fiber optic cable segment installed and the number of connector pairs installed, based on equation in TIA-568.D-0. When tested at both windows in both directions, the measured attenuation of each fiber optic cable segment shall be less than or equal to the design attenuation of the segment being tested. Until this condition has been met, the installation shall not be considered complete, and will not be accepted.

c. Single-Mode Link Measurement:

1) Test at 1310 nm in 1 direction according to ANSI/TIA-526-7, Method B, One Reference Jumper.

2) Each element of all new single-mode fiber optic cabling shall be tested for continuity and attenuation in both directions at both 1310 and 1550 µM, with a fiber optic light source and power meter. Before beginning testing, the contractor shall submit a design fiber optic loss budget for the segment to be tested, based upon the length of fiber optic cable segment installed and the number of connector pairs installed, based on equation in TIA-568.D-0. When tested at both windows in both directions, the measured attenuation of each fiber optic cable segment shall be less than or equal to the design attenuation of the segment being tested. Until this condition has been met, the installation shall not be considered complete, and will not be accepted.

d. Provide all test records for the cabling that has been installed in both “native” and pdf format as part of the as-built documentation.

2. Horizontal Cabling System Voice and Data, Category 6 Note: Data on patch panels, voice on 110 fields.

a. Line map continuity

b. Length

c. Link Insertion Loss (formerly attenuation) Less than 31.0 dB @ 250 MHz.

d. Link NEXT/FEXT Pr. To Pr. greater than 38.3 dB @ 250 MHz.

e. Link NEXT/FEXT PWR. greater than sum 32.7 dB @ 250 MHz.

f. Link ELFEXT Pr. To Pr. 16.2 dB @ 250 MHz.

g. Link ELFEXT PWR. Greater than sum 13.2 dB @ 250 MHz.

h. Return loss 10.0 dB @ 250 MHz.

3. Horizontal Cabling System Voice and Data Category 6A Note: Data on patch panels

a. Line map continuity

b. Length

c. Link Insertion Loss (formerly attenuation) Less than 43.8 dB @ 500 MHz.

d. Link NEXT/FEXT Pr. To Pr. greater than 26.7 dB @ 500 MHz.

e. Link PsumNEXT greater than sum 23.8 dB @ 500 MHz.

f. Link ACRF 10.2 dB @ 500 MHz.

g. Link PsumACRF Greater than sum 7.2 dB @ 500 MHz.

h. Return loss 8.0 dB @ 500 MHz

4. Note: To accomplish/facilitate complete Category 6/6A Link testing. Telecommunication Installer shall utilize a Level IV accuracy cable tester with the manufacturer's latest version of firmware software. The contractor shall use the same model of for all test gear from the same manufacturer for this project.

5. Installer to coordinate with test equipment manufacturer for exact test procedures for SYSTIMAX Link testing.

6. Save all test records for Category 6 and Category 6a cabling in both tabular and graphical format.

7. Provide all test records for the cabling that has been installed in both "native" and pdf format as part of the as-built documentation.

PART 4 - DIAGRAMS

END OF SECTION

SECTION 27 11 16 COMMUNICATION CABINETS, RACKS, FRAMES AND ENCLOSURES

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.
2. Electrical contract documents.
3. Mechanical equipment.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer
2. Local Exchange Carrier (LEC)

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

PART 2 - PRODUCTS

2.01 TELECOMMUNICATIONS ENCLOSURE (TE)/RACKS - SYSTIMAX

A. Rack

1. Floor mounted two-post racks 7'H x 19"W shall be SYSTIMAX RK3-45A, Material ID 760082479.
2. Floor mounted four-post racks 7'H x 19"W x 36" Deep shall be SYSTIMAX RK4P45-36A, MID 760082560.
3. Between-the-rack cable management shall be SYSTIMAX 12-inch wide double-sided vertical management, Material ID 760089375, VCM-DS-84-12B. Or, 10-inch wide double-sided vertical management, Material ID 760089367, VCM-DS-84-10B.
4. End-of-rack management shall be SYSTIMAX 6-inch double-sided vertical cable management, Material ID 760089342, VCM-DS-84-6B. Or, 8-inch-wide double-sided vertical management, Material ID 760089359, VCM-DS-84- 8B.

5. Note: Coordinate vertical cable management size for each project with HUIT Representative

6. Racks shall be secured to the floor

7. Racks shall contain adequate cable management to accommodate all patch Cords

B. Telecommunications Enclosure

1. 19” wide SYSTIMAX Server Cabinet Telecommunications Enclosure 760172536, SC 42U 800X1200 Modular Kit. Equipment racks will be provided in locations specified by HUIT personnel.

2.02 TELECOMMUNICATIONS ENCLOSURE (TE)/RACKS - CHATSWORTH

A. Rack

1. Floor mounted racks 7’H x 19”W shall be Chatsworth P/N 46053-503.

2. Racks shall be secured to the floor and ladder tray above.

B. Telecommunications Enclosure

1. 19” wide CPI Mega Frame Telecommunications Enclosure (CPI M1130-732) equipment racks will be provided in locations specified by HUIT personnel.

PART 3 - EXECUTION

3.01 TELECOMMUNICATIONS ENCLOSURE/RACKS

A. Each rack shall house equipment and devices of the following in various quantities:

1. Fiber optic termination hardware.

2. Fiber optic management panels.

3. Electronic equipment provided by others (coordinate with Owner).

4. Communications patch panels (voice and data).

5. Horizontal and vertical cable management panels.

B. Provide and install quantity of racks to house the aforementioned equipment and devices plus 20 percent additional space for field changes and future expansion.

C. All racks shall be secured to the floor using the factory recommended hardware and installation practices.

D. All racks shall be properly grounded, conforming to ANSI/TIA/ 607-D, National Electric Code and all related grounding standards and codes.

E. All racks and enclosures will be individually grounded directly to a TGB and not to overhead tray or ladder racks.

F. Install cable racks in accordance with ANSI/NFPA 70, Article 318 requirements and as specified herein.

G. Whenever permissible, provide a 3 foot clearance on three sides of each row of equipment racks and/or cabinets.

PART 4 - DIAGRAMS

END OF SECTION

SECTION 27 11 19 COMMUNICATION TERMINATION BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.
2. Electrical contract documents.
3. Mechanical equipment.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer
2. Local Exchange Carrier (LEC)

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

PART 2 - PRODUCTS

2.01 FIBER OPTIC ENCLOSURES

A. SYSTIMAX Standard Density Fiber Optic Shelves

1. Standard Density 1U sliding Panel, accepts (3) LGX/1000 style splice cassettes, modules or panels, providing up to 36 duplex LC ports, MID 760231449 P/N SD-1U
2. Standard Density 2U sliding Panel, accepts (6) LGX/1000 style splice cassettes, modules or panels, providing up to 72 duplex LC ports MID 760231456 P/N SD-2U
3. Standard Density 4U sliding Panel, accepts (12) LGX/1000 style splice cassettes, modules or panels, providing up to 144 duplex LC ports MID 760231464, P/N SD-4U

B. Fiber Optic Adapter Panels

1. LC Adapter Pack, Black, 1000-Type, with 12 LazrSPEED® 50 Micron MM duplex LC adapters, MID 760148171 P/N PNL-BK-024-MFA-LC02-AQ-NS or 6 MM duplex LC adapters MID 760149344 P/N PNL-BK-012-MFA-LC02-AQ-NS

2. LC Adapter Pack, Black, 1000-Type, with 12 TeraSPEED® SM duplex LC adapters, blue, MID 760148361 P/N PNL-BK-024-SFA-LC02-BL-NS or with 6 TeraSPEED® SM duplex LC adapters MID 760149351 P/N PNL-BK-012-SFA-LC02-BL-NS

3. Note: Coordinate exact patch panel with HUIT Representative

2.02 DATA AND VOICE PATCH PANELS

A. Use Category 6 Solution or Category 6A Solution.

1. Category 6 solution, 24 port, high density patch panel shall be SYSTIMAX, 760152561, 360-IPR-1100-E-GS3-1U-24.

2. Category 6A solution, 24 port, high density patch panel shall be SYSTIMAX, 760152587, 360-IPR-1100-E-GS6-1U-24.

3. Category 6 solution, 48 port, high density patch panel shall be SYSTIMAX, 760152579, 360-IPR-1100-E-GS3-2U-48.

4. Category 6A solution, 48 port, high density patch panel shall be SYSTIMAX, 760152595, 360-IPR-1100-E-GS6-2U-48

5. SYSTIMAX PatchMAX panels shall only be used in locations where patch panels mount on wall locations: For Cat 6 24 port, use MID 760102244; For Cat 6A, 24 port, use MID 760102251; For Cat 6, 48 port, use MID 760117366; For Cat 6A, 48 port, use MID 760128207.

6. Note: Coordinate exact patch panel with HUIT Representative.

2.03 VOICE HORIZONTAL TERMINATION BLOCKS FOR VOICE EXTENSION TO RACK

A. Horizontal Voice Field extension from rack-mounted patch panels

1. 300 pair termination blocks, 110 type, shall be CommScope, Material ID 558843-1.

2. 100 pair termination blocks, 110 type, shall be CommScope Material ID 558842-1.

3. C-4 clips shall be CommScope, Material ID 558401-1.

4. Designation strips shall be CommScope, Material ID 1375354-2.

5. Designation strip, transparent label holder shall be CommScope, Material ID 558417-1.

6. Complete kit, consisting of 300-pair 110-block, 4-pair connector clips, labels, and label holders, Commscope Part No. 110AB2-300FT, Material ID 107058943

7. Complete kit, consisting of 100-pair 110-block, 4-pair connector clips, labels, and label holders, Commscope Part No. 110AB2-100FT, Material ID 107058919.

2.04 VOICE BACKBONE TERMINATION BLOCKS

A. Riser Termination Blocks

1. 300 pair termination blocks, 110 type, shall be CommScope, Material ID 558843-1.

2. 100 pair termination blocks, 110 type, shall be CommScope Material ID 558842-1.

3. C-4 clips shall be CommScope, Material ID 558401-1.

4. C-5 clips shall be CommScope, Material ID 558402-1.

5. Designation strips shall be CommScope, Material ID 1375354-2.

6. Designation strip, transparent label holder shall be CommScope, Material ID 558417-1.

7. Complete kit, consisting of 300-pair 110-block, 5-pair connector clips, labels, and label holders, Commscope Part No. 110AA2-300FT, Material ID 107058935

8. Complete kit, consisting of 100-pair 110-block, 5-pair connector clips, labels, and label holders, Commscope Part No. 110AA2-100FT, Material ID 107058901

PART 3 - EXECUTION

3.01 FIBER PATCH PANELS

A. Provide and install quantity of empty fiber panels and adapters to terminate all fiber cables distributing from each Telecommunication Room (TR), plus 20% growth.

1. Note: Coordinate with Harvard's HUIT for exact location of panels within each equipment rack

3.02 DATA AND VOICE PATCH PANELS

A. Horizontal

1. Provide and install quantity of empty data patch panels and modular inserts to terminate all horizontal data cables distributing from each Telecommunication Room (TR), plus 20% growth.

2. All Category 6/Category 6A cables are to be terminated on the patch panels. The cables are to be cut down numerically in ascending order starting from the upper left port (left to right, top to bottom).

    a. Coordinate with Harvard's HUIT for exact location of panels within each equipment rack.

3.03 VOICE HORIZONTAL TERMINATION BLOCKS

A. Voice Horizontal Termination Blocks

1. Provide Category 6 UTP solid conductor patch cord with factory terminated male RJ-45 plug on one end, open on the other end. The quantity of patch cords shall equal the quantity of voice horizontal cables terminated on patch panels, plus 20% spare.

2. Provide and install 110 termination blocks for terminating all Category 6 solid conductor patch cords, extending voice horizontal cables to the wall field.

3. Mount 110 termination blocks on provided plywood.

4. Coordinate with Harvard's HUIT for exact location of blocks on wall field.

5. Patching

    a. Patch each corresponding patch cord to its' corresponding RJ-45 outlet in the patch panel.

3.04 VOICE BACKBONE TERMINATION BLOCKS

A. Voice Backbone Termination Blocks

1. Provide and install 110 termination blocks for terminating all voice riser backbone cables.

2. Mount 110 termination blocks on provided plywood.

3. Coordinate with Harvard HUIT for exact location of blocks on wall field.

4. Provide and install 110 C-4 clips when terminating riser cables, with the exception of the last clip in each row. The last clip in each row terminates with a 110 C-5 clip. The clip covers the 25th pair of the riser, even though it will not be cross-wired.

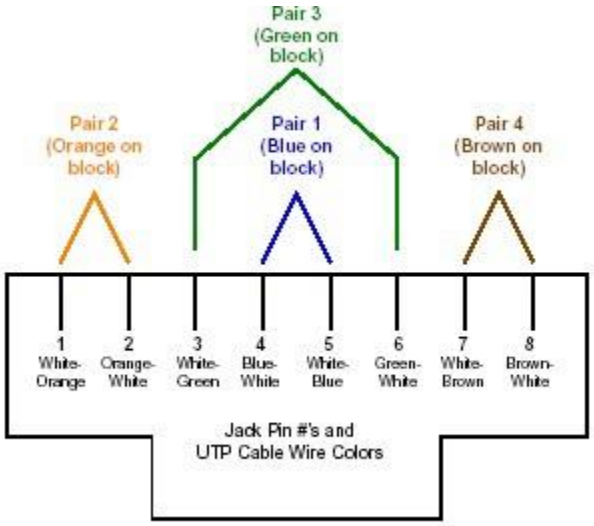
5. Cross-wiring:

    a. Use: All Blue pairs of the station cable must be cross-wired to the riser system. Twenty-five (25) stations will be crossed-wired per 25 pair row.

    b. Contractor to provide as-built sheet, laminated and hanged in MDF room on the wall, showing riser pair correlation w/ horizontal voice jack numbers for every voice outlet.

PART 4 - DIAGRAMS

4.01 568B JACK PINOUT



END OF SECTION

SECTION 27 11 23 COMMUNICATION CABLE MANAGEMENT AND LADDER RACK

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.

2. Electrical contract documents.

3. Mechanical equipment.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer

2. Local Exchange Carrier (LEC)

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

PART 2 - PRODUCTS

2.01 CABLE SUPPORTS AND MANAGEMENT

A. Cable hangers shall be open-top cable supports (J-Supports), 2" diameter loop.

B. Vertical Cable Management

1. 6" wide, double-sided, vertical cable management shall be CommScope VCM-DS-84-6B, Material ID 760244779.

2. 8" wide double-sided, vertical cable management shall be CommScope VCM-DS-84-8B, Material ID 760244780.

3. 10" wide double-sided, vertical cable management shall be CommScope VCM-DS-84-10B, Material ID 760244781.

4. 12" wide double-sided, vertical cable management shall be CommScope VCM-DS-84-12B, Material ID 760244782.

2.02 LADDER RACK (CABLE RUNWAY)

A. 12”, 18” and 24” wide cable ladder rack sections shall be manufactured by Chatsworth, part #: 11275-712, 11275-718 and 11275-724.

B. Description:

C. Open rung UL Classified ladder type cable tray with runway dropouts, complete with splice hardware, runway termination hardware, and 5/8-inch ceiling support hardware. Constructed of steel tubing with 9-inch rung spacing.

1. Color: Black

2. Size: As indicated on drawings.

3. Cross-members welded at 9" intervals.

4. UL Listed cable runway.

D. Accessory Products:

1. Radius drop-cross member, radius drop-stringer, junction splice kit, butt splice kit, wall angle support kit, end closing kit, protective end caps, 6" cable runway elevation kit, cable runway moveable cross member as needed.

2. Provide any accessory products related to the wire management components to provide a complete and functional infrastructure system.

3. Triangular support bracket are prohibited for this project.

4. All splice and connection kits shall be UL classified

PART 3 - EXECUTION

3.01 CABLE SUPPORTS AND MANAGEMENT

A. J-Hook supports shall be installed in accordance with the manufacturer’s recommendations and located at intervals such that the cables do not rest on ceiling tile or grid at any point along the pathway. Refer to “Cabling Methods and Termination” in Part 3 (Execution) of this specification for additional cable routing requirements.

B. Cable management straps shall be of the Velcro variety. Cable ties shall not be used.

3.02 CABLE SUPPORTS AND MANAGEMENT

A. Generally, cable pathways are provided by an electrical Installer SEC 16100. The pathways shall be parallel to building lines and shall sweep/turn at 90 degree angles maintaining minimum bend radius for cable and will comply with the guidelines and recommendations outlined in ANSI/TIA -568-D and ANSI/TIA-569-D.

B. Provide cable and supports as required. All cables shall be supported.

C. Where cable tray, ladder rack and conduit are not provided for support of the telecommunication cables, provide cable support at 4 to 5 foot intervals.

D. Cable supports shall not be supported from the ceiling structure, mechanical, electrical, fire protection or plumbing devices.

E. Where metal conduit is provided by electrical Installer per SEC 16100 for use by the telecommunications installer, provide each end of the conduit with plastic grommets for cable sheath protection.

F. Provide all strain relief for the purpose of maintaining bend radius and providing additional protection/support of exposed cables.

G. At all equipment racks, provide Velcro straps at 1-foot intervals for support of cables.

H. Voice Infrastructure

1. Provide management and supports as required.

I. Data Infrastructure

1. Provide and install management and support as required. Refer to telecommunications drawings and details for location and quantity of horizontal cable management.

2. Provide and install vertical management on equipment rack.

3. Provide and install D-rings for custom cabinet, mount three rows of five D-rings (per row). Refer to T-series details for additional information.

3.03 CABLE RUNWAY/LADDER RACK SYSTEM

A. MDF/IDF/TR

1. Provide, install and ground cable runway/ladder rack in the MDF, IDF and TR's.

2. All ladder rack components shall be properly grounded conforming ANSI/TIA-607-D.

PART 4 - DIAGRAMS

4.01 VELCRO

A. Use VELCRO® fasteners to secure all cables bundles. VELCRO® products won't crush or damage cables like tie wraps can and are reusable for moves, adds and changes.

END OF SECTION

SECTION 27 11 26 COMMUNICATIONS RACK MOUNTED POWER PROTECTORS AND POWER STRIPS

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.

2. Electrical contract documents.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer

2. Local Exchange Carrier (LEC)

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

PART 2 - PRODUCTS

2.01 Power Distribution Units

A. All devices shall be provided and installed by HUIT

PART 3 - EXECUTION

PART 4 - DIAGRAMS

END OF SECTION

SECTION 27 13 13 COMMUNICATION COPPER BACKBONE CABLING

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.
2. Electrical contract documents.
3. Mechanical equipment.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer
2. Local Exchange Carrier (LEC)

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

PART 2 - PRODUCTS

2.01 COPPER BUILDING BACKBONE CABLE

A. Copper cable for backbone distribution shall be 100 pr, 24 AWG, Plenum Rated, Category 3 SYSTIMAX P/N 2010B WH 100, Material ID 107766057.

B. Copper cables for backbone distribution shall be 100 pr, 24 AWG, riser rated, Category 3, MID 9-57315-1, 1010A SLT 100/24 R1000. (this is a non-armored cable)

PART 3 - EXECUTION

3.01 COPPER BUILDING BACKBONE CABLE

A. Provide and install the specified number of 100-pair copper backbone cables from the MDF to each Telecommunication Room (TR), as shown on the drawings provided.

1. Coordinate with Harvard HUIT for sizing of the riser or backbone cable.
2. Coordinate with Harvard HUIT for exact location of 110 termination blocks.
3. Refer to construction drawings for exact number of 100-pair backbone cables required for each individual project.

3.02 VERIZON NETWORK TERMINATION AND 110 POINT OF PRESENCE (POP)

A. Provide and install 110 termination for all RJ21x's. 110 POP will be placed on the backboard by the wiring contractor.

B. The 110 block shall have a 25-pair cable terminated at one end and the other end shall run to the RJ21X and terminated with a female Amphenol connector and connected to the Verizon block.

PART 4 - DIAGRAMS

END OF SECTION

SECTION 27 13 23 COMMUNICATION FIBER BACKBONE CABLING

PART 1 - GENERAL

1.01 GENERAL

A. The cable must meet the requirements of the NEC for placement in an indoor environment.

B. Plenum applications - Application Flame Test: UL910 (NFPA 262-1994).

C. See HUIT Wire & Cable Outside Wiring Master format and HUIT Manhole and Conduit Standards.

D. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard.

E. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.
2. Electrical contract documents.
3. Mechanical equipment.

F. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer
2. Local Exchange Carrier (LEC)

G. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

H. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

1.02 FIBER CHARACTERISTICS

A. All optical fibers shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification.

B. Each optical fiber shall consist of a doped silica core surrounded by a concentric glass cladding.

PART 2 - PRODUCTS

2.01 FIBER OPTIC BUILDING BACKBONE CABLE

A. Building Fiber Optic Backbone Cable

1. Multimode Fiber Optic

    a. Primary fiber optic building backbone system infrastructure shall consist of one (1), 12 strand, multimode OM3 50 micron, Plenum rated OFNP, LazrSPEED SYSTIMAX P/N P-012-DS-5L-FSUAQ, Material ID 700009731 or R-012-DS-5L-FSUAQ, Material ID 700208150 Riser Rated, depending on pathway

    b. Legacy fiber optic building backbone system infrastructure shall consist of one (1), 12 strand, multimode 62.5/125 micron, Plenum rated OFNP, OptiSPEED SYSTIMAX P/N P-012-DS-6F-FSUOR, Material ID 700009400 or R-012-DS-6F-FSUOR, Material ID 700010168 Riser Rated, depending on pathway. Coordinate cable rating (plenum or riser) with Harvard HUIT.

    c. Multimode fiber optic cable (62.5/125 Micron) shall support 10 gigabit Ethernet operating at the first window of 850 nm forthe distance of 150 meters (500 feet).

2. Single-mode Fiber Optic

    a. Future/high bandwidth fiber optic building backbone system infrastructure shall consist of one (1), 12 strand, single-mode 8.3/125 OFNP TeraSPEED SYSTIMAX P/N P-012-DS-8W-FSUYL, Material ID 760004358, Plenum or R-012-DS-8W-FSUYL, Material ID 760004440 Riser Rated, depending on pathway.

3. Composite Armored Fiber Optic Cable

    a. Primary fiber optic building backbone system infrastructure shall consist of a single cable with one (1), 12 strand, single-mode 8.3/125 OFNP and one (1), 12 strand, multimode 62.5/125 micron, Plenum rated OFNP TeraSPEED/OptiSPEED Composite armored Cable SYSTIMAX P/N P-024-DS-CM-FSUOR/8W012/6F012, Material ID 760175752 or one (1), 12 strand, single-mode 8.3/125 OFNP and one (1), 12 strand, multimode 50/125 micron (OM3), Plenum rated OFNP TeraSPEED/LazrSPEED Composite 760018754 P/N P-024-DS-CM-FSUAQ/8W012/5L012

    b. Note: Armored cable may be used in lieu of an inner-duct system.

2.02 FIBER OPTIC CAMPUS BACKBONE CABLE

A. General

1. See HUIT Wire & Cable Outside Wiring Master format and HUIT Manhole and Conduit Standards.

PART 3 - EXECUTION

3.01 FIBER OPTIC BUILDING BACKBONE CABLE

A. Building Backbone

1. Provide install, terminate and test one (1) 12-strand multimode fiber optic cable from the MDF to each Telecommunications Room (TR).

2. Provide install, terminate and test one (1) 12-strand single-mode fiber optic cable from the MDF to each Telecommunications Room (TR).

3. Fiber to fiber splicing will not be permitted where a continuous length of cable would otherwise be installed.

4. Fiber optic splicing shall require approval from HUIT.

5. Coordinate pathways, and cable rating (Plenum or Riser) with Harvard's HUIT, the electrical, engineer, and local fire inspector. The pathways and spaces will determine the cable rating (Plenum & Riser).

6. Armored hybrid Fiber Optic may be used with the approval of HUIT.

3.02 FIBER OPTIC CAMPUS BACKBONE CABLE

A. Campus Backbone (See the HUIT Outside Plant Standards).

PART 4 - DIAGRAMS

END OF SECTION

SECTION 27 15 00.53 ANTENNAS COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard.

B. All oDAS projects must be approved by Building owners (FAS, HRES, etc.)

C. All oDAS projects must go thru Campuses Services for review and approval.

D. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.

2. Electrical contract documents.

3. Mechanical equipment.

4. Submit oDAS system RF Site Safe Reports to Health and Safety Officer for review an approval.

E. Coordinate all work with on-site installers including, but not limited to:

1. HUIT Project Manager

2. Cellular Carriers and their sub-contractors

3. Coordinate regular meeting updates with building manager

4. Provide two week look ahead for local contact review approval

5. Work with Harvard Safety Officer for project kick off

F. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

G. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

1.02 DESCRIPTION

A. This specification describes the technical and performance criteria for deploying a Neutral-Host Basic Distributed Antenna System (DAS) capable of supporting Wireless Service Providers (WSP) for Cellular Telephone System at Harvard University Campus.

B. This specification does not address Public Safety DAS. However, Public Safety DAS can be deployed in two approaches:

1. Stand-alone: this application entails the deployment of a separate support infrastructure for the Public Safety DAS; and,

2. Converged: where the Public Safety DAS services would ride on the cellular DAS infrastructure with the addition of the required active and passive devices (electronics and antennas).

1.03 RELATED DOCUMENTS

A. American National Standard ANSI/TIA Telecommunications Building Wiring Standards.

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

1.04 SYSTEM DESCRIPTION

A. Services: Upon commissioning, the DAS shall provide coverage for the WSPs listed below on all frequencies currently being used by the designated WSPs in the given market.

1. AT&T Wireless

2. Sprint

3. T-Mobile

4. Verizon

B. Expansion: Without replacing the Passive DAS Infrastructure, the DAS shall have expansion capabilities to support the following WSP deployed in a SISO antenna environment. MIMO antenna solution will be provided in selected buildings depending on the capacity needs. Any additional Components required for system expansion shall comply with all specifications of this Section.

Service	**Uplink, MHz**	**Downlink, MHz**
Commercial 700 Band	698-716, 776-787	728-746
Cellular	824-849	869-894
PCS	1850-1915	1930-1995
AWS	1710-1755	2110-2155
800 Band	806-824	851-869
900 Band	896-902	935-941
BRS/EBS	2496-2690	

AT&T WCS	2305-2320 and 2345-2360
CBRS	3.55-3.7GHz

C. Most WSP RF signal sources will be from their BTS equipment located at the DAS headend location(s) provided by the Harvard University. But some buildings cellular services may be provided with femtocell or other small cell technologies.

D. Broadband Active Distribution: Single-mode fiber-optic cable will be used for Active distribution. In-line amplifiers are not allowed.

E. Network Management: The DAS shall have a Network Management System (NMS) capable of alarm, monitor, configuration and control of all Active Components.

1.05 ALTERNATIVES

A. No alternative component(s) shall be accepted as equal to the components and manufacturers specified in this document unless the Contractor proves that the alternative component(s) are of equal or superior specifications and quality, and that they have been used in similar projects of size and complexity for no less than 3-years. The following information shall be required for each alternative component with submittal proposed:

1. Passive Components:

   a. Product samples

   b. Detailed product specifications

   c. Independent test results verifying the product specifications

   d. Written documentation from the manufacturer guaranteeing that the alternative component(s) shall remain available for new purchase for a period of 7-years from the date of system acceptance.

2. Active Components: Hardware and software manuals

   a. Detailed product specifications

   b. Mean Time Between Failure (MTBF) data for each Active Component

   c. Independent test results verifying the product specifications

   d. Written documentation from the manufacturer guaranteeing that the alternative component(s) shall be supported for a period of 7-years from the date of system acceptance.

   e. For Active Components serving the WSPs, written documentation from the WSPs that the alternative component(s) are approved for use within the WSP's network and that interconnection of the DAS to the

WSP's network will not be withheld due to the alternative component being used in the DAS.

1.06 CODES, STANDARDS AND CERTIFICATIONS

A. All work, including but not limited to: cabling, pathways, support structures, wiring, equipment, installation, workmanship, maintenance and testing shall comply with the latest editions of the National Electrical Code, National Electrical Safety Code, all applicable local rules and regulations, equipment manufacturer's instructions, and the National Electrical Contractors Association (NECA) Standard of Installation. In case of discrepancy or disagreement between the documents noted above, the contractor shall satisfy the most stringent requirements.

1.07 ABBREVIATIONS AND ACRONYMS

A. ACG: Automatic Gain Control

B. AHJ: Authority Having Jurisdiction

C. ATP: Acceptance Test Plan

D. AWS: Advanced Wireless Service

E. BDA: Bi-Direction Amplifier

F. BOM: Bill-of-Material

G. BRS: Broadband Radio Service

H. BTS: Base Transceiver Station

I. CDMA: Code Division Multiple Access

J. C/N: Carrier-to-Noise Ratio

K. CWDM: Coarse Wave Division Multiplexing

L. DAS: Distributed Antenna System

M. DWDM: Dense Wave Division Multiplexing

N. EBS: Educational Broadband Service

O. ESMR: Enhanced Specialized Mobile Radio

P. FCC: Federal Communications Commission

Q. GUI: Graphical User Interface

R. iDEN: Integrated Enhanced Digital Network

S. KPI: Key Performance Indicator

T. LMR: Land Mobile Radio

U. LTE: Long Term Evolution

V. MTBF: Mean Time Between Failure

W. NFPA: National Fire Protection Association

X. NMS: Network Management System

Y. PCS: Personal Communications System

Z. PSN: Public Safety Network

AA. RoF: Radio-over-Fiber

BB. RoHS: Restriction of Hazardous Substances

CC. RSL: Received Signal Level

DD. SISO: Single-Input, Single-Output

EE. SMR: Specialized Mobile Radio

FF. SMS: Short Message Service

GG. SNIR: Signal-to-Noise Interference Ratio

HH. SNMP: Simple Network Management Protocol

II. SOW: Statement of Work

JJ. VSWR: Voltage Standing Wave Ratio

KK. WSP: Wireless Service Provider

1.08 DEFINITIONS

A. Acceptance: Expressed approval by the customer

B. Active: DAS components that require AC/DC power for operation

C. Carrier Approval: Expressed approval to interconnect to the WSP macro network

D. Channel: A path for an RF transmission between two points

E. Component: A main system element of the DAS

F. Contractor: The prime contractor bidding the project

G. IDAS: Indoor DAS is more common and is used to enhance coverage for indoor facilities such as buildings, malls, stadiums, public halls and so on. iDAS is the most common type of DAS infrastructure.

H. Mule string: pull string in a conduit to allow for future access for pulling more cable trough exiting conduit

I. ODAS: Outdoor DAS is used for outdoor facilities such as university campuses, ski resorts, remote areas, urban clusters, tunnels and so on.

J. Passive: DAS components that do not require AC/DC power for operation

K. POE: Power over Ethernet or PoE describes any of several standard or ad hoc systems which pass electric power along with data on twisted pair Ethernet cabling. This allows a single cable to provide both data connection and electric power to devices such as wireless access points, IP cameras, and VoIP phones.

L. Radio Node are high-capacity, power-over-Ethernet (PoE) capable, small cells. In any deployment, multiple RNs are deployed inside an enterprise or venue, and are connected to the Services Node using standard Ethernet LAN infrastructure.

1.09 DAS PERFORMANCE REQUIREMENTS

A. On a per channel basis, the downlink RSL for each frequency band shall meet or exceed the criteria in Table 1.

1. Table 1. System Parameters

Parameter	Unit	700 MHZ, BRS/EBS	Cellular, PCS, AWS, 800/900 MHz
Minimum downlink receive signal level (RSL)	dBm	-75	-85

B. Contractor shall state the assumed channel loading and frequency bands for the proposed WSP in-building coverage. Prior to installation, contractors shall confirm the channel loading and frequency use in the serving area, and shall guarantee coverage for these channels per the criteria in Table 1.

C. The DAS shall deliver coverage per the criteria in Table 1 throughout 95% of the building. The coverage areas shall include the stairwells, elevators, basement, and garage.

D. The contractor shall explain the method used to avoid downlink and uplink interference.

1.10 DAS DESIGN

A. In-Building DAS Design Goals: To provide reliable and ubiquitous services inside buildings with BTS fed DAS, there are three key design goals:

1. Indoor solution shall be sufficiently dominant within defined scope of the venue area thus improving coverage, quality and capacity.

2. The overlap (soft handover) percentages shall remain within specified targets under all circumstances so that planned capacity numbers can be realized.

3. The indoor solution shall be seamlessly integrated into the existing macro network in a coordinated manner without causing excessive interference or otherwise impacting the macro network KPIs.

B. DAS Design Approach: With above goals in mind, following approach should be used:

1. Baselining of Venue Coverage – This will be done as the very first step based on analyses of venue walk-test data and also drive test data collected from the surrounding macro.

2. Identify Macro Overshooter – Based on the analyses of indoor walk test data, the design team would need to identify the macro cells that are very strong within the venue and so far provided coverage and capacity within the venue, but would not be needed once indoor solution is put in place, The next step will be to review those cases with the market RAN team and discuss the feasibility of optimizing those sites/sectors.

3. Develop Design Assumption – Objective is to frame a common set of assumption before commencement of the design and get everyone to agree to that.

a. Equipment – Includes vendor type, frequency band, and PA power.

b. Traffic – Includes traffic demand per user, call model, throughput demand, activity factor, device type (smartphone vs. feature phone etc).

4. Finalize Design Target – Based on analyses of the above steps, the design targets will need to be developed for each technology under consideration.

5. Perform Actual Design – Once the design targets are developed, the next steps would involve performing actual design exercise and associated validation.

C. Input Required: The following information is required to perform a proper DAS design:

1. Building floor plans

2. Areas where equipment cannot be installed due to inaccessibility

3. Areas where equipment cannot be installed due to aesthetic purposes

4. Areas which do not require to be provided with coverage

5. Areas where coverage is to be restricted

6. DAS headend and BTS equipment location

7. Any existing infrastructure, like fiber, coax or power supply, that can be used

1.11 SUBMITTALS

A. Submittal Requirements with Bid Response:

1. Product Data: Submit manufacturer datasheets for the following components:
    a. DAS Antennas
    b. Coaxial Cable and Connectors
    c. Splitters, Combiners and Couplers
    d. Fiber-Optic Master Unit
    e. Fiber-Optic Remote Units
2. Shop Drawings: Submit the following items:
    a. RF link budget
    b. Overlay of system Components on floor plans
    c. Bill-of-Material (BOM)
    d. Statement of Work (SOW): Submit sample SOW
    e. Acceptance Test Plan (ATP): Submit sample ATP
    f. Recommended Spares
    g. Warranty Documents:
        1) Submit for all manufactured Components specified in this Section.
        2) Submit Contractor's System Warranty.
        3) Submit Manufacturer's Extended Warranty.

B. Submittal Requirements Prior to Start of Construction

1. Final RF link budget
2. Overlay of system Components on floor plans
3. RF propagation modeling
4. Signal to Noise Interference Ratio (SNIR) Map
5. Bill-of-Material (BOM)
6. Maintenance Service Contract
7. Statement of Work (SOW): The contractor shall submit a SOW that has been accepted by the customer or customer's designated representative.
8. Acceptance Test Plan (ATP): The contractor shall submit an ATP that has been accepted by the customer or customer's designated representative.

C. Submittal Requirements at Close Out

1. Drawings: Submit as-built drawings indicating:

a. Cable routing, splitters, couplers and coverage antenna locations

b. Active component locations, layout and configuration

2. Test Reports

a. WSP DAS: Submit accepted ATP reports confirming the requirements of Section 1.08 have been met.

3. Field Reports: Submit sweep-testing results for all cable runs.

4. Field Reports: Submit OTDR test results for all fiber runs.

5. Operation and Maintenance Data: Submit hardware and software manuals for all Active Components.

6. Warranty Documents:

a. Submit for all manufactured components specified in this Section.

b. Submit Contractor's System Warranty.

c. Submit Manufacturer's Extended Warranty

1.12 QUALITY ASSURANCE

A. Qualifications: Contractor, and/or Sub-Contractors, shall have a minimum of 5-years full time experience executing work of similar scope and complexity.

B. Certifications:

1. Passive Components: Contractor or Sub-Contractor shall provide manufacturer certification that their personnel have been trained on the components being installed.

2. Active Components: Contractor or Sub-Contractor shall provide manufacturer certification that their personnel have been trained on the components being installed.

1.13 WARRANTY

A. All Warranty shall be provided to Cellular carriers by system vendors.

1.14 MAINTENANCE

A. The maintenance program is provided by Cellular Carriers to Harvard.

PART 2 - PRODUCTS

2.01 ONE OF THE FOLLOWING DAS MANUFACTURERS SHOULD BE SELECTED:

A. CommScope

B. TE Connectivity

C. Corning Mobile Access

2.02 COMPONENTS

A. DAS builds are comprised of a flourish of components specific to each DAS build and wireless operator preferences. The following categories comprise the overall type of components to be used and installed:

1. Radio Access Network (RAN) equipment: Each wireless operator will provide their own RAN equipment according to their respective network needs.

2. Passive RF components: Passive RF components are used to split, combine, attenuate, modulate RF frequencies and can be placed throughout the build. Approved Passive RF equipment manufacturers are accountable for the certification of their equipment in accordance with FCC, UL and NEC regulations.

3. DAS Equipment:

a. DAS equipment is split between head end equipment and remote equipment from the above manufacturers.

b. Head end equipment will be used to combine RF frequencies and technologies and modifies the signal to light for fiber optic transport. Remote location equipment will modify the light signal back to RF and amplify the signal to the equipment's characteristics for RF propagation according to the design.

c. Approved DAS manufactures are accountable for the certification of their equipment in accordance with FCC, UL and NEC regulations.

4. Telco equipment:

a. RAN equipment will require backhaul transport equipment. Therefore, additional fixed line telecommunication equipment will need to be deployed.

b. Such equipment can either be collocated with the DAS equipment or placed in the existing Telco room facilities at the venue owner's property.

5. Cables:

a. Throughout the DAS build the following cables comprise the variety of cabling required for the build. These cables shall all be rated and certified for indoor use in accordance with existing National

b. Electric Code (CM ratings). It is the DAS owner's responsibility to ensure adequate cable manufacturers are used:

1) Coaxial cable

2) Fiber Optic cables

3) Ethernet cables

4) Power Cable (AC or DC)

6. Radio Antennas:

a. Radio antennas are placed at strategic locations throughout the build in accordance with the design. Antenna types are selected based on desired frequency (e.g. multi frequency or wideband antennas) and beam width characteristics (e.g. Omni directional or narrow beam antennas) required at a particular location based on the DAS design.

1) All antennas shall be built in accordance with FCC regulated requirements. Any regulatory emission characteristics and minimum distance characteristics are identified during the design phase and shall be made available upon request.

7. Power plants and batteries: As most of the above mentioned components are DC powered, it is the DAS owner's responsibility to work out the adequate power plant according to the DAS equipment needed per DAS design and their current approved manufacturers.

a. Approved Power equipment manufacturers are accountable for the certification of their equipment in accordance with UL and NEC regulations.

b. Most wireless operators will require adequate backup systems for their equipment so as to provide continued operation of the equipment despite potential commercial power failures. The DAS owner will work with the venue owner on the necessary details. Preference should be given to battery backup solution, but Hydrogen Fuel cell, UPS systems and backup generators are all adequate options. All backup systems must be regulated and certified according to UL and NEC codes.

8. Equipment bays, conduits, ladder racks: Equipment comes in a variety of form factors. The DAS operator shall provide adequate equipment bays, cable conduits and ladder rack to support the build and use of the above mentioned equipment components.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall follow wherever practical BCSI practices and industry standards.

B. The DAS owner shall review with the Venue owner the various DAS equipment locations, equipment placement at those locations, cable pathways, conduit runs, antenna locations, core drilling needs ahead of construction start for acceptance.

C. The DAS owner shall install, commission and test the various equipment in accordance with the manufacturer's instructions and recommendations.

D. The DAS owner shall install the equipment and DAS system in accordance with the accepted scope of work based on the specific DAS design and required equipment.

3.02 POWER

A. It is the installer's responsibility to identify the required AC load for the entire DAS build. The installation vendor shall provide the necessary electrician to sector off required AC requirements for head end location.

B. It is the venue owner's responsibility to accommodate the required AC load and ensure that the additional AC usage can be accommodated.

C. Agreement between venue owner and DAS owner shall be reached in regards to appropriate electrical billing, either via sub-metering of on a monthly recurring cost according to contract terms and lease agreements.

D. The DAS operator will require adequate backup solutions through the use of batteries or other power backup systems. It is understood that such backup solution will be required both at the head end and possibly at the remote locations. The use of adequate line power solution could eliminate the need for such backup solutions at the remote end, but NEC and distance limitations of such line power solution might make this solution impossible to use and/or uneconomical.

E. Providing appropriate backup solutions will ensure adequate coverage in case of commercial power interruption. Venue owner's backup generators can be used if mutually agreed upon, but sufficient and adequate transition backup systems must be put in place through the use of batteries so as to avoid a hard shut down and reboot of the DAS equipment, therefore providing un-interrupted service.

3.03 SPACE REQUIREMENT

A. It shall be agreed upon between venue owner and DAS owner that the necessary space requirement both at the head end and remote locations can be granted according to the DAS design and equipment layout.

B. Standard installation procedure for DAS equipment is in electronic equipment bays. A limited amount of equipment can/must be wall mounted.

C. As DAS equipment is split between the head end equipment and the remote location equipment and between the remote location and the required antennas, horizontal and vertical cable management must be utilized to place the appropriate cables.

D. Existing cable pathways (both vertical and horizontal) are the preferred method of cable placement. The venue owner can limit the use of such facilities and/or demand separate cable facilities to be placed if needed.

E. The DAS operator and installers may choose to select the placement of new pathways upfront and identify such in the Architecture and Engineering drawings submitted to the venue owner for review and approval prior to construction start.

F. The DAS operator and the DAS installers will be responsible to place any additional agreed upon cable pathways, including all necessary conduits and junction boxes in accordance with BCSI standards.

PART 4 - DIAGRAMS

END OF SECTION

SECTION 27 15 13 COMMUNICATION COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.
2. Electrical contract documents.
3. Mechanical equipment.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer
2. Local Exchange Carrier (LEC)

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

PART 2 - PRODUCTS

2.01 DATA HORIZONTAL CABLE

A. Use Category 6 horizontal cable utilized for the distribution of communications shall be 4 pair, 24 AWG, plenum, Category 6 (GigaSPEED), SYSTIMAX P/N 2071E SGR C6 4/23 W1000, WE TOTE box, Material ID 700210164.

B. Category 6A (GigaSPEED X10D), SYSTIMAX P/N 2091B GRN C6A 4/23 W1000, Material ID 760107219, WE TOTE box, or P/N 2091B GRN C6A 4/23 R1000 Material ID 760105890, REEL.

1. The Horizontal cable, homerun to/from each communication port shall be GREEN in color (jacket).

a. Note: Coordinate cable type for each project with HUIT Representative.

2.02 VOICE HORIZONTAL CABLE

A. The horizontal cable utilized for the distribution of communication, shall be 4 pair, 24 AWG, Plenum Category 6 (GigaSPEED), SYSTIMAX P/N 2071EYEL C6 4/23 W1000, Material ID 700210123.

B. Category 6A (GigaSPEED X10D), SYSTIMAX P/N 2091B YEL C6A 4/23 R1000, Material ID 760105957, Reel or P/N 2091B YEL C6A 4/23 W1000 Material ID 760107276, WETOTE box.

C. The horizontal cable, homerun to/from each communication port shall be YELLOW in color.

PART 3 - EXECUTION

3.01 DATA HORIZONTAL CABLE

A. Provide, install, terminate and test one (1) horizontal data cable from each data modular insert to its corresponding patch panel. Provide, install, terminate and test category 6 cable which shall be GREEN in color for data transmission.

B. All four pairs of each data horizontal cable shall be terminated at both ends.

1. One end of the data horizontal cable shall be terminated in an 8 position, 8 conductor T568-B wired modular insert at the communications outlet.

2. The other end of the data horizontal cable shall be terminated in an 8 position, 8 conductor T568-B wired modular insert in the patch panel, or SYSTIMAX Patch Panel, or 110 block.

3. Note: Coordinate exact panel or block with HUIT Representative.

C. All data horizontal cables shall be terminated in sequential order in accordance to the Owner specified labeling scheme as indicated in this specification and The HUIT Wire and Cable Standards.

D. All data modular inserts shall be colored Gray or Black. The Gray modular insert shall be placed in the first data position in each faceplate. If there is a second data position on the faceplate, a Black modular insert shall be used. The colors, Gray and Black shall then alternate when there are more data position to fill in each faceplate.

E. Provide and install wire and cable in approved/ provided raceways and cable tray as specified and as approved by the authorities that have jurisdiction.

F. Cable Pulling: Pulling Tension: Maximum-pulling tensions for 4-pair horizontal UTP cable shall not exceed 110N (25 lbf).

G. Maintain cable twist to within ½" of the main point of insulation displacement contact.

H. When stripping cable for termination, remove only a minimum amount (i.e., as little as possible) of cable jacket insulation.

I. Additional cable slack (service loop) may be considered at both ends for maintenance or future cabling system changes:

1. Telecommunication Room Loop = 10 feet (Looped in a figure 8)

2. Telecommunications Outlet = 1 foot

J. Splices are not permitted for any horizontal cabling.

K. No horizontal cable run shall exceed 90 Meters or 295 Feet (including slack).

L. Never use staples to install Telecommunications Cabling.

M. Station wiring SHALL NOT be installed near fluorescent lamps, high-voltage sources, electrical motors, or other source of interference.

1. To avoid electromagnetic interference, all distribution should provide clearance of at least:

a. Four (4) ft. from large motors and/or transformers.

b. One (1) ft. from conduit and cables used for electrical distribution.

c. Five (5) in. from fluorescent lighting.

d. Refer to ANSI/TIA 568-D, 569-D and ANSI/NFPA 70 for additional cable clearance.

2. Horizontal distribution pathways should cross perpendicular to fluorescent lighting and electrical power cables and conduits.

3.02 VOICE HORIZONTAL CABLE

A. Provide, install, terminate and test one (1) horizontal voice cable from each voice modular insert to its corresponding patch panel. All Voice horizontal cable shall be Category 6, YELLOW in color.

B. All four pairs of each horizontal voice cable shall be terminated at both ends.

1. One end of the horizontal cable shall be terminated in an 8-position,8-conductor T568B wired modular insert at the communications outlet. The modular outlet color shall always match the faceplate color.

2. The other end of the voice horizontal cable shall be terminated in an 8-position, 8-conductor T568-B wired modular insert in the patch panel, or SYSTIMAX Patch Panel.

3. Note: Coordinate exact panel or block with HUIT Representative.

C. All horizontal cables shall be terminated in sequential order in accordance with the Owner specified labeling scheme as indicated in this specification and The HUIT Wire and Cable Standards.

D. Provide wire and cable in approved/ provided raceways and cable tray as specified and as approved by the authorities that have jurisdiction.

E. Cable Pulling: Pulling Tension: Maximum pulling tensions for 4-pair horizontal UTP cable shall not exceed 110N (25lbf).

F. Maintain cable twist to within ½" of the main point of insulation displacement contact.

G. When stripping cable for termination, remove only a minimum amount (i.e., as little as possible) of cable jacket insulation.

H. Additional cable slack (service loop) may be considered at both ends for maintenance or future cabling system changes:

1. Telecommunication Rooms = 10 ft (Looped in figure 8)

2. Telecommunications Outlet = 1 ft

I. Splices are not permitted for any horizontal cabling.

J. No horizontal cable run shall exceed 90 Meters or 295 Feet (including slack).

K. Never use staples to install telecommunications cabling.

L. Horizontal cabling wiring SHALL NOT be installed near fluorescent lamps, high-voltage sources, electrical motors, or other source of interference.

1. To avoid electromagnetic interference, all distribution should provide clearance of at least:

a. Four (4) ft. from large motors and/or transformers.

b. One (1) ft. from conduit and cables used for electrical distribution.

c. Five (5) in. from fluorescent lighting.

2. Refer to ANSI/TIA/ 568-D, 569-D and ANSI/NFPA 70 for additional cable clearance

3. Horizontal distribution pathways should cross perpendicular to fluorescent lighting and electrical power cables and conduits.

3.03 WIRELESS ACCESS POINTS

A. Provide, install and test (2) Category 6A M-series data modular inserts, coiled inside 4" electrical back-box with single gang flat reducer ring. No faceplate shall be used for wireless access point outlets.

B. Install wireless access point bracket, provided by HUIT, over electrical back-box.

PART 4 - DIAGRAMS

END OF SECTION

SECTION 27 15 43 COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-D.0, D.1, D.2 Commercial Building Telecommunication Cabling Standard.

B. All telecommunication outlets shall be T568-B wiring configuration.

C. All UTP cabling shall meet or exceed all requirements in this specification, ANSI/TIA-568-D.0, D.1, D.2 Commercial Building Telecommunication Standard and ANSI/ICEA S-80-576 that are applicable to four-pair inside wiring cable for plenum spaces within a building.

D. All data horizontal cabling shall meet or exceed Category 6/6A Link performance outlined in the latest revision. Additional transmission performance specification for the 4 pair 100-ohm Category 6/6A cabling for shall be ANSI/TIA568-D.1.

E. All voice horizontal cabling shall meet or exceed Category 6/6A channel performance outlined in the latest revision. Additional transmission performance specification for 4 pair 100-ohm Category 6/6A cabling shall be ANSI/TIA568-D1.

F. Distribution Frame

1. Fiber optic termination hardware shall be SYSTIMAX. Please consult with HUIT for sizing.

G. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard.

H. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.

2. Electrical contract documents.

3. Mechanical equipment.

I. Coordinate all work with on-site installers including, but not limited to:

1. Harvard’s Installer

2. Local Exchange Carrier (LEC)

J. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

K. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

PART 2 - PRODUCTS

2.01 FIBER OPTIC TERMINATION HARDWARE

A. Fiber Optic Connectors – LC Connector Type

1. 62.5µm MM Fiber Optic connector (for legacy re-termination projects) – AFL Global field installable 62.5µm multi-mode FUSEConnect™ Fusion-Spliced connector. P/N FUSE-LC9M62-6.

2. Single Mode Fiber Optic connector (for all new projects projects) – AFL Global field installable Single-mode FUSEConnect™ Fusion-Spliced connector. P/N FUSE-LC9SMU-6.

3. 50µm MM Fiber Optic connector (for Data Center projects) – AFL Global field installable 50µm Laser Optimized multi-mode FUSEConnect™ Fusion-Spliced connector. P/N FUSE-LC9M50L-6.

B. Splice Cassettes with Pigtails for SYSTIMAX Standard Density Fiber Enclosures

1. OM3/OM4 50 Micron LazrSPEED® Splicing cassette, 24LC, 900µm MID 760221697 P/N PNL-CS-24LCX-PT or OM3/OM4 LazrSPEED® Splicing cassette, 12LC, 900µm, MID 760221739 P/N PNL-CS-12LCX-PT

2. Single-mode TeraSPEED® Splicing cassette, 24LC, 900µm MID 760221705, P/N PNL-CS-24LCW-PT or TeraSPEED® Splicing cassette, 12LC, 900µm, MID 760221747 P/N PNL-CS-12LCW-PT

2.02 FACE PLATES

A. Wall, Flush Mounted

1. Single gang 1-port faceplate shall be SYSTIMAX P/N M10L-262, Material ID 108258427.

2. Single gang 2-port faceplates shall be SYSTIMAX P/N M12L-262 Material ID 108168469.

3. Single gang 3-port faceplate shall be SYSTIMAX P/N M13L-262, Material ID 108168501.

4. Single gang 4-Port faceplates shall be SYSTIMAX P/N M14L-262, Material ID 108168543.

5. Single gang 6-port faceplate shall be SYSTIMAX P/N M16L-262, Material ID 108168584.

B. Wall Telephone Face Place

1. Single gang faceplates shall be Stainless SYSTIMAX P/N M10LWSP, Material ID 760117572.

2.03 VOICE MODULAR INSERTS

A. Use a single modular insert for voice communication ports, 8 position, 8 conductor, non-keyed, Category 6 (GigaSPEED), SYSTIMAX P/N MGS400-262, Material ID 700206725, Category 6A (GigaSPEED X10D), shall be SYSTIMAX MID 760092429 P/N MGS600-262.

B. All voice modular inserts shall be the same as the faceplate in color.

C. Blank inserts shall be SYSTIMAX P/N M20AP-262, Material ID 107067928, or shall match faceplate color.

2.04 DATA MODULAR INSERTS

A. Use a single modular insert for data communication ports, 8 position, 8 conductor, non-keyed, Category 6 (GigaSPEED), Gray, SYSTIMAX P/N MGS400-270, Material ID 700206733 or Category 6A (GigaSPEED X10D), Gray, SYSTIMAX P/N MGS600-270, Material ID 760092437 in the first position. In the second data position in the same faceplate alternate to Category 6, Black, SYSTIMAX P/N MGS400-003, Material ID 700206667 or Category 6A SYSTIMAX P/N MGS600-003, Material ID 760092361, and back to Gray for the third position, etc.

B. Blank inserts shall be SYSTIMAX P/N M20AP-262, Material ID 107067928, or shall match faceplate color.

PART 3 - EXECUTION

3.01 FACE PLATES

A. Provide and install all communication faceplates, label, and raceway inserts.

B. Coordinate Above Finished Floor (AFF) with Architect and Harvard HUIT.

3.02 DATA MODULAR INSERTS

A. Provide and install Category 6/Category 6A data modular inserts.

B. Provide and install all blank inserts.

3.03 FIBER OPTIC TERMINATION HARDWARE

A. Provide and install termination hardware to support all fiber optic cables installed.

B. Provide and install fiber optic coupler panels required to terminate all installed fiber optic backbone cable(s).

C. Provide, install and test quantity of fiber optic termination hardware to terminate all fiber optic strands of fiber optic backbone cable.

D. All fiber optic terminations shall be tested and labeled according to HUIT Wire and Cable standards.

E. Coordinate with Harvard's HUIT for exact location on wall field.

3.04 WALL TELEPHONE FACE PLATES

A. Provide and install all telephone faceplates.

1. Wall phone shall be mounted 54" AFF and 48" for ADA requirement locations. Verify final mounting heights with architect before installation.

3.05 VOICE MODULAR INSERTS

A. Provide and install all Category 6/Category 6A voice modular inserts.

PART 4 - DIAGRAMS

END OF SECTION

SECTION 27 16 19 COMMUNICATIONS PATCH CORDS, STATION CORDS AND CROSS CONNECT WIRES

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-D Commercial Building Telecommunications Standard.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.
2. Electrical contract documents.
3. Mechanical equipment.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer
2. Local Exchange Carrier (LEC)

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

1.02 FIBER OPTIC LINE/PATCH CABLES

A. All fiber optic patch cables shall be factory terminated and 100% tested. To be provided by Harvard.

B. To gain optimum performance from the fiber optic infrastructure, use factory manufactured patch cords.

PART 2 - PRODUCTS

2.01 UTP LINE/PATCH CABLES

A. Category 6 Solution or Category 6A Reduced Diameter Solution.

1. To gain the optimum performance from the Category 6 Solution, use 8 pin modular patch cords, CommScope P/N MiNo6-XX.
2. Category 6A Solution, use 8 pin modular patch cords, CommScope P/N MiNo6A-XX.

3. Category 6 GigaSPEED Solution, for extending voice cross-connect from patch panel to 110-block, use GS8E Single End Solid Cable modular patch cord, SYSTIMAX P/N CPC3482-03, GS8E117-S-DG- XXFT (where XX = length in feet, color dark gray)

B. Length & color to be determined by Harvard HUIT

PART 3 - EXECUTION

3.01 UTP LINE/PATCH CABLES

A. Harvard to provide all patch cords. It is required that CommScope manufactured patch cords be used.

3.02 FIBER OPTIC LINE/PATCH CABLES

A. Harvard to provide fiber optic patch cords.

PART 4 - DIAGRAMS

END OF SECTION

SECTION 27 21 33 DATA COMMUNICATIONS WIRED AND WIRELESS DATA NETWORK CONNECTIVITY

(These sections are not to be implemented without direct HUIT project participation)

PART 1 - GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-B Commercial Building Telecommunications Standard.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.
2. Electrical contract documents.
3. Mechanical equipment.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

1.02 THE DATA NETWORK

A. Harvard University Information Technology (HUIT) is the provider of data network connectivity on the Harvard Campus. At the time of this document's creation the network consists of over 300 buildings made up of undergraduate and graduate dormitories, faculty research centers, libraries, museums, athletic facilities, staff and administrative offices. Most connected buildings are on the Cambridge/Boston campus but wide area connections link Harvard buildings within and outside of Massachusetts. The scope of this network requires specific standards be met to effectively expand a supportable solution. This document will provide specifics regarding the efficient involvement and participation of HUIT Networking in construction or renovation projects, and the application of its standards relating to the growth of supportable data networking at Harvard.

1.03 DEFINITIONS

For the purposes of this document the definition of a project will be the addition of 10 or more data cables, or demolition and construction in a building that impacts the existing data infrastructure.

A. MDF (Main Distribution Frame) - Tel/Data closet that houses the building Tel/Data links to the external network in a typical configuration, also a termination point for the building jack wiring. There is usually one per building.

B. IDF (Intermediate Distribution Frame) - Tel/Data closet that houses termination point for the building jack wiring and is connected back to the MDF via fiber. There may be none or several IDF depending on the size of the building.

C. FDF (Fiber Distribution Frame) – A data closet where copper horizontal cabling may be terminated, but is an inter-building aggregation point for data networking fiber.

1.04 HUIT NETWORKING INVOLVEMENT

A. Initial Contact

1. In the renovation or construction of any space where a viable network service is expected to be commissioned by HUIT Networking prior to occupancy, it is critical the project contacts HUIT networking early in its planning to coordinate with it throughout the project for a successful data network delivery. Please send email to wcable@harvard.edu to inform us of your project needs.

2. If a project has no apparent networking needs of its own, it is still prudent to inform HUIT Networking of its demolition/construction scope as it may impact existing networking service. This will avert unscheduled network service interruptions top the surrounding client community.

1.05 PROJECT UPDATES

A. Any changes that occur during the project affecting the wiring infrastructure or the Distribution Frames need be communicated to the network group promptly via the email alias wcable@harvard.edu or to the identified networking point of contact.

1.06 EQUIPMENT AND SERVICES

A. The HUIT network group will:

1. Coordinate with the project for the successful delivery of the data network

2. Provide estimates for networking gear required to connect all project data jacks based on per DF totals of installed data cables.

3. Provide estimates for networking gear required to connect deliver wireless connectivity to project identified areas. (In special cases HUIT will identify and coordinate the involvement of an outside survey vendor to meet the project needs)

4. Procure all copper patch cords to connect the DF data terminations to the network equipment and perform all patching.

5. Procure all fiber patch cords to connect the network equipment to the fiber infrastructure and perform all patching.

6. Design, install, configure, test, troubleshoot, and commission the wired and wireless networks for the project, and maintain them throughout their existence.

1.07 OCCUPANCY COORDINATION PLANNING

A. The installation of network gear in DFs and connecting it to the cabling infrastructure does not make the building's data network ready for the occupants. Clients, students, researchers, staff, administrators, building systems, etc., all have differing needs and network configurations that meet them.

B. A crucial prerequisite to a successful occupancy is the identification of the individual clients/systems moving and their existing system configuration needs far in advance of network equipment deployment to allow that equipment to be configured correctly for them. The location occupants are moving from can have a considerable impact on how the network configuration will serve them in the new location requiring changes, sometimes complex, to the existing network that is not physically affected by the project. Network connections cannot be delivered to systems that are new to the Harvard network and not registered on it. HUIT Field Support plays a prominent role in this preparation.

C. Early identification of the move planning/coordination authorities working with the occupants and HUIT Field Support will provide the time required to compile the information required for network configuration and deliver it to networking enough in advance to be assessed, challenges identified, solution timelines developed, and implementation executed in advance of a move date. Other components to be considered in occupancy coordination are;

1. Early device connectivity requirements (Usually but not confined to building systems)

2. Unique systems connectivity

3. Special connectivity test circumstances

4. Special devices with network interface card data or cut sheets

5. Multiple or special networks

6. Registration of new systems

7. Occupancy approach (en masse, staggered, delayed, other)

8. Identified downtime limitations

D. Identification of accurate configuration information well in advance of a move will avoid connectivity delays upon occupant arrival in the new space.

1.08 DF CONSTRUCTION

A. The amount of network gear serving a closet is determined by the amount of data cables terminated within that closet. The Harvard data network has DFs with over 1300 data cables terminated within them and as few as (incomplete thought here)

1. There is no reliable rule of thumb for estimation of a DFs network infrastructure needs, each closet is a custom design.

1.09 QUANTITY OF DFS

A. The quantity of DFs are determined by the Harvard 295 foot (90 m) maximum standard distance between an Unshielded Twisted Pair (UTP) cable termination in the DF, and the same cable's opposing end termination within the project building space. The Harvard standard is based on the IEEE 802.3 technical standards regarding the maximum length of a 1000baseT Ethernet connection. The 1000baseT standard specifies a maximum overall length of 328 feet (100 m) between the network device and the end device's Network Interface Card. To accommodate for the length of patch cords in the closet and connection cables between the computer and the wall jack, HUIT has limited the DF to room wiring cable to 295 feet (90 m). DFs should be placed appropriately throughout the building to maintain Unshielded Twisted Pair length below the 295 foot (90 m) standard without creating superfluous DFs. Limiting the amount of DFs eliminates the deployment of extraneous networking hardware that is costly in both initial procurement and annual maintenance contracts.

1.10 DF UTP DATA CABLE COUNT

A. To allow HUIT networking to plan for the network and deliver accurate cost estimates, a project need identify its unshielded twisted pair (UTP) data jack needs completely. Not only the occupants of building space are key, but the potential Harvard service provider components within the project affect wiring needs. Some examples of Harvard service organizations and general services needing network data jacks are, Dining Services, Siemens Systems (building security), University Operating Systems (building systems), Media Services (Audio Visual), IPTV, VOIP, point of sale terminals, etc.. More unique scientific research or pedagogic connectivity requirements should be identified and brought to HUIT networking's attention as early as possible. Datasheets, or cut sheets, on non-personal computer based devices requiring connection the Harvard data network need be supplied as early as possible for planning purposes.

B. The total amount of data jacks destined for each DF should be provided as soon as an accurate forecast can be made. This information is intrinsic to the specification of network equipment needed to provide service for the location. Network connections will be made by HUIT Networking to every installed data jack.

C. HUIT Networking standards require all installed data jacks to be provided ports and connected.

1.11 DF SIZE

A. The size of a DF will vary depending on the total number of voice and data cable terminations, networking equipment, and supporting equipment that must be housed within it. The only effective means to identify DF size is though reasonably accurate estimation of voice and data cable counts, and identification of all supporting and non-supporting equipment within the DF. All wired network planning for equipment, power, HVAC, space, racks, etc. is based on the total data cable quantity assigned to a DF. Installation within DF's of equipment other than Telephony or Data must be brought to the attention of HUIT Network as early as possible to assess the effects on closet layout.

B. Randomly assigning space to a DF will result in space shortages or wasted space, and unnecessary network equipment costs over the life of the building. Considering these core accommodations for a vital modern technology service that can be addressed on the fly beyond the early planning stages will ensure addition cost to the project to correct deficiencies or degrade the operational environment of the networking equipment.

1.12 DF LAYOUT

A. DF plan view and elevation drawings need be created to reflect the closet space assignments as early as possible and provided to the HUIT network group and affected participants. The network group should be informed of any issues or changes affecting the DF and its environs that may arise during the construction process.

B. Installation in DF's of equipment other than Telephony or Data must be brought to the attention of HUIT networking as early as possible to assess any effects on closet layout.

1.13 DF POWER REQUIREMENTS

A. There are multiple network equipment options for providing building connectivity. The network equipment best suited is determined by identification of DF data cable quantities, which identifies the type of power and quantity required to operate it. Separate power will be required for telephony.

B. All network circuits must be dedicated and optimally sourced from separate electrical panels to allow electrical work on one panel without eliminating network service from the closet.

C. Connecting the networking equipment power outlets to a building emergency power system is advantageous since many important building systems increasingly depend upon the data network. If a building based emergency generator and uninterruptable

power supply (UPS) is available or planned its application in support of the data network should be incorporated.

D. The importance of providing emergency power to a DF will coincide with its importance to other parts of the building, or to other Harvard building's network infrastructure.

1.14 DF ENVIRONMENTAL NEEDS

A. The operating temperature range for the network devices is generally 32 - 104 degrees Fahrenheit. Operation of the network equipment above 80F degrees is deleterious to the longevity of the equipment and a DF that maintains a temperature no greater than 75F degrees is optimal. Some DF's will be nonstandard in their equipment deployment and will require more cooling. These are usually, but not limited to, FDF's. Consult with the identified HUIT networking point of contact to determine the heat output of network equipment for a specific DF after the data cable quantities for it have been determined or adjusted. Heat dissipation for network equipment will be provided based on data cables count totals per closet. Non network equipment device heat dissipation within a DF must be determined by the project and factored into the overall cooling requirements.

1.15 WIRE AND CABLE STANDARDS

A. Because the Harvard network provides a wide variety of communications services, it is important that the underlying infrastructure be sound. Specific wire and cable standards have been developed by Harvard University Information Technology. These standards were developed and adopted by the University as part of its long-range plan to provide the Harvard community with consistent campus wiring to access new technology efficiently and cost-effectively.

B. The Wire and Cable standards are identified in detail in separate documents titled:

1. Inside Wiring
2. Outside Wiring
3. Manhole & Conduit Systems
4. HUIT Standard Jack Labeling
5. Authorized SYSTIMAX PartnerPRO Vendors
6. Authorized Corning NPI Vendors

1.16 WIRELESS NETWORK CONNECTIVITY PLANNING

A. Wireless data network connectivity is considered a standard service in Harvard buildings and is included in all construction/renovation projects unless the frequencies it employs conflict with activities within the space.

B. The optimal means for designing a wireless solution for any space is to physically survey the actual signal propagation within that space. In cases of new construction or gut rehabs this is not possible.

C. Planning wireless access point locations without conducting an actual signal propagation survey in an existing environment is unorthodox. Building composition or occupants' equipment may present unique problems that are difficult to identify. To avoid the installation of data cables after a space is completed HUIT Networking will design a wireless solution in advance of construction to allow the data cable installation while walls and pathways are open. This survey without a physical measurement of actual signal propagation is referred to as a pseudo survey.

D. The pseudo survey is based on a detailed review of the most stable (no changes to walls, ceilings, or infrastructure) iteration of construction drawings. The more stable the drawing set used in the pseudo survey, the more effective the wireless design solution will be. Wireless Access Points (WAPs) operate in a collective format to deliver a viable service throughout a space. The wireless design documentation from a HUIT networking pseudo survey will identify the precise strategic locations of single data jacks, each serving a WAP, throughout a space facilitating robust 2.4 GHz and 5 GHz wireless data service.

E. A full hardcopy set, of all disciplines in half size, and a softcopy set of the telecom and architecture drawings in AutoCAD 2004 format, of the stable construction drawings iteration is required by networking to conduct research, design, and document a wireless solution. In instances of HUIT coordinated outside vendor wireless survey these requirements are subject to change.

F. A pseudo survey meeting with the representatives who thoroughly understand the occupants' wireless needs and expectations starts the design process. The meeting will precisely identify and document service coverage areas, the service expectations within them, and any specific or unique applications depending upon the wireless service. This information is the foundation of the pseudo survey design.

G. The size of the building space requiring wireless service is the most important factor in the time required to conduct a pseudo survey and deliver documentation on it. Small projects may take two weeks, while larger projects may take a few months or more depending upon the location restrictions identified by the project. It is critically important the wireless design documentation delivered by HUIT networking be precisely implemented. What may seem minor changes to WAP locations could alter the design enough to negatively impact the service. Any changes to a HUIT networking pseudo survey must be approved by HUIT networking prior to implementation.

H. It is critically important the wireless design documentation be implemented precisely. Even minor changes to WAP locations can alter the design enough to negatively impact the service. Any changes to a HUIT networking pseudo survey must be approved by HUIT networking prior to implementation.

I. If enough WAP locations identified in a pseudo survey are rejected by the project, the pseudo survey may have to start over from the beginning due to the collective operation of the WAPs in their service delivery. HUIT networking looks to the project for cooperation in the problematic exercise of designing a wireless solution in the absence of a physical signal survey to avoid time consuming redesign delays.

J. Power for indoor WAP devices is provided by the network switch over the data jack connecting the WAP. Outdoor WAP device power requirements may differ.

K. Wireless connectivity will not be ready at the same time the wired network comes on-line as it depends upon the successful wired network installation. The wireless service installation will follow on the heels of the wired network and the time required to bring it online will vary with the amount of WAP devices deployed.

1.17 NON HUIT AND LEGACY NETWORKS IN BUILDINGS

A. In some instances a non HUIT network may be within a building that HUIT Networking is expected to deploy equipment in. In mixed occupancy space construction projects, please provide the identified HUIT networking point of contact with information to reach the existing networks' management entity early in the project planning as conflicts may require special coordination to identify and resolve in a timely manner.

B. There exist legacy data networks within the existing Harvard network that are redundant in their utilization of the fiber infrastructure. Efforts to maximize fiber infrastructure resources may require the connectivity for systems served by legacy networks be delivered over standard HUIT Networking infrastructure. Contact HUIT Networking via the email address wcable@harvard.edu or the identified networking point of contact to identify instances where this applies early in project planning so issues may be addressed in a timely manner and unnecessary or unannounced service interruptions avoided.

PART 2 - PRODUCTS

2.01 DATA NETWORK EQUIPMENT

A. All active data networking components will be specified and procured by HUIT.

B. All passive data networking components subject to be identified or reviewed and approved by HUIT.

PART 3 - EXECUTION

3.01 NETWORK EQUIPMENT INSTALLATION TIMELINE

A. HUIT networking is dependent upon the timely execution of a serial infrastructure installation process before being able to deploy the networking equipment:

1. Cabling pathways/conduits completed

2. Data cabling, copper and fiber, rough wiring completed via the established paths/conduits
3. Data cabling, copper and fiber, termination and testing completed between the DFs and rooms
4. Total completion of MDF; Power, Lighting, HVAC, Racks, Cable Trays, Floor, Ceiling, Walls, etc
5. Total completion of IDF/s; Power, Lighting, HVAC, Racks, Cable Trays, Floor, Ceiling, Walls, etc
6. DFs cleared of any contractor storage, and no longer used for storage.
7. DF access is secured via the NSA key system at a minimum.
8. Delivery of data cable information to the networking group for assimilation into the database

3.02 DF COMPLETION ORDER

A. All IDF locations are dependent upon the MDF. The MDF must complete in advance or in conjunction with IDFs so the IDF network equipment can be deployed and brought online.

3.03 CONCLUSION OF INFRASTRUCTURE WORK IN DFS

A. Networking equipment is costly and sensitive to its environment. It is prudent to deploy the network equipment after the majority of work in a DF has completed to avoid damage.

3.04 NETWORK EQUIPMENT DEPLOYMENT

A. Bringing network equipment fully on-line extends past the equipment's presence within a DF or on a wall. There is a supporting infrastructure for both wired and wireless networks that documents all the connections and configurations to enable effective troubleshooting. The network is not on-line and fully supported status until identified so by HUIT networking.

B. The receipt of data cable information triggers the start of the physical network deployment with its assimilation into the database and patch sheets being produced. The time required by networking to install, power up, configure, test, troubleshoot, and commission the network equipment will vary with the quantity of data cables and DFs and the complexity of the network configuration.

C. Wireless connectivity cannot be ready at the same time the wired network comes on-line as it depends upon the successful completion of the wired network installation. The wireless service installation will follow on the heels of the wired network and the time required to bring it on line will vary with the amount of WAP devices deployed.

D. Early connectivity requirements enabling building systems/occupancy certification should be brought to the attention of HUIT networking well in advance of their need so the installation timeline can be assessed and adjusted to minimize risk to the networking equipment and supply the connectivity.

E. Bringing a building or space to completion in phases requires special consideration and planning. This approach to completion should be identified as early as possible to define and address the challenges it may present.

F. Accurate advance dates, and timely updates, regarding any phased approach are intrinsic to a successful equipment deployment/occupancy implementation.

G. The key to a smooth network installation is keeping the network group informed, the quick and accurate delivery of the "as built" jack information, and the timely completion of all wiring contractor work.

H. No project personnel are permitted to tamper with or connect to, the network equipment and its cables. Any project issues regarding the network equipment must be brought to HUIT networking attention immediately via the project contact and they will be promptly addressed.

3.05 OCCUPANCY COORDINATION

A. The information previously identified under the first **Occupancy Coordination** title is used to configure the network gear and plays a critical role in delivering a smooth move in connectivity experience for the occupants.

3.06 POST NETWORK EQUIPMENT DEPLOYMENT

A. Power interruptions affecting the any DF network equipment must be planned with notification provided HUIT networking at least 48 hours in advance of the interruption prior to project space occupancy, and 72 hours in advance of power interruption after any part of the project space is occupied. Power interruptions that affect non project buildings require 72 hours notices and may require temporary generator power throughout the interruption to prevent a major campus network service outage.

B. No project personnel are permitted to tamper with or connect to, the network equipment and its cables. Any project issues regarding the network equipment must be brought to HUIT networking attention immediately via the project contact and they will be promptly addressed.

PART 4 - DIAGRAMS

END OF SECTION

SECTION 27 24 00 DATA COMMUNICATIONS PERIPHERAL DATA EQUIPMENT

PART 1 - HUIT SUPPORTED HOUSE LAB COMPUTERS AND PRINTERS

1.01 HARDWARE

A. HUIT Support Services will need the requirements for hardware; including any unique size or aesthetic design requirements.

B. Once hardware is selected and project billing code is provided, Support Services will:

1. Order, configure, install and test all computers and printers in the new House location.

2. Installation coordination with a project representative is needed to ensure equipment is installed as desired.

3. Allow up to 4 weeks for ordering, configuration and installation.

1.02 COMPUTERS

A. Computers will be imaged with HUIT standard lab image.

1. LabStats software is included in the standard image to monitor usage of computers and software applications.

2. Additional software can be requested.

1.03 BUDGET CONSIDERATIONS

A. The House Renewal Project will pay for any new equipment.

B. HUIT will pay for maintenance and replacement costs of equipment; computers are refreshed every 3 years, printers are refreshed 4-5 years.

C. Adding additional equipment may increase the cost of support to the FAS

1. HUIT lab support is directly funded by the FAS. An increase in the number of devices supported by HUIT may require HUIT to increase support resources.

1.04 ONGOING SUPPORT

A. HUIT Support Services will visit labs weekly to make sure all equipment is in good working order.

1. Any lab support issues should be directed to the HUIT Support Center, 617.495.9000, ithelp@harvard.edu

SECTION 27 25 00 DATA COMMUNICATIONS SOFTWARE

PART 1 - PRINTING

A. Crimson Print is the standard software for student pay-for-printing. https://huit.harvard.edu/crimson-print

B. Wireless printing is not permitted per HUIT Security regulations.

SECTION 27 32 23 ELEVATOR TELEPHONES

PART 1 - ELEVATOR TELEPHONES

A. Elevator phones are maintained by UOS, the elevator phone lines are maintained by HUIT.

1. Communication Connection

a. The contractor shall be responsible for the installation of the traveling cable from the elevator panel to the Cat Operating Panel (COP). A minimum of four 18-gauge wires will be provided in the traveling cable for the purpose of communication services transport. The communication wires per car will extend from the elevator panel to the nearest jack located within the elevator room

b. The contractor shall provide a ¾ inch conduit extending from the topof the elevator panel and extending to the nearest jack located within the elevator room.

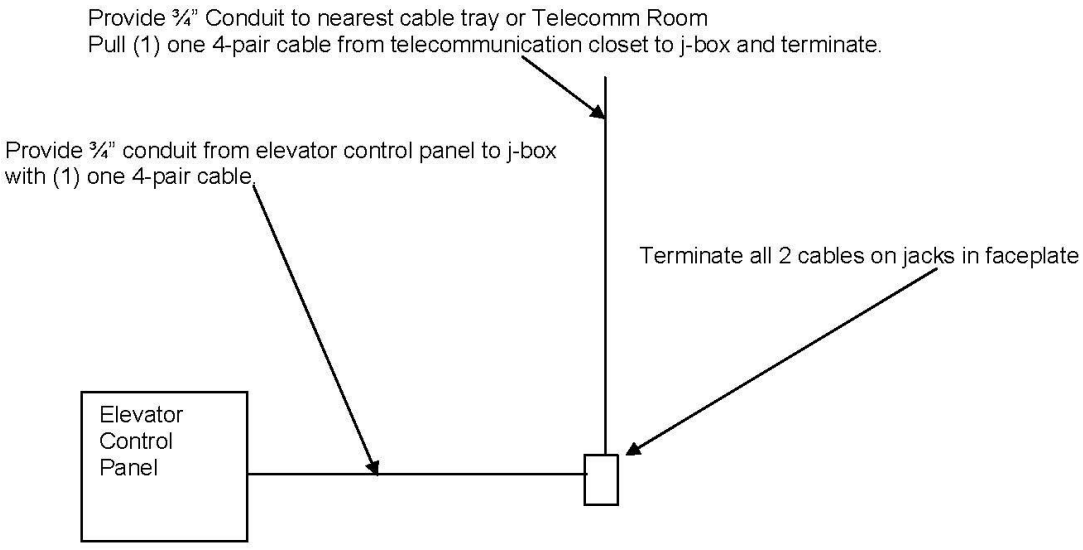
c. The telephone line that is used in the elevator is a standard Centrexline that automatically rings down to UOS's University Operations Center. It is the responsibility of the Project Manager to order the line for the elevator and to notify UOS that a new phone is being added to their system.

PART 2 - PRODUCTS

PART 3 - EXECUTION

PART 4 - DIAGRAMS

A. PROVISION FOR ELEVATOR PHONE INSTALLATION



Provide 6" jumper cable for extending service between jacks for elevator.

SECTION 27 32 26 RING-DOWN EMERGENCY TELEPHONES

PART 1 - GENERAL

1.01 GENERAL

A. All indoor and outdoor Emergency Phones should be shown on the T-drawings.

B. All Emergency Phone equipment for outdoor and indoor installations will be procured by HUIT

C. Harvard standard calls for Talk-A-Phone brand emergency phones as they integrate with the Talk-A-Lert polling software

D. HUIT will program and test all Emergency Phones as part of installation

E. HUIT will order and coordinate installation of all necessary phone lines

F. The Project will provide all Category 6 cables/RJ45 jacks to the phone locations

G. HUIT will crosswire the line from the Verizon demarc to the jack

H. In some cases, additional data cabling will be required if there is a camera or WAP device planned for a tower application

I. Harvard University Blue Light/Emergency Phone guidelines can be found in Div 280000 specifications.

J. All devices shall comply with ANSI/TIA 568-B Commercial Building Telecommunications Standard.

K. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.
2. Electrical contract documents.
3. Mechanical equipment.

L. Coordinate all work with on-site installers including, but not limited to:

1. Harvard’s Installer
2. Local Exchange Carrier (LEC)

M. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

N. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

PART 2 - PRODUCTS

A. Indoor Emergency Phones

1. Project will provide flush mount opening at each emergency phone location with dimensions specified by installation information for flush mount sleeve (Talk-A-Phone MS-400) and in keeping with ADA Compliance

2. Project will install MS-400 Flush Mounting Sleeves in opening at each emergency phone location.

3. HUIT will install ETP-100EBV Emergency phone into the Flush Mounting Sleeve

A. Outdoor Blue Light/Emergency Phones

1. Project to provide (2) 1 1/4 inch conduits to the Emergency Phone location one for low voltage (Category 6) wiring and one for high voltage wiring for the light

2. Project to provide 120V power to Emergency Phone location

3. For all Blue Light installations, a quick release clip is used as part of the installation (see cutsheet)so that light replacements can be made by non-electricians

4. For tower installations, Project to provide cement pad to manufacturers installation specifications. Bolt kits will be procured by HUIT and delivered to project prior to cement pad installation.

5. For tower installations, HUIT will install tower, phone, and LED Blue Light

6. For outside locations on buildings, the Project will provide a path from the phone unit to the blue light for a running wire. The housing will be provided to the project if conduit is to be used on outside of building so that installation can take place simultaneously

7. For outside locations on buildings, HUIT will install housing, phone, light and connections to light.

PART 3 - EXECUTION

PART 4 - DIAGRAMS

END OF SECTION

SECTION 27 50 00 DISTRIBUTED COMMUNICATIONS AND MONITORING SYSTEMS

PART 1 - PART 1. GENERAL

1.01 GENERAL

A. All devices shall comply with ANSI/TIA 568-B Commercial Building Telecommunications Standard.

B. Coordinate all work with Contract Documents including, but not limited to:

1. Architectural floor plans and electrical layouts.
2. Electrical contract documents.
3. Mechanical equipment.

C. Coordinate all work with on-site installers including, but not limited to:

1. Harvard's Installer
2. Local Exchange Carrier (LEC)

D. Refer to Telecommunications Contract Documents (drawings and specifications) for additional information.

E. Perform work so that progress of entire project including work of other sections is not interfered with nor delayed. Obtain detailed installation information from all manufacturers of equipment provided under this section.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION

APPENDIX A - HUIT SPECIFIED PRODUCT LIST

Harvard University IT - Specified Products List			
Copper Products			
Material ID	**Part Number**	**Description**	**Spec Location**
Cable			
700210164	2071E SGR C6 4/23 W1000	GigaSPEED XL® 2071E ETL Verified Category 6 U/UTP Cable, plenum, spring green jacket, 4 pair count, 1000 ft (305 m) length, WE TOTE® box	Category 6 Horizontal Data Cable
760107219	2091B GRN C6A 4/23 W1000	GigaSPEED X10D® 2091B ETL Verified Category 6A U/UTP Cable, green jacket, 4 pair count, 1000 ft (305 m) length, WE TOTE® box	Category 6A Horizontal Data Cable
700210123	2071E YEL 4/23 W1000	GigaSPEED XL® 2071E ETL Verified Category 6 U/UTP Cable, plenum, yellow jacket, 4 pair count, 1000 ft (305 m) length, WE TOTE® box	Category 6 Horizontal Voice Cable
760107276	2091B YEL C6A 4/23 W1000	GigaSPEED X10D® 2091B ETL Verified Category 6A U/UTP Cable, yellow jacket, 4 pair count, 1000 ft (305 m) length, WE TOTE® box	Category 6A Horizontal Voice Cable
107766057	2010B WH 100/24 R1000	2010B Category 3 U/UTP Cable, plenum, white jacket, 100 pair count, 1000 ft (305 m) length, reel	Copper Building Backbone Cable
9-57315-1	1010A SLT C3 100/24 R1000	1010ACategory 3 U/UTP Cable, riser, gray jacket, 100 pair count, 1000 ft (305 m) length, reel	Copper Building Backbone Cable
Copper Patch Panels			
760152561	360-IPR-1100-E-GS3-1U-24	SYSTIMAX 360™ GigaSPEED XL® 1100GS3 Evolve Category 6 U/UTP Patch Panel, 24 port	Data/Voice Patch Panels
760152579	360-IPR-1100-E-GS3-2U-48	SYSTIMAX 360™ GigaSPEED XL® 1100GS3 Evolve Category 6 U/UTP Patch Panel, 48 port	Data/Voice Patch Panels
760152587	360-IPR-1100-E-GS6-1U-24	SYSTIMAX 360™ GigaSPEED X10D® 1100GS6 Evolve Category 6A U/UTP Patch Panel, 24 port	Data/Voice Patch Panels
760152595	360-IPR-1100-E-GS6-2U-48	SYSTIMAX 360™ GigaSPEED X10D® 1100GS6 Evolve Category 6A U/UTP Patch Panel, 48 port	Data/Voice Patch Panels
760102244	360-PM-GS3-2U	SYSTIMAX 360™ GigaSPEED XL® PATCHMAX® GS3 Category 6 U/UTP Patch Panel, 24 port	Wall Mount Data/Voice Patch Panel
760102251	360-PM-GS6-2U-24	SYSTIMAX 360™ GigaSPEED X10D® PATCHMAX® GS6 Category 6A U/UTP Patch Panel, 24 port	Wall Mount Data/Voice Patch Panel

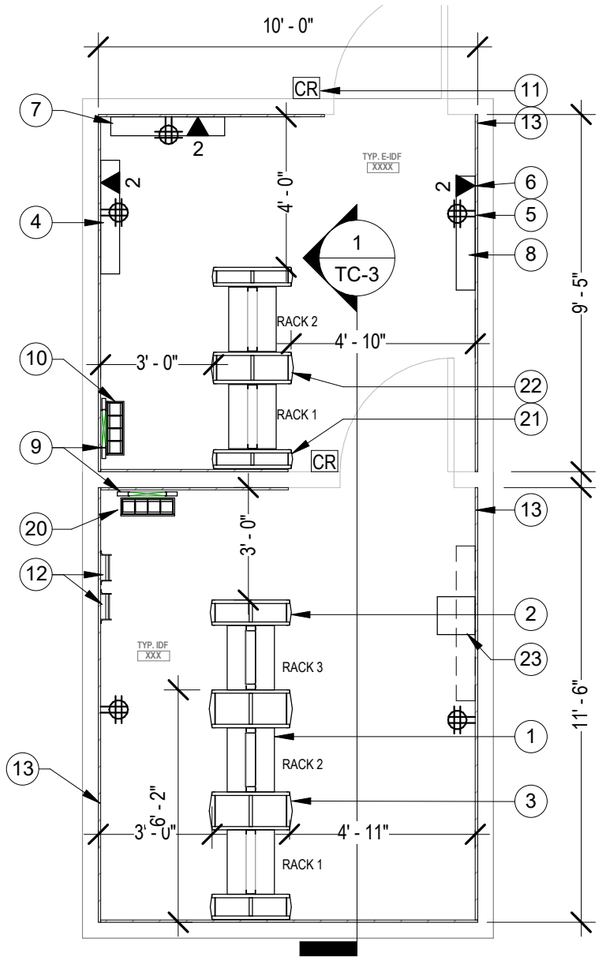
760117366	360-PM-GS3-2U-48P	SYSTIMAX 360™ GigaSPEED XL® PATCHMAX® GS3 Category 6 U/UTP Patch Panel, 48 port	Wall Mount Data/Voice Patch Panel
760128207	360-PM-GS6-2U-48	SYSTIMAX 360™ GigaSPEED X10D® PATCHMAX® GS6 Category 6A U/UTP Patch Panel, 48 port	Wall Mount Data/Voice Patch Panel
Modular Inserts/Jacks			
700206725	MGS400-262	GigaSPEED XL® MGS400 Series Category 6 U/UTP Information Outlet, white	Category 6 Voice Modular Insert
760092429	MGS600-262	GigaSPEED X10D® MGS600 Series Category 6A Information Outlet, white	Category 6A Voice Modular Insert
700206733	MGS400-270	GigaSPEED XL® MGS400 Series Category 6 U/UTP Information Outlet, gray	Category 6 Data Modular Insert
760092437	MGS600-270	GigaSPEED X10D® MGS600 Series Information Outlet, gray	Category 6A Data Modular Insert
700206667	MGS400-003	GigaSPEED XL® MGS400 Series Category 6 U/UTP Information Outlet, black	Category 6 Data Modular Insert
760092361	MGS600-003	GigaSPEED X10D® MGS600 Series Information Outlet, black	Category 6A Data Modular Insert
Patch Cords			
CO166R2-XX	MiNo6-XX	CommScope Category 6 MiNo6 Series 28AWG Solid Cordage Modular Patch Cord	UTP Line/Patch Cables
CO199K2-XX	MiNo6A-XX	CommScope Category 6A MiNo6A Series 28AWG Solid Cordage Modular Patch Cord	UTP Line/Patch Cables
CPC3482-XX	GS8E117-S-XX	GigaSPEED XL® GS8E Single End Solid Cable Modular Patch Cord	UTP Line/Patch Cables (110 wall-field to PP)
Faceplates			
106622251	M106FR2-262	M106 Flush Mounted Modular Mounting Frame, two port white	Floor Boxes
106622285	M106FR4-262	M106 Flush Mounted Modular Mounting Frame, four port white	Floor Boxes
108258427	M10L-262	L Type Flush Mounted Faceplate, one port white	Faceplates
108168469	M12L-262	L Type Flush Mounted Faceplate, two port white	Faceplates
108168501	M13L-262	L Type Flush Mounted Faceplate, three port white	Faceplates
108168543	M14L-262	L Type Flush Mounted Faceplate, four port white	Faceplates
108168584	M16L-262	L Type Flush Mounted Faceplate, six port white	Faceplates
760117572	M10LWSP	Wall Mount Telephone, one port Stainless	Faceplates
107067928	M20AP-262	M20 Dust Cover for M-Series Faceplates and Outlets, white	Faceplates

Wall Mount			
558843-1		110Connect XC System Cross-Connect Wiring Block with Legs, Category 5e, 110 punch down, 300-pair	Voice Horizontal/Backbone Terminations for Voice Ext Blocks
558842-1		110Connect XC System Cross-Connect Wiring Block with Legs, Category 5e, 110 punch down, 100-pair	Voice Horizontal/Backbone Terminations for Voice Ext Blocks
558401-1		110Connect XC System Connector Block, 4-pair, PCB, 110 punchdown, white	Voice Horiz/Backbone Terminations for Voice Ext Blocks
1375354-1		110Connect XC System LABEL, PAPER, 0.5 in high x 7.9 in width, white matte	Voice Horiz/Backbone Terminations for Voice Ext Blocks
558417-1		110Connect XC System Designation Strip	Voice Horiz/Backbone Terminations for Voice Ext Blocks
Telecom Rooms			
760082479	RK3-45A	Equipment Rack, 2-Post, 3 in (76 mm) Channel x 7ft (2134 mm) H - 19 in (482.6 mm) Alu (45U) 12-24 Tapped Rails, Black	Telecommunication Enclosures/Racks
760082560	RK4P45-36A	Equipment Rack, 4-Post, 36 in (914 mm) D x 7 ft (2134 mm) H - 19 in (482.6 mm) Alu (45U) 12-24 Tapped Rails, Black	Telecommunication Enclosures/Racks
760244782	VCM-DS-84-12B	Vertical Cable Management Kit, 12in X 84in (305mm X 2134mm) Double Sided, With Doors, Black	Telecommunication Enclosures/Racks
760244781	VCM-DS-84-10B	Vertical Cable Management Kit, 10in X 84in (254mm X 2134mm) Double Sided, With Doors, Black	Telecommunication Enclosures/Racks
760244780	VCM-DS-84-8B	Vertical Cable Management Kit, 8in X 84in (203mm X 2134mm) Double Sided, With Doors, Black	Telecommunication Enclosures/Racks
760244779	VCM-DS-84-6B	Vertical Cable Management Kit, 6in X 84in (152mm X 2134mm) Double Sided, With Doors, Black	Telecommunication Enclosures/Racks
	EZDP44S2	STI Fire-stop Sleeves, Series 44+, 4” Single Pathway for through wall installations	CSI Division 07
	EZDP144FKS2	STI Fire-stop Sleeves, Series 44+, 4” Single Pathway for through floor installations	CSI Division 07
	11275-712	Chatsworth 12” UL Classified Cable Runway	Communications cable management and ladder rack
	11275-718	Chatsworth 18” UL Classified Cable Runway	Communications cable management and ladder rack
	11275-724	Chatsworth 24” UL Classified Cable Runway	Communications cable management and ladder rack
	12100-718	Chatsworth 17” Cable Runway Radius Drop for Cross-members	Communications cable management and ladder rack

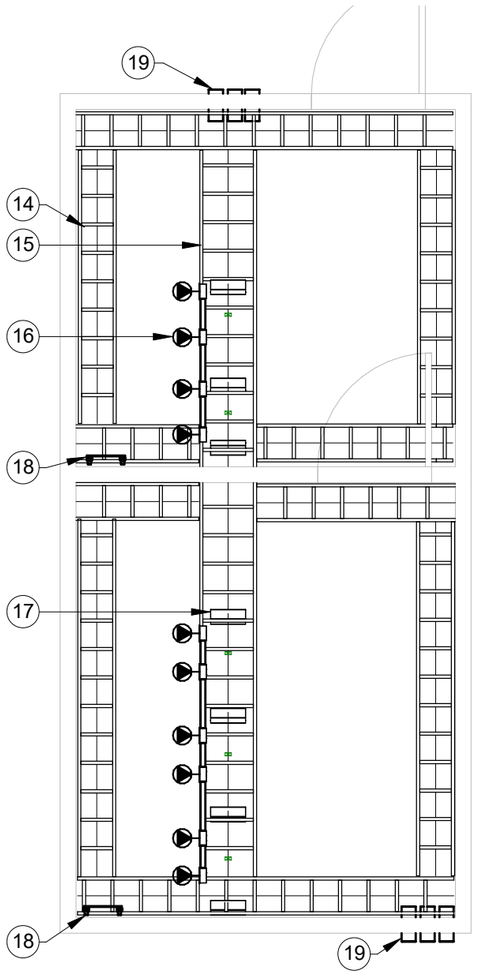
	12100-712	Chatsworth 11" Cable Runway Radius Drop for Cross-members	Communications cable management and ladder rack
	16301-701	Chatsworth Butt-Splice Kit for 1 1/2" side stringers	Communications cable management and ladder rack
	12730-718	Chatsworth 3" Channel Rack-to-Runway Mounted plate	Communications cable management and ladder rack
Fiber Products			
Material ID	**Part Number**	**Description**	**Spec Location**
Cables			
700009731	P-012-DS-5L-FSUAQ	LazrSPEED® OM3 Plenum Distribution Cable, 12 fiber single-unit	Fiber Backbone Cable
700208150	R-012-DS-5L-FSUAQ	LazrSPEED® OM3 Riser Distribution Cable, 12 fiber single-unit	Fiber Backbone Cable
700009400	P-012-DS-6F-FSUOR	OptiSPEED® OM1 Plenum Distribution Cable, 12 fiber single-unit	Fiber Backbone Cable (Legacy Only)
700010168	R-012-DS-6F-FSUOR	OptiSPEED® OM1 Riser Distribution Cable, 12 fiber single-unit	Fiber Backbone Cable (Legacy Only)
760004358	P-012-DS-8W-FSUYL	TeraSPEED® OS2 Plenum Distribution Cable, 12 fiber single-unit	Fiber Backbone Cable
760004440	R-012-DS-8W-FSUYL	TeraSPEED® OS2 Riser Distribution Cable, 12 fiber single-unit	Fiber Backbone Cable
760175752	P-024-DS-CM-FSUOR/8W012/6F012	TeraSPEED® 12-fiber OS2/12-fiber OM1 Plenum Distribution Cable, 24 fiber single-unit	Fiber Backbone Cable (Legacy Only)
760018754	P-024-DS-CM-FSUAQ/8W012/5L012	TeraSPEED® 12-fiber OS2/12-fiber OM3 Plenum Distribution Cable, 24 fiber single-unit	Fiber Backbone Cable
Panels			
760231449	SD-1U	Standard Density 1U sliding Panel, accepts (3) LGX/1000 style splice cassettes, modules or panels, providing up to 36 duplex LC ports	Fiber Optic Enclosures
760231456	SD-2U	Standard Density 2U sliding Panel, accepts (6) LGX/1000 style splice cassettes, modules or panels, providing up to 72 duplex LC ports	Fiber Optic Enclosures
760231464	SD-4U	Standard Density 4U sliding Panel, accepts (12) LGX/1000 style splice cassettes, modules or panels, providing up to 144 duplex LC ports	Fiber Optic Enclosures
Adapter Panels			
760148171	PNL-BK-024-MFA-LC02-AQ-NS	Adapter Pack, Black, 1000-Type, with 12 LazrSPEED® MM duplex LC adapters, aqua, no shutter	Fiber Optic Adapter Panels

760149344	PNL-BK-012-MFA-LC02-AQ-NS	Adapter Pack, Black, 1000-Type, with 6 LazrSPEED® MM duplex LC adapters, aqua, no shutter	Fiber Optic Adapter Panels
760148361	PNL-BK-024-SFA-LC02-BL-NS	Adapter Pack, Black, 1000-Type, with 12 TeraSPEED® SM duplex LC adapters, blue, no shutter	Fiber Optic Adapter Panels
760149351	PNL-BK-012-SFA-LC02-BL-NS	Adapter Pack, Black, 1000-Type, with 6 TeraSPEED® SM duplex LC adapters, blue, no shutter	Fiber Optic Adapter Panels
Connectors			
	FUSE-LC9M62-6	AFL Global Fusion spliced 62.5µm OM1 connector, for 900µm fibers, six pack - Beige	Fiber Optic Connector (Legacy projects only)
	FUSE-LC9SMU-6	AFL Global Fusion spliced OS2 connector, for 900µm fibers, six pack- Blue	Fiber Optic Connector (all new projects)
	FUSE-LC9M50L-6	AFL Global Fusion spliced 50µm OM4 connector, for 900µm fibers, six pack - Aqua	Fiber Optic Connector (Data Center Projects)

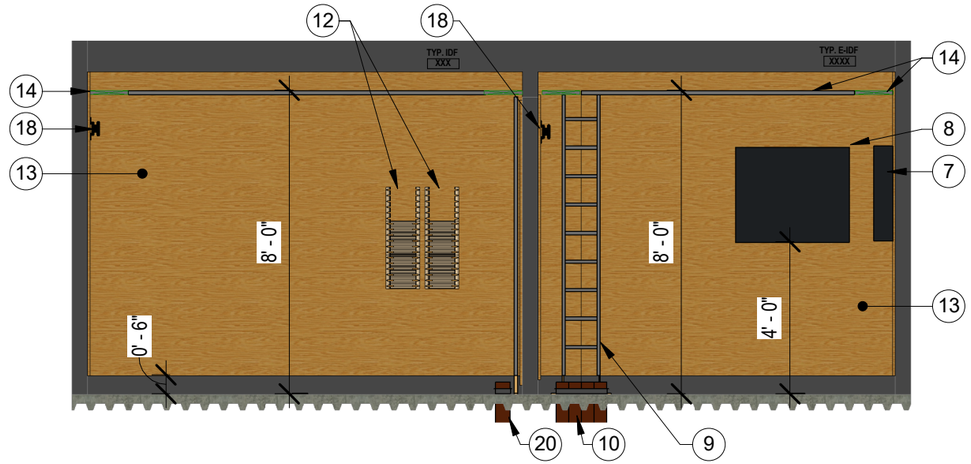
APPENDIX B - HUIT STANDARD MDF AND IDF LAYOUT



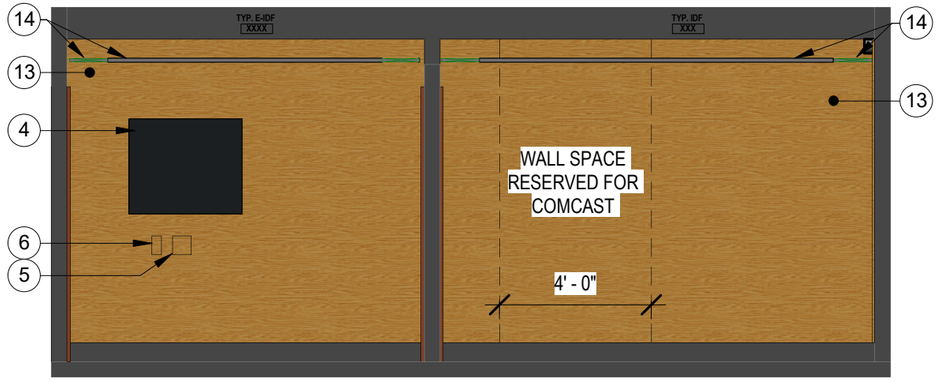
1 IDF & E-IDF FLOOR PLAN
1/4" = 1'-0"



2 IDF & E-IDF REFLECTED CEILING PLAN
1/4" = 1'-0"



3 IDF, E-IDF - WEST WALL ELEVATION
1/4" = 1'-0"



4 IDF, E-IDF - EAST WALL ELEVATION
1/4" = 1'-0"

DETAIL NOTES:

1. 2-POST 45U EQUIPMENT RACK
2. 8" DOUBLE SIDED VERTICAL MANAGER, TYPICAL
3. 12" DOUBLE SIDED VERTICAL MANAGER, TYPICAL
4. SECURITY ACCESS CONTROL PANEL
5. QUAD 120VAC POWER RECEPTICAL
6. DUAL JACK DATA OUTLET
7. BUILDING MANAGEMENT SYSTEM PANEL
8. LIGHTING CONTROL PANEL
9. 18" W VERTICAL LADDER RACK
10. STI EZ-PATH 44-SERIES SLEEVES FOR E-IDF
11. CARD READER, TYPICAL
12. 300 PAIR, 110-STYLE VOICE BLOCKS WITH 188B BACKBOARD, TYPICAL
13. FIRE-RATED PLYWOOD BACKBOARD - 8'T X 3/4"D, 6" AFF
14. 12" LADDER RACK, MOUNTED AT 8'-0"" AFF
15. 18" LADDER RACK, MOUNTED AT 8'-0" AFF
16. NEMA - TWIST-LOCK POWER RECEPTICAL, TYPICAL
17. CABLE RADIUS DROP, TYPICAL
18. GROUNDING BUS BAR
19. 4" WALL SLEEVES FOR HORIZONTAL CABLING, TYPICAL
20. STI EZ-PATH 44-SERIES SLEEVES FOR IDF
21. 6" DOUBLE-SIDED VERTICAL MANAGER, TYPICAL
22. 10" DOUBLE-SIDED VERTICAL MANAGER, TYPICAL
23. 4' W SPACE FOR COMCAST COAX SPLITTER EQUIPMENT

GENERAL NOTES:

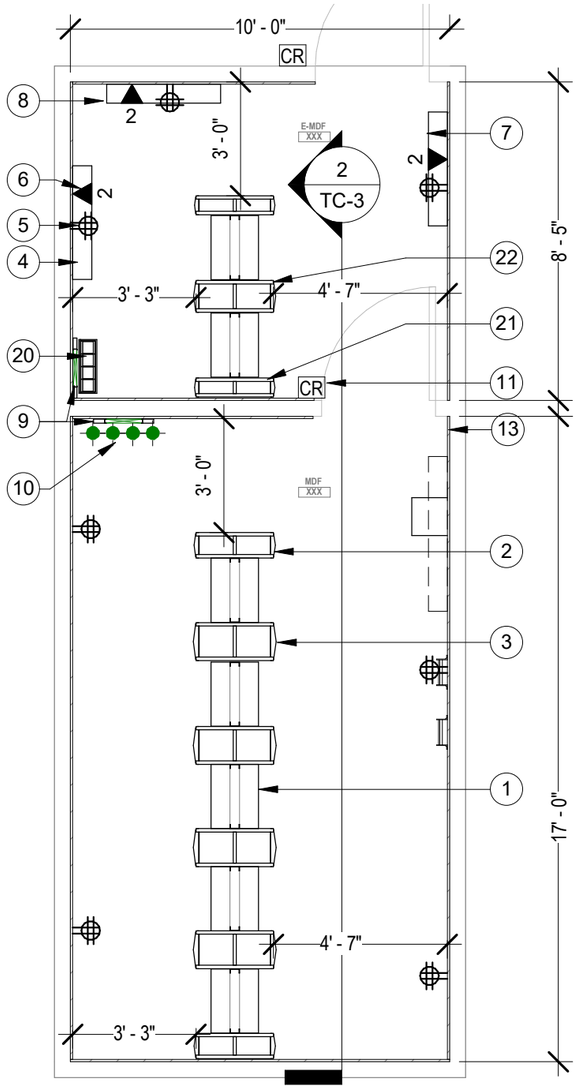
1. ALL DIMENSIONS SHOWN ON PLANS MUST BE MAINTAINED DURING CONSTRUCTION. IF ANY DEVIATIONS ARISE - THEY MUST BE BROUGHT TO THE ATTENTION OF HUIT PROJECT MANAGER PRIOR TO MDF AND IDF CONSTRUCTION.
2. ANY PIPING, CONDUIT OR DUCTWORK THAT DOESN'T SERVE MDF OR IDF SPACES SHALL NOT PASS THROUGH THESE ROOMS, UNLESS APPROVED BY HUIT PROJECT MANAGER.
3. EACH RACK IN IDF CAN SUPPORT A MAXIMUM OF 240 DATA CABLES. IDF LENGTH MUST INCREASE BY MINIMUM OF 2'-10" FOR EACH ADDITIONAL RACK:
   A. 240 CABLES - MINIMUM LENGTH 6'-5"
   B. 480 CABLES - MINIMUM LENGTH 9'-2"
   C. 720 CABLES - MINIMUM LENGTH 11'-6"
   D. 960 CABLES - MINIMUM LENGTH 14'-4"
4. COORDINATE TWIST-LOCK RECEPTICAL TYPES ABOVE RACKS WITH HUIT FOR EACH INDIVIDUAL PROJECT.

VE RI TAS

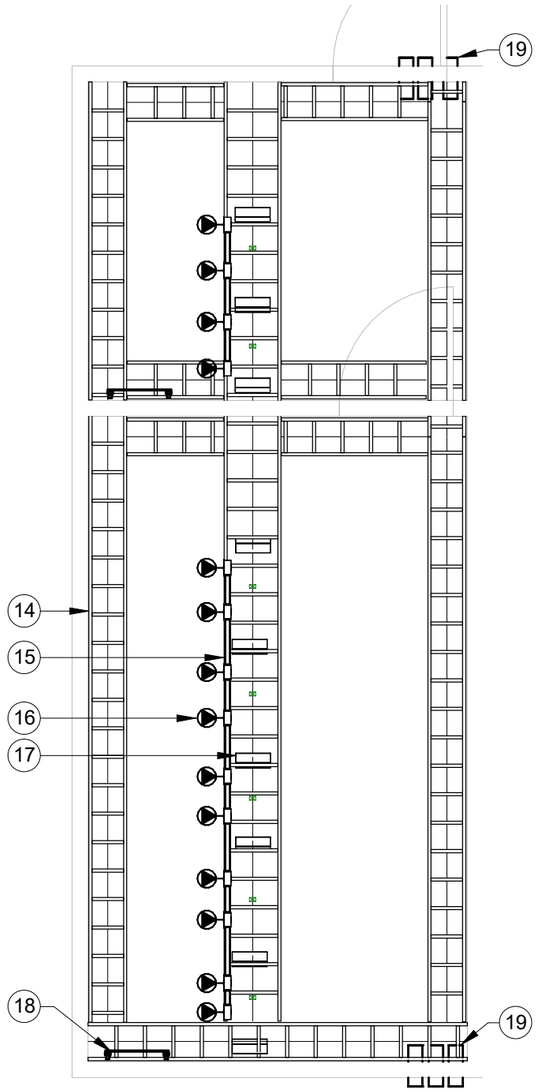
TYPICAL HUIT IDF LAYOUT

DATE: 2020-04-15
REVISION: 1.0
SHEET #: TC-1

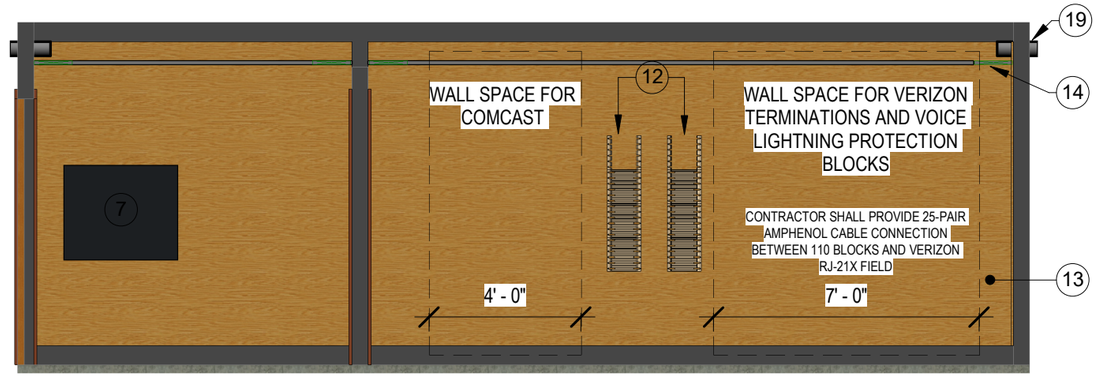
APPENDIX B OF MASTER FORMAT DIVISION 270000 SPECIFICATIONS



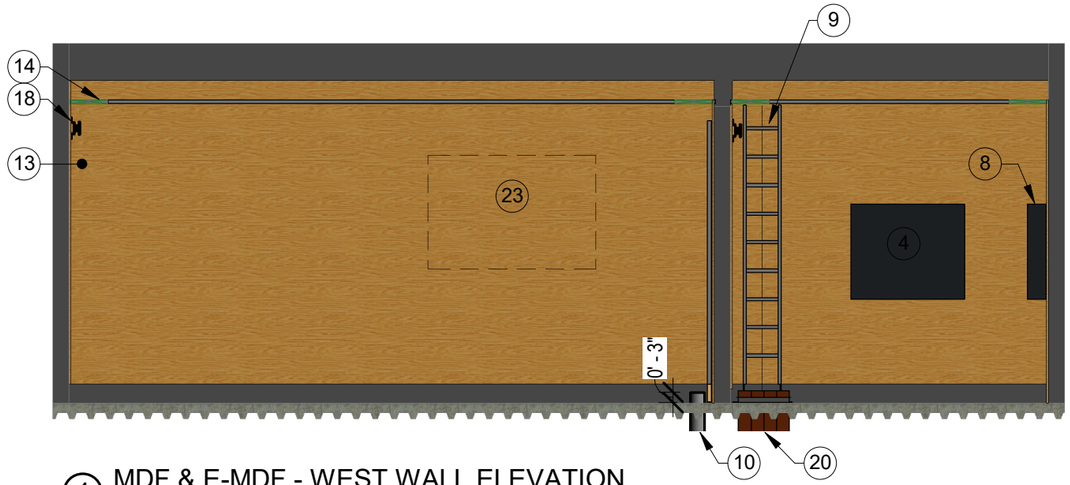
1 MDF & E-MDF FLOOR PLAN
1/4" = 1'-0"



2 MDF & E-MDF RCP
1/4" = 1'-0"



3 MDF & E-MDF - EAST WALL ELEVATION
1/4" = 1'-0"



4 MDF & E-MDF - WEST WALL ELEVATION
1/4" = 1'-0"

SHEET NOTES:

1 2-POST 45U EQUIPMENT RACK
2 8" DOUBLE-SIDED VERTICAL MANAGER, TYPICAL
3 12" DOUBLE-SIDED VERTICAL MANAGER, TYPICAL
4 ACCESS CONTROL PANEL
5 QUAD 120VAC POWER RECEPTICAL
6 DUAL JACK DATA OUTLET
7 LIGHTING CONTROL PANEL
8 BUILDING MANAGEMENT SYSTEM PANEL
9 18" W VERTICAL LADDER RACK
10 4" INCOMING SERVICE CONDUITS - TERMINATE 3" ABOVE FINISHED FLOOR.
11 CARD READER
12 300 PAIR, 110-STYLE VOICE BLOCKS WITH 188B BACKBOARD, TYPICAL
13 FIRE-RATED PLYWOOD BACKBOARD - 8'T X 3/4"D, 6" AFF
14 12" LADDER RACK, MOUNTED AT 8'-0" AFF
15 18" LADDER RACK, MOUNTED AT 8'-0" AFF
16 NEMA - TWISTLOCK POWER RECEPTICAL, TYPICAL
17 CABLE RADIUS DROP, TYPICAL
18 GROUNDING BUS BAR
19 4" WALL SLEEVES FOR HORIZONTAL CABLING, TYPICAL
20 STI EZ-PATH 44-SERIES SLEEVES FOR E-MDF
21 6" DOUBLE-SIDED VERTICAL MANAGER, TYPICAL
22 10" DOUBLE-SIDED VERTICAL MANAGER, TYPICAL
23 WALL POSTER WITH AS-BUILT PLANS

GENERAL NOTES:

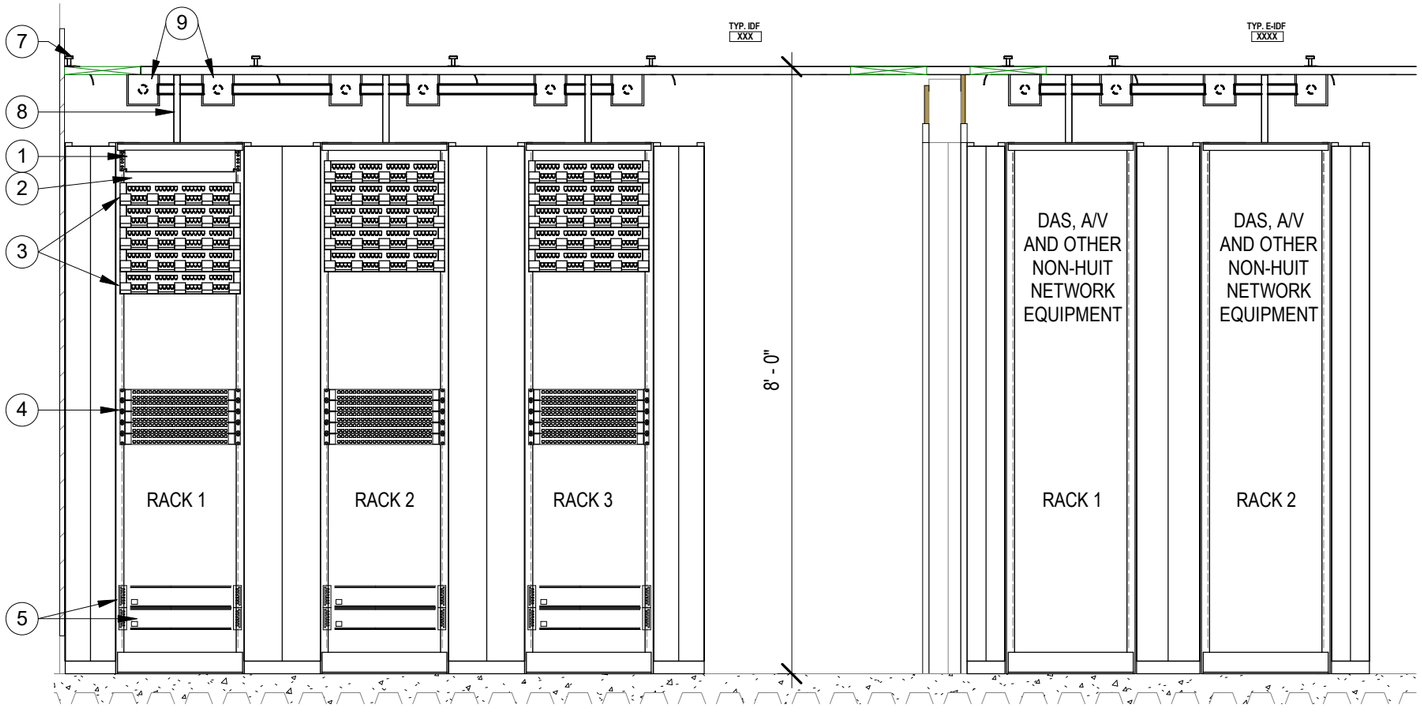
1. ALL DIMENSIONS SHOWN ON PLANS MUST BE MAINTAINED DURING CONSTRUCTION. IF ANY DEVIATIONS ARISE - THEY MUST BE BROUGHT TO THE ATTENTION OF HUIT PROJECT MANAGER PRIOR TO MDF AND IDF CONSTRUCTION.
2. ANY PIPING, CONDUIT OR DUCTWORK THAT DOESN'T SERVE MDF OR IDF SPACES SHALL NOT PASS THROUGH THESE ROOMS, UNLESS APPROVED BY HUIT PROJECT MANAGER.
3. COORDINATE TWIST-LOCK RECEPTICAL TYPES ABOVE RACKS WITH HUIT FOR EACH INDIVIDUAL PROJECT.

VE RI TAS

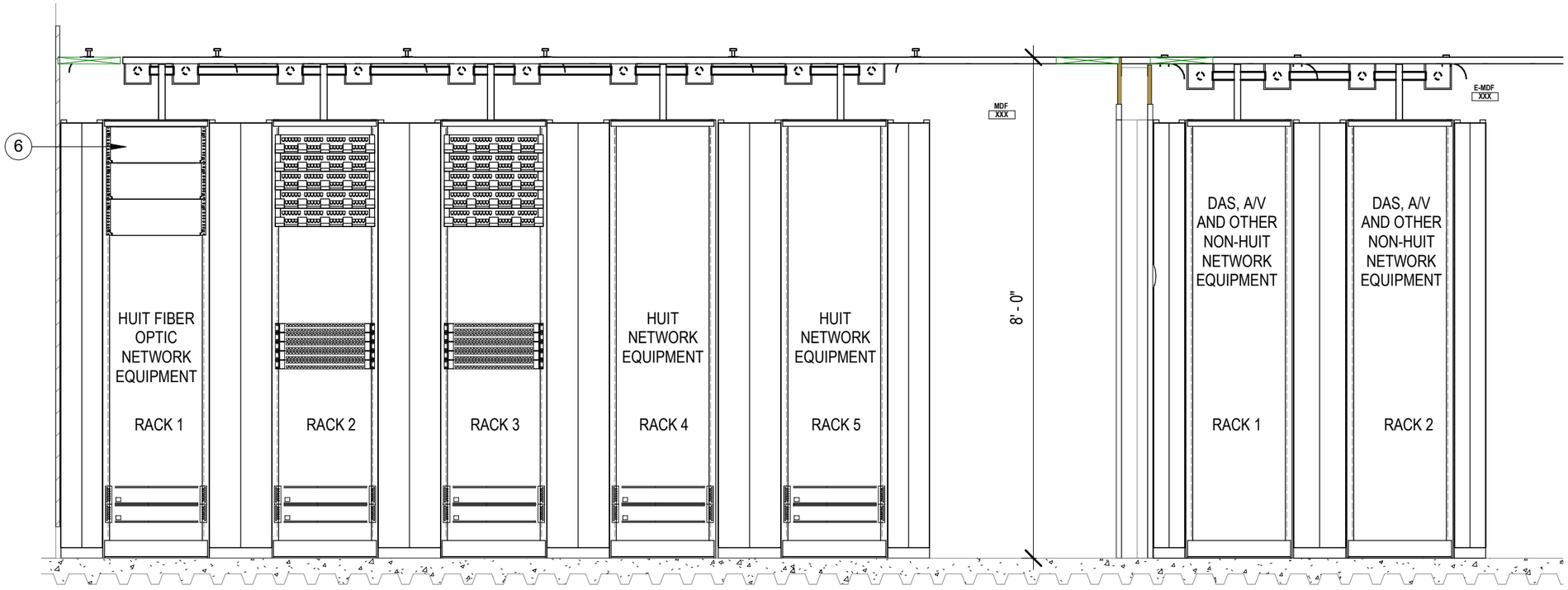
TYPICAL HUIT MDF LAYOUT

DATE: 2020-04-15
REVISION: 1.0 SHEET #: TC-2

APPENDIX B OF MASTER FORMAT DIVISION 270000 SPECIFICATIONS



1 IDF & E-IDF RACK ELEVATION
1/2" = 1'-0"



2 MDF & E-MDF RACK ELEVATION
1/2" = 1'-0"

SHEET NOTES: ◯

1. 2U FIBER LIU ENCLOSURE
2. 1U BLANK SPACE. TYPICAL ABOVE PATCH PANELS IN EACH RACK
3. 2U UTP 48-PORT PATCH PANELS. MAX 5 PER RACK
4. HUIT ACTIVE EQUIPMENT
5. 2U POWER DISTRIBUTION UNIT WITH 10' CORD, TYPICAL. PROVIDED AND INSTALLED BY HUIT
6. 4U FIBER LIU ENCLOSURE
7. CABLE RADIUS DROP, TYP
8. RACK TO LADDER BRACE. TYPICAL
9. NEMA - TWISTLOCK POWER RECEPTICAL, TYPICAL. COORDINATE TWIST-LOCK RECEPTICAL TYPES ABOVE RACKS WITH HUIT FOR EACH INDIVIDUAL PROJECT.

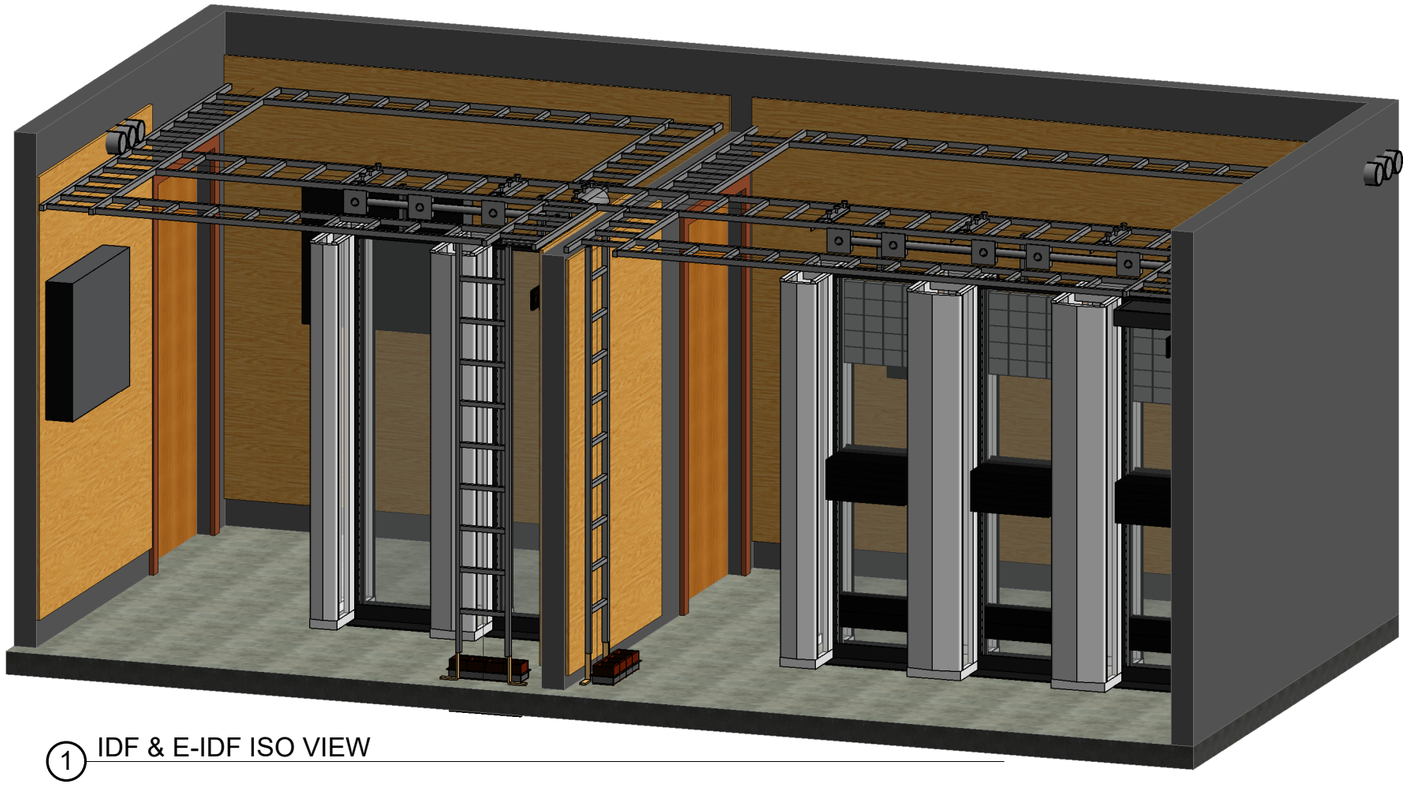
VE RI TAS

TYPICAL HUIT MDF & IDF RACK ELEVATIONS

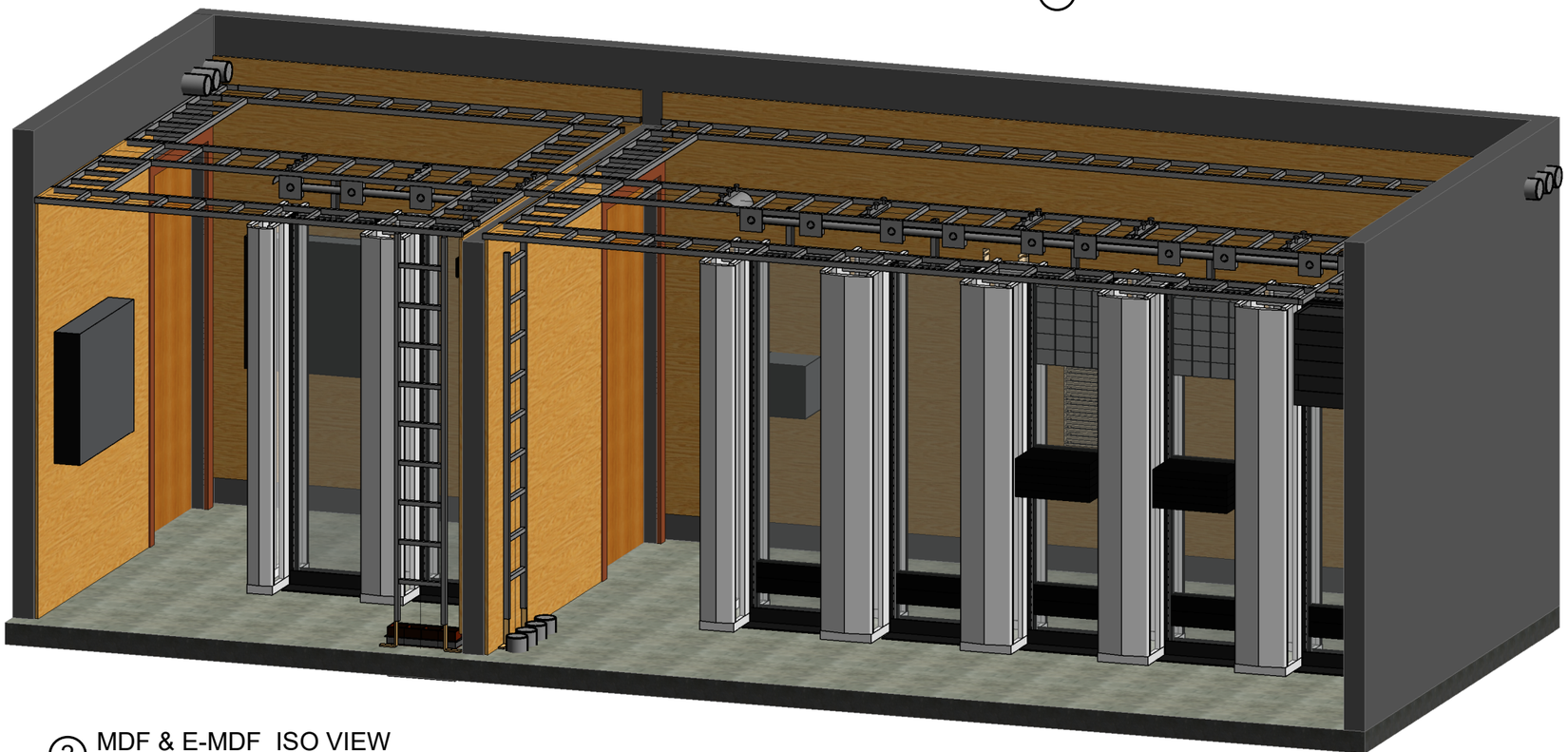
DATE: 2020-04-15
REVISION: 1.0

SHEET #: TC-3

APPENDIX B OF MASTER FORMAT DIVISION 270000 SPECIFICATIONS



1 IDF & E-IDF ISO VIEW



2 MDF & E-MDF ISO VIEW

TYPICAL HUIT MDF & IDF ISOMETRIC VIEW

DATE: 2020-04-15
REVISION: 1.0 SHEET #: TC-4

APPENDIX B OF MASTER FORMAT DIVISION 270000 SPECIFICATIONS