SECTION 27 05 03

*~~~ **PROJECT NOTE** ~~~~~~*
ARCHITECT OF RECORD/ENGINEER OF RECORD IS RESPONSIBLE FOR REVIEWING THIS SPECIFICATION SECTION IN DETAIL FOR COORDINATION WITH THE PROJECT SCOPE OF WORK.

ALL "PROJECT NOTE" TEXT IS TO BE REMOVED FOLLOWING REVIEW OF THE CONTENT OF EACH NOTE BY THE ARCHITECT OF RECORD/ENGINEER OF RECORD.

EDIT THE DOCUMENT FOOTER TO INCLUDE THE PROJECT NAME AND NUMBER.

EDIT THE DOCUMENT HEADER TO INDICATE THE "AOR PROJECT ISSUE" DATE. THE "CPS CONTROL" DATE SHOULD NOT BE EDITED.

ANY MODIFICATIONS TO THE TECHNICAL STANDARDS IN THIS SECTION - INCLUDING THE REMOVAL OR ADDITION OF MANUFACTURERS - MUST BE APPROVED BY CPS.

REQUESTS FOR MODIFICATION ARE TO BE SUBMITTED TO THE DESIGN MANAGER DURING THE DESIGN PHASE FOR REVIEW AND APPROVAL.

*~~~ **END OF PROJECT NOTE** ~~~~~~~~~~~~~~~~~~~~~~~~~~*

COMMUNICATIONS GENERAL REQUIREMENTS

*~~~ **PROJECT NOTE** ~~~~~~*
IT IS THE RESPONSIBILITY OF THE ARCHITECT/ENGINEER ON RECORD TO BE IN COMPLIANCE WITH THE MOST RECENT VERSION AND/OR REVISIONS OF THE CHICAGO PUBLIC SCHOOLS INFRASTRUCTURE STANDARDS.
*~~~ **END OF PROJECT NOTE** ~~~~~~~~~~~~~~~~~~~~~~~~~~*

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Communications system design requirements.
   1. Section covers general requirements for communications structured cabling systems used as signal pathways for voice and high-speed data transmission. Communications hardware and equipment furnished shall conform to the requirements of this specification and the particular application specifications.

B. Installer Qualifications

C. Special Warranty.

1.02 DEFINITIONS

A. ACE: Administrative Concentrator Enclosure.

B. BICSI: Building Industry Consulting Service International.

C. Broadband: For the purposes of this Section, wide bandwidth equipment or systems that can carry signals occupying in the frequency range of 5 to 1000 MHz.

D. Carrier: An RF signal that is modulated to carry information. In the process of modulation, it is spread out over a wider band.

E. Cat 6 PP: Category 6 Patch Panel (Are installed in Equipment Racks/Enclosures).

F. CATV: Community Antenna Television; a communication system that simultaneously distributes several different channels of broadcast programs and other information to customers via a coaxial cable.

G. CCTV: Closed circuit television.

H. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.

I. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

J. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

K. CXP: RG6 Coax Patch Panel (Are installed in Equipment Racks).

L. dB: Decibel.

M. dBmV: Decibels relative to 1 mV across 75 ohms. Zero dBmV is defined as 1 mV across 75 ohms. dBmV = 20 log 10(V1/V2) where V1 is the measurement of voltage at a point having identical impedance to V2 (0.001 V across 75 ohms).

N. Device Port: is the location on the patch panel, faceplate or product where the label is located.

O. EMI: Electromagnetic interference.

P. ESD: Electrostatic discharge.

Q. FOPP: Fiber Optic Patch Panel.

R. GPS: Global Positioning System.

S. Headend: The control center of the master antenna television system, where incoming signals are amplified, converted, processed, and combined into a common cable along with any locally originated television signals, for transmission to user-interface points.

T. ICC: Intercom Control Cabinet. The ICC may also be referred to as the Intercom Headend.

U. IDC: Insulation displacement connector.

V. IDF: Intermediate Distribution Frame.

W. ITS: Office of Information and Technology Services.

X. Jack / Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates, these outlets are typically inserted in a faceplate.

Y. Ladder Rack: A fabricated structure consisting of two longitudinal side rails (stringers) connected by individual transverse members (rungs).

Z. LAN: Local area network.

AA. LCE: Lab (computer, library, or science) concentrator enclosure.

AB. MDF: Main Distribution Frame.

AC. MMTV: Media Management Television.

AD. Modulator: An active device that modulates a baseband audio and video source onto an NTSC 6 MHz wide channel. This device shall employ a custom SAW filter to provide true vestigial sideband selectivity with built-in FCC group delay pre-distortion. This will allow for adjacent channel operation without any interference. This device shall also comply with FCC Docket 21006.

AE. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

AF. NIST: National Institute of Science and Technology.

AG. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

AH. PATHWAY: A pathway is typically a conduit that requires labeling so that IT can understand where the conduit begins and ends.

AI. PC: Personal computer.

AJ. PORT: A port is an end of line location on a patch panel, faceplate or switch.

AK. QCE: Quad (Four) Classroom Concentrator Enclosure.

AL. RCDD: Registered Communications Distribution Designer.

AM. RF: Radio frequency.

AN. SCE: Shared Concentrator Enclosure.

AO. TBB: Telecommunication Bonding Backbone.

AP. TCE: Three Classroom Concentrator Enclosure.

AQ. TGB: Telecommunication Ground Bus Bar.

AR. TMGB: Telecommunication Main Ground Bus Bar.

AS. User Interface: End point of Contractor's responsibility for Work of this Section. User interfaces are the 75-ohm terminals on device plates.

AT. UTC: Universal time coordinated. The precisely measured time at zero degrees longitude; used as a worldwide standard for time synchronization.

AU. UTP: Unshielded Twisted Pair.

AV. VU: Volume unit.

AW. W: Workstation which is a location / faceplate where cables are terminated.

AX. WAP: Wireless Access Point.

AY. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.

1.03 REFERENCE STANDARDS

A. City of Chicago Building Code - Municipal Code of Chicago for the Building Industry; 2017.

B. City of Chicago Electrical Code - National Electrical Code with Chicago Amendments; 2017.

C. NECA/BICSI 568 - Standard for Installing Commercial Building Telecommunications Cabling; 2006.

D. NFPA 70 - National Electrical Code; 2017.

E. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set; 2016.

F. TIA-569-D - Telecommunications Pathways and Spaces; Rev D, 2015.

G. TIA-607-C - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; Rev C, 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate layout and installation of communications equipment with Board's Representative, telecommunications and LAN equipment, and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
      a. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and the Board to exchange information and agree on details of equipment arrangements and installation interfaces.
      b. Record agreements reached in meetings and distribute them to other participants.
      c. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
      d. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
   2. Coordinate communications outlet/connector locations with location of power receptacles at each work area.
   3. Notify Architect/Engineer of Record of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details.
   1. Ensure required submittals have been provided with sufficient time for review prior to scheduling the Preinstallation Meeting.
   2. Review the detailed requirements for the work of this section and to review the drawings and specifications for this work
      a. Require attendance by all affected installers including but not limited to
         1) Contractor's Superintendent
         2) Installer
         3) Manufacturer/Fabricator Representative
         4) Other affected Subcontractors
         5) Architect/Engineer of Record
         6) Board's Representative
   3. Record minutes and distribute copies within 5 days after meeting to participants as well as Architect/Engineer of Record, Board and those affected by decisions made.

1.05 SUBMITTALS

A. General:
   1. Reviews of submittals are to establish general conformance to design intent and does not waive contract requirements. Contractor is responsible for dimensions, quantities, mounting accessories, methods of construction, and compliance with the Contract Documents.
   2. Provide separate submittal product data/shop drawings for each fixture, device, and equipment type clearly indicating the type designation per the Contract Documents and all pertinent options and accessories. Do not group similar fixture types together on a single cut sheet. Submittals which do not indicate option data where multiple selections exist will be returned without being reviewed.

B. Refer to "Submittals" article of each Division 27 Section for requirements specific to the Section.

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

D. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

E. Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).

F. Evidence of qualifications for installer.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: A company having at least five (5) years' experience in the installation and testing of the type of system specified, and:
   1. Employing a BICSI Registered Communications Distribution Designer (RCDD).
      a. If personnel of Contractor are not BICSI-trained and –certified, Contractor to submit with bid all necessary credentials and certificates of training for personnel staff for evaluation and determination by CPS ITS Sr. Infrastructure Manager that said credentials and certificates are equal to BICSI standards. The project shall be staffed at all times by Installers and Technicians who, in the role of lead crafts persons, will be able to provide leadership and technical resources for the remaining crafts persons on the project.
   2. Supervisors and installers factory certified by manufacturers of products to be installed.
      a. Shall be certified by the manufacturing company(-ies) in all aspects of installation and testing of the products described within the telecommunications systems specifications. Specifically, those manufacturer(s) whose components constitute a component of the structured cabling system(s) installed as part of the voice and data transport systems. Said certification is to be such that the Contractor is able to offer

and fully comply with the requirements to provide the Board with an extended warranty as defined in “System Warranty and Application Assurance” Article of this Section.

B. Installer Supervision:
   1. The selected Contractor shall provide a Project Manager to act as a single point of contact for all activities performed under this Section. The Project Manager shall be a Registered Communications Distribution Designer (RCDD). The RCDD shall have a minimum of 3 years' experience in design and installation. The designer must have sufficient experience in this type project(s) as to be able to lend adequate technical support to the field forces during installation, during the warranty period and during any extended warranty periods or maintenance contracts. The Contractor must attach a resume of the responsible designer to the Contractor's response for evaluation.
   2. The Project Manager, or designee thereof, shall be required to attend project meetings as required until project closeout/signoff.
   3. Should the Project Manager assigned to this project change during the installation, the new Project Manager assigned must meet all qualifications stated in this Section, and must also submit a resume for review by the Board.
   4. If, in the opinion of the Board, the Project Manager does not possess adequate qualifications to support the project, the Board reserves the right to require the Contractor to assign a designer whom, in the Board's opinion, possesses the necessary skills and experience required of this project.

C. Materials and equipment shall be the standard product of a manufacturer regularly engaged in the production of the required type of material or equipment for at least five (5) years (unless specifically exempted by the Board) and shall be the manufacturer's latest design with published properties.

D. Source Limitations: Equipment and materials of the same general type shall be of the same manufacturer throughout the project to provide uniform appearance, operation and maintenance.

E. Equipment and materials shall be without blemish or defect.

F. Comply with City of Chicago Building Code.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in City of Chicago Electrical Code, by a qualified testing agency, and marked for intended location and application.

H. Comply with NFPA 70 for abandoned cabling.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Do not deliver or install equipment frames and ladder rack until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

C. Receive, handle, and store communications system items and materials at the project site. Materials and items shall be placed so that they are protected from damage and deterioration.

D. Stage materials in a secure area of the project site until installation.

1.08 SYSTEM WARRANTY AND APPLICATION ASSURANCE

A. General Warranty: The warranty specified in this Article shall not deprive the Board of other rights the Board may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under other requirements of the Contract Documents.

B. The Contractor shall guarantee at the time of the bid that all telecommunications equipment, cabling and components meet or exceed specifications.

C. Special Warranty: Provide to the Board an Extended System and Application Assurance Warranty covering product and installation defects for all passive manufactured components of the structured cabling system(s) installed as part of the voice and data transport systems. Passive components are defined as those exhibiting no gain or contributing no energy. Warrant to the Board the following:
   1. The passive products that comprise the telecommunications structured cabling system will be free from manufacturing defects in material or workmanship under normal and proper use.
   2. All approved passive cabling products that comprise the structured cabling system exceed the specification standards and will conform to the performance specifications of the associated product data sheet in effect at the time the product is utilized.
   3. The installation will meet, if not exceed, the requirements and the standards for cabling configurations specified in these standards.
   4. The Special Warranty shall provide an application assurance guaranteeing structured cabling system shall be capable of running a minimum of Gigabit Ethernet (1000Mbs) in the horizontal channel, and 10-Gigabit Ethernet (10,000Mbs) in the backbone.
   5. The Special Warranty shall be applicable to the original site of installation. Under the warranty, the manufacturer will either repair or replace the defective product itself at the manufacturer's cost, or the manufacturer will pay an authorized reseller for the cost to repair or replace any such defective product on behalf of the manufacturer.
   6. Transfer manufacturer's warranties to the Board in addition to the General System Guarantee. Submit these warranties on each item in list form with shop drawings. Detail specific parts within equipment that are subject to separate conditional warranty. Warranty proprietary equipment and systems involved in this contract during the guarantee period. Final payment shall not relieve Contractor of these obligations.
   7. Special Warranty shall be held by the product manufacturer(s).

D. Special Warranty Period: 25 years from date of acceptance.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

A. Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.
   1. Comply with TIA-568 (SET) (cabling) and TIA-569-D (pathways), latest editions (commercial standards).
   2. Provide fixed cables and pathways that comply with City of Chicago Electrical Code and TIA-607-C and are UL listed or third party independent testing laboratory certified.
   3. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F at relative humidity of 0 to 95 percent, noncondensing.
   4. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.

B. Main Distribution Frame (MDF): Centrally located support structure for terminating horizontal cables that extend to telecommunications outlets, functioning as point of presence to external service provider.
   1. Locate main distribution frame as indicated on the drawings.

C. Intermediate Distribution Frames (IDF): Support structures for terminating horizontal cables that extend to telecommunications outlets.
   1. Locate intermediate distribution frames as indicated on the drawings.

D. Backbone Cabling: Cabling, pathways, and terminal hardware connecting intermediate distribution frames (IDF's) with main distribution frame (MDF), wired in star topology with main distribution frame at center hub of star.

E. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

PART 3 EXECUTION

*~~~ **PROJECT NOTE** ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~*
INCLUDE "COMMUNICATIONS DEMOLITON" ARTICLE FOR EXISTING BUILDINGS; DELETE "COMMUNICATIONS DEMOLITION" ARTICLE FOR NEW CONSTRUCTION.

*~~~ **END OF PROJECT NOTE** ~~~~~~~~~~~~~~~~~~~~~~~~~*

3.01 COMMUNICATIONS DEMOLITION

A. For a renovation project in an existing building, demo and remove back to source, all abandoned communications wiring serving communications outlets and devices within the area of work. Coordinate work to not disrupt communications services to areas outside the project's area of work as may be served by components and communications infrastructure located within the project's area of work.

B. Remove and dispose of termination devices, panels, housings, outlets, mounting frames, cable supports, wire management, etc. abandoned as a result of demolition work, except where indicated for re-use and except where remove of said components would disrupt communication infrastructure and communications systems service to areas outside project's area of work.

C. Coordinate any disruption to existing communications systems service with CPS ITS Sr. Infrastructure Manager, and provide at least fourteen days advance notice to CPS ITS prior to disruption.

D. Removal of all existing electronic equipment shall be coordinated, with at least fourteen days advance notice, with CPS ITS Sr. Infrastructure Manager. All existing electronic equipment shall be turned over to CPS ITS Sr. Infrastructure Manager, and shall not be disposed by Contractor.

3.02 INSTALLATION - GENERAL

A. The drawings for work under Division 27 Sections related to communication systems are diagrammatic and are intended to convey the scope of work and indicate the general arrangement of outlets, equipment, termination hardware, fixtures and other work included in the Contract.

B. Location of items required by the drawings or specifications not definitely fixed by dimensions are approximate only and exact locations necessary to secure the best conditions and results shall be determined at the site and shall be subject to the approval of the Board.

C. Follow drawings in laying out work, check drawings of other trades to verify spaces in which work will be installed, and maintain maximum headroom and space conditions at all points.
   1. Where headroom or space conditions appear inadequate, the Board shall be notified before proceeding with installation.
   2. Minor rerouting and changes in location shall be made at no additional cost to the Board.
   3. Coordinate the mounting heights of communications equipment and raceways to clear the opening heights of doors and the heights of equipment which needs to be removed and replaced.
   4. As necessary, adjust elevations of rack-mounted termination hardware and horizontal wire management panels so as to compensate for rack unit sizes of actual hardware used, as compared to hardware rack unit sizes depicted in Contract Drawings.

D. Perform all work with skilled mechanics of the particular trade involved in a neat and workmanlike manner.

E. Perform all work in cooperation and coordination with other trades and schedule.

F. Furnish other trades advance information on locations and sizes of frames, boxes, sleeves and openings needed for the work, routes for conduit, and also furnish information and shop drawings necessary to permit trades affected to install their work properly and without delay.

G. Where there is evidence that work of one trade will interfere with the work of other trades, all trades shall assist in working out space allocations to make satisfactory adjustments and shall be prepared to submit and revise coordinated shop drawings.

H. With the approval of the Board and without additional cost to the Board, make minor modifications in the work as required by structural interferences, by interferences with work of other trades or for proper execution of the work.

I. Work installed before coordinating with other trades so as to cause interference with the work of such other trades shall be changed to correct such condition without additional cost to the Board and as directed by the Board.

J. Minor changes in the locations of outlets, fixtures and equipment shall be made prior to rough in at the direction of the Board and at no additional cost to the Board.

K. Contractor shall cooperate with other trades and coordinate work so that conflicts with other work are eliminated.

L. Equipment shall be installed with adequate space allowed for removal, repair or changes to equipment. Ready accessibility to removable parts of equipment and to wiring shall be provided without moving other equipment which is to be installed or which is in place. Contractor shall verify measurements. Discrepancies shall be brought to the Board's attention for interpretation.

M. Determine temporary openings in the buildings that will be required for the admission of apparatus furnished under this Division, and notify the Board accordingly. In the event of failure to give sufficient notice in time to arrange for these openings during construction, assume all costs of providing such openings thereafter.

N. Location of communication outlets and raceway pathways are approximate and exact locations shall be determined on site.

O. Contractor shall refer to contract documents for details, reflected ceiling plans, and large scale drawings.

P. Comply with latest editions and addenda of TIA-568 (SET) (cabling), TIA-569-D (pathways), TIA-607-C (grounding and bonding), NECA/BICSI 568, City of Chicago Electrical Code, and SYSTEM DESIGN as specified in PART 2.

Q. Comply with Communication Service Provider requirements.

R. Grounding and Bonding: Perform in accordance with TIA-607-C and City of Chicago Electrical Code.

3.03 EXAMINATION OF PATHWAYS

A. Examine pathway elements intended for cables.
   1. Verify proposed routes of pathways. Check raceways, ladder racks, and other elements for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation. Verify that cabling can be installed complying with EMI clearance requirements.
   2. Prepare wall penetrations and verify that penetrations of rated fire walls are made using products labeled for type of wall penetrated.
   3. Identify plan to support cables and raceways in suspended ceilings. Verify weight of individual types and sizes of cables. Verify that load capacity of cable support structures is adequate for each pathway.
   4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 INSTALLATION OF EQUIPMENT AND CABLING

A. Cabling:

1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
2. Do not over-cinch or crush cables.
3. Do not exceed manufacturer's recommended cable pull tension.
4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.

B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:
1. At Distribution Frames: 120 inches.
2. At Outlets - Copper: 12 inches.
3. At Outlets - Optical Fiber: 39 inches.

C. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569 for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.05 FIRESTOPPING

A. Utilize an approved firestop assembly to seal all cable and raceway penetrations of fire-rated floor and wall assemblies. Assembly must achieve the same smoke/fire-resistance rating as the floor or wall being penetrated.

B. Comply with requirements in Section 07 84 00 - Firestopping.

C. Comply with TIA-569-D, Annex A, "Firestopping."

D. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.06 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with TIA-607-C.

C. Coordinate location of communications grounding bus bar to minimize the length of bonding conductors.

D. Bond metallic equipment to the communications grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.07 IDENTIFICATION

A. Comply with requirements in Section 27 05 53 - Identification for Communication Systems.

3.08 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit communications systems installation, including all pathway elements and supports necessary for same. Perform cutting by skilled mechanics of trades involved. Perform work so as to not impair structural stability of building construction and systems.

B. Conduits passing through roofs or other surfaces exposed to weather shall be properly flashed as specified in roofing and waterproofing Sections. This flashing work shall be part of this Division of work.

C. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new firestopping where existing firestopping has been disturbed during the course of install. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.09 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint. Paint materials and application requirements are specified in Section 09 91 05 - Renovation Painting.
   1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
   2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
   3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.10 TEMPORARY UTILITIES

A. Comply with requirements of Division 01 regarding furnishing of temporary communications services for use during construction of the Project.

3.11 CLEANING

A. On completion of installation inspect exposed finishes. Remove burrs, dirt, paint spots, and construction debris. Repair damaged finish(es), including chips, scratches, and abrasions.

B. All equipment, hardware and finishes shall be cleaned prior to final acceptance. Unless otherwise indicated, clean shall mean free of dust, dirt, mud, debris, oil, grease, residues, and contamination.

C. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion. Protect conduit and wireway openings against the entrance of foreign matter by means of plugs or caps. Cover fixtures, materials, equipment and devices furnished or installed under this Section or otherwise protect against damage, both before and after installation. Hardware, materials, equipment, or devices damaged prior to final acceptance of the work shall be restored to their original condition or replaced.

D. During the course of communications installation work, provide for on-going proper disposal of all debris, including but not limited to: equipment packaging and shipping materials, shipping pallets, empty cable reels/boxes, cable cuttings, etc. The Contractor shall, at all times, keep the site free from accumulations of waste material or rubbish caused by its employees or work. Remove all crates, cartons, and other waste materials or trash from the working areas at the end of each working day. Flammable waste material must be removed from the working areas at the time of generation. All rubbish and debris, combustible or not, shall be discarded in covered metal containers daily and removed from the premises at least weekly and legally disposed of.

3.12 COMMISSIONING AND DEMONSTRATION

A. Comply with requirements in Section 27 08 00 - Commissioning of Communications for performance tests, inspections, correction of deficiencies, and preparation of test and inspection reports.

END OF SECTION 27 05 03