

SECTION 28 23 00
VIDEO SURVEILLANCE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes

1. Analog and IP-based Cameras & Enclosures
2. Lenses
3. Power Supplies
4. Control Equipment

B. Substitutions:

1. Certain items of equipment are specified herein by manufacturer and model number to indicate the quality and functional performance required from the system and its components. Substitutions of equal equipment beyond the alternatives listed shall be permitted only with the written permission of the engineer.
2. Substitute products shall be considered only under the terms and conditions of Section 280500 - Common Work Results For Electronic Safety and Security.

1.03 REFERENCES

- A. American National Standards Institute (ANSI).
- B. National Electrical Manufacturer's Association (NEMA).

1.04 SYSTEM DESCRIPTION

- A. The video surveillance system shall provide visual surveillance of the areas noted. The cameras shall be fixed and pan-tilt-zoom mount.

1.05 SUBMITTALS

- A. General: Make submittals in accordance with Section 280500 - Common Work Results For Electronic Safety and Security.
- B. Shop Drawings: Prepare block diagrams indicating the proposed connections of all equipment to be furnished, control facilities, and equipment racks. Indicate materials, construction, layouts and quantities
- C. Operations and Maintenance Manuals.
 1. Furnish simplified as-built block diagrams of the system giving the essentials of the installation and their functional relations with all numbered inputs, outputs and wires printed on the diagrams. One copy of the system diagram shall be

mounted, framed behind glass with the equipment racks. Furnish a chart of line connections inside the rear door of each rack.

1.06 QUALITY ASSURANCE

- A. All equipment shall be furnished and installed by an authorized factory distributor with proven experience in the design and installation of systems of this type. Distributor shall provide proof of being in the video surveillance contracting business for the preceding five (5) years.
- B. Construct the system following good engineering practices and in accordance with applicable codes and safety precautions.
- C. Periodically inspect portions of the system installed by other contractors to minimize potential interference problems.
- D. All materials and equipment shall be new and shall conform to the applicable requirements of the Underwriter's Laboratories and with the American National Standards Institute.

1.07 WARRANTY

- A. All equipment shall be guaranteed to be free of defective components or faulty workmanship for a period of one year from the date of final acceptance. If any materials prove to be defective within the above period, they shall be replaced within two days at no expense to the owner.

1.08 MAINTENANCE

- A. The contractor shall provide, at his expense, maintenance service for a period of one year after final acceptance of the installation. All service calls shall be answered within twenty-four (24) hours by the sound system contractor.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The equipment manufacturers and model numbers specified herein are meant to provide a standard of quality. It is the responsibility of the bidder to ensure that his proposed product meets or exceeds the quality and performance of the specified model.

2.02 CAMERAS SELECT FROM CAMERA FILE

- A. Camera
 - 1. Imager: Interline transfer CCD, 1/2-inch image format
Active Picture Elements: 768 H by 494 V.
Horizontal Resolution: 576 television lines
Signal to Noise (AGC off): 54dB minimum
AGC: 30dB
Light Range: 1,000,000:1 minimum with f/1.4-360 autoiris lens
Video Output: 1.0 V p-p, 75 ohm
Synchronization: Vertical interval switching. Line locked to power line zero crossing.
 - 2. Pelco PCHM575-2 or equal.
- B. Lens: 3.5mm, auto iris, fixed focus with ALC. f/1.4-360. Field of view 94.6 deg. horizontal by 73.5 deg. vertical. Pelco MFH3.5GAIABC-1 or equal.

- C. Camera Housing: Formed/welded 14 gauge steel with textured semi-gloss gray and black enamel. Equipped with 1/4" impact and abrasion resistant clear Lexan window and an adjustable tilt table camera mounting. Provide with terminal block inside housing and four 1/2" conduit openings on mounting surface. Conduit entrance shall be through the back of the housing. Pelco HS2500 or equal.

2.03 POWER SUPPLY SELECT FROM SEPARATE FILE

PART 3 - EXECUTION

3.01 INSTALLATION

- A. It shall be the responsibility of the contractor to cooperate with representatives of the owner in order to achieve well-coordinated progress and satisfactory results. Schedule all work to prevent conflicts with other activities in the building. Execute without claim for extra payment moderate moves or changes as are necessary to accommodate other equipment, or to preserve symmetry and pleasing appearance.
- B. The contractor shall be responsible for all signal cable routing, termination, connection and testing associated with equipment required to provide a fully operational and functioning video surveillance system. This includes cable and routing to other rooms associated with and connected to the video surveillance system.
- C. All cabling shall be run in conduit or cable tray.
- D. Rack mount all equipment unless otherwise indicated. Dress all cabling into equipment rack with proper strain relief and secure with cable ties to the side of the rack opposite the AC power strip. When installation is complete cables should be secured and neatly organized in rack or panel locations and label must be visible.
- E. Label each end of all cables with number and identification legend clearly identifying the connection point for cable end. Labels shall be self laminating type compatible with Brady DAT-151-292.
- F. Provide proper video terminations at all times. Do not use a video "T" in place of a proper video distribution amp to route a signal to more than one location. Terminate all video signals into 75 ohms at the final device. If a video signal path passes through more than one device, each device shall have looping input capability or a video distribution amplifier must be used to distribute the signal to all required devices.
- G. Maintain signal integrity at all times. During installation, pay attention to open grounds, broken shields, and other possible causes of poor video quality. Inspect all wiring after installation and make corrections as necessary when deficiencies are noted.

3.02 CAMERA PLACEMENT

- A. Camera placement shown on drawings are approximate. Contractor shall place all cameras to provide maximum coverage of intended viewing area. Review proposed camera installation locations with Architect prior to installation.
- B. Coordinate placement of cameras in ceilings with the work of other trades.
- C. Position cameras to avoid viewing direct light sources.

3.03 TESTING

- A. On completion of the system installation, demonstrate that proper signal level and quality have been maintained through all signal paths. All test equipment shall be provided and calibrated by the video surveillance contractor.
- B. An RS-170A test signal generator shall be the signal source for all signal measurements. Test signals shall be inserted at the first entry point to the video projection system and distributed downstream to the remainder of the system.
- C. Using a waveform monitor and vector scope, the signal shall be monitored through all signal paths that may affect the integrity of the original signal by changing levels, clamping, phase, or any other artifact relating to proper signal alignment. At all test points the signal shall conform to proper EIA RS-170A standards.
- D. Signals must comply with the manufacturer's specification for each piece of equipment under test. If discrepancies between the test results and the manufacturer's specifications are noted, this shall be brought to the attention of the consultant and appropriate corrective action taken.
- E. The signal shall be observed for AC hum or non-video related noise that is either visible in the displayed picture or detectable on the scope. The video surveillance contractor shall be responsible for correcting any discrepancies relating to signal quality.
- F. All adjustments to equipment shall be made by a qualified technician.
- G. Notify the architect a minimum of 48 hours prior to testing so that he may, at his discretion, furnish representatives to witness the testing procedure and results.
- H. Submit copies of the test results as described above prior to final acceptance and training. Include copies of the test results in the O&M manuals. Include the names of the individuals performing and witnessing the tests, and the manufacturer's name and model number of the test equipment used. Include a block diagram of the test setup for each test.
- I. Cameras shall be setup and adjusted to accommodate the different lighting conditions present in the room. Output of the camera shall conform to RS-170A standards.
- J. Securely mount all camera housings and brackets to support structure using approved fastening methods. Mounting shall adequately support camera, housing, and all accessories. Contractor shall consider the affects of wind, snow, and ice loading when mounting exterior cameras. All exterior fasteners shall be rust-proof. Seal all exterior building penetrations in an approved manner to make water-tight.
- K. After installation, field adjust cameras and internal camera settings in accordance with manufacturers instructions. Cameras shall be adjusted to provide the best possible performance under installed conditions.
- L. During construction phase, protect cameras and housings from dust, paint, moisture, and the like. Provide temporary protective masking as needed. Upon completion of construction, and prior to final Acceptance test, remove protective masking and thoroughly clean all cameras and housings.

3.04 DIGITAL VIDEO RECORDING SYSTEM

- A. Install digital video recording system in accordance with manufacturer's installation instructions. Coordinate IP addressing and network connections with Owner's designated telecommunications representative.

- B. Install three (3) copies of remote viewing software on owner-provided personal computers. Locations to be determined by Owner prior to start of installation.

3.05 DEMONSTRATION

A. At the completion of the system installation, the Contractor shall demonstrate that each camera can provide a fully operational video signal to a temporary local monitor, and can respond to all of the manufacturer's installation, maintenance, and operational controls via the serving signal cable, control cabling, and local setup connections. Included shall be demonstrations for:

1. Video image
2. PTZ control
3. PTZ pre-set
4. Alphanumeric labels for each of eight zones
5. Password protection
6. Pan/tilt speed preset
7. Window blanking
8. Action on alarm
9. Resume after alarm
10. Patterns
11. Proportional pan and tilt
12. Variable speed scan.

3.06 FIELD ADJUSTMENTS

- A. Contractor shall make final field adjustments to cameras as requested by Architect or Owner's Representative at time of Demonstration.
- B. Final field adjustments may include, but shall not be limited to:
 1. Relocation of camera housing within ceiling grid spaces.
 2. Change of camera positioning within housing.
 3. Change of lens settings to provide improved coverage.
 4. Adjustment of focus, iris and internal camera settings.

3.07 INSTRUCTION

- A. At the satisfactory completion of the system demonstration and acceptance testing, the Contractor shall conduct a minimum two hour instruction session of the Owner's designated personnel. The session shall be conducted by a Contractor's representative thoroughly familiar with the system. System O&M manuals shall be transmitted to the Project Representative prior to scheduling the instruction session. The training session shall include:
 1. General operation of the system.

2. Specific operation of all user-accessible equipment.
3. Explanation of the system warranty and the process for the owner to follow during the warranty period for system malfunctions.

END OF SECTION

SECTION 27 05 00

COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Communications equipment coordination and installation.
 - 2. Sleeves for pathways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common communications installation requirements.

1.03 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For sleeve seals.

1.05 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.01 SLEEVES FOR PATHWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.02 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
 - 3. Pressure Plates - Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.03 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.01 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.02 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.03 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.04 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Firestopping.

END OF SECTION

SECTION 27 05 26

COMMUNICATIONS GROUNDING AND BONDING

PART 1 - GENERAL

1.01 SCOPE OF WORK

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

1.02 RELATED SECTIONS

- A. Section 27 00 00 General Requirements.
- B. Section 27 05 28.29 Hangers and Supports for Communication Systems.
- C. Section 27 05 28.33 Conduits and Back Boxes for Communication Systems
- D. Section 27 11 00 Communications Equipment Room Fittings
- E. Section 27 13 00 Communications Backbone Cabling.
- F. Section 27 15 00 Communications Horizontal Cabling.

1.03 DEFINITIONS

- A. TBC (Telecommunications Bonding Conductor) - The bonding conductor installed from the building's grounding electrode system to the TMGB. This bonding conductor shall be sized the same as the TBB.
- B. BC (Bonding Conductor) – Typical bonding conductor installed from any telecommunications grounding bus bar (TMGB or TGB) to telecommunications equipment and/or raceway.
- C. TBB (Telecommunications Bonding Backbone) – Continuous bonding conductor installed from the TMGB to the furthest telecommunications room. All TGBs shall attach to the TBB.
- D. TMGB (Telecommunications Main Grounding Busbar) – The main telecommunications grounding bar located where the Outside Plant cables enter the telecommunications room.
- E. TGB (Telecommunications Grounding Busbar) – The telecommunications grounding bar located in every telecommunications room that does not contain the TMGB.

PART 2 - PRODUCTS

2.01 GROUNDING BUSBARS

- A. Telecommunications Main Grounding Busbar (TMGB)
 - 1. Part# XXX ground busbar with busbar insulators.
- B. Telecommunications Grounding Busbar (TGB)
 - 1. Part# XXX ground busbar with busbar insulators.

2.02 GROUNDING CONNECTIONS

- A. Grounding conductor terminations (lugs) shall be listed compression type, two hole, long barrel with window lug with a minimum of (2) crimps. Part# XXX or equal. Crimp according to manufacturer's recommendation.
- B. Grounding conductor terminations (HTAP) shall be listed compression type with a minimum of (2) crimps. Part # XXX or equal. Crimp according to manufacturer's recommendation.

2.03 BONDING CONDUCTORS

- A. Cable Tray Bonding Conductor
 - 1. Stranded green #6 AWG insulated bonding jumper (12" max) with appropriate lugs, or manufactured braided copper grounding jumper.
- B. Equipment Frame Grounding Strip
 - 1. Part# Telecommunications Rack Grounding Strip.
- C. Telecommunications Bonding Conductor (TBC)
 - 1. Green insulated copper bonding conductor, size as required by NEC.
 - 2. The TBC shall be, as a minimum, the same size as the TBB.
- D. Telecommunications Bonding Backbone (TBB)
 - 1. Green insulated copper conductor, minimum size of No. 6 AWG. The TBB shall be sized at 2 kcmil per linear foot of conductor length up to a maximum size of 3/0 AWG. Insulation shall meet fire ratings of its pathway.

Table 1. Sizing of the TBB

TBB length (ft)	TBB Size (AWG)
Less than 13	6
14-20	4
21-26	3
27-33	2
34-41	1

TBB length (ft)	TBB Size (AWG)
42-52	1/0
53-66	2/0
Greater than 66	3/0

PART 3 - EXECUTION TELECOMMUNICATIONS INSTALLATION

- A. Installation of the TMGB
1. Install the TMGB at the bottom of plywood backboard near the outside plant entrance conduits in the "MPOE".
 2. TMGB shall be installed so that the TBC for telecommunications is as short as possible and maintains a horizontal or downward path to the building's grounding electrode system.
- B. Installation of the TBC for Telecommunications
1. TBC shall be installed in continuous 3/4" PVC conduit. Install in EMT conduit only if the path passes through a plenum area. EMT conduit must be bonded to the TBC at both ends of the conduit.
 2. TBC shall maintain a horizontal or downward path from the TMGB to the building's grounding electrode system. No bend shall form an included angle of more than 90 degrees or have a radius of less than 6".
- C. Installation of the TGB
1. Install the TGB at the bottom of plywood backboard near the TBB.
 2. TGB shall be installed so that the bonding conductor connecting the TGB to the TBB is as short as possible and maintains a horizontal or downward path to the TBB.
 3. Install a stranded bonding conductor (same size as the TBB) from the TGB to the TBB. This wire shall be terminated on the TGB end with the two hole compression type lug and terminated on the TBB end with the HTAP kit.
- D. Installation of the TBB
1. Install Green insulated copper grounding conductor (refer to 2.03.D for conductor size) from the TMGB to the furthest telecommunications room.
 2. Conductors shall be installed in continuous 3/4" PVC conduit until it enters a telecommunications room. Where the TBB pathway passes through a plenum area, the installation of EMT conduit is required and must be bonded on each end to the TBB.
 3. Paint all conduit fittings, junction boxes and covers "GREEN".
 4. Each TBB shall be continuous to the furthest IDF.
 5. The end of the TBB shall be terminated on the TGB of the furthest telecommunications room.

6. TBB shall maintain a horizontal or downward path to the TMGB. No bend shall form an included angle of more than 90 degrees or have a radius of less than 6”.

E. Grounding of Cable Tray

1. Install Green #6 AWG bonding jumper (12” max) with two-hole lugs at each cable tray joint or install manufactured braided copper grounding jumper equal. Install Green #6 AWG grounding conductor with two hole lugs from side of cable tray down to TMGB or TGB. Maintain a horizontal or downward path from the cable tray to the TMGB or TGB. Drill and tap side of cable tray (for appropriate size bolt, ¼” x 20 min.), making sure that bolt does not extend into wire management part of tray.

F. Grounding of Equipment Frame

1. Install Equipment Frame Grounding Strip on back side of all equipment frames. Maintain a horizontal or downward path of the bonding conductor from the Equipment Frame Grounding Strip to the TMGB or TGB. No bend shall form an included angle of more than 90 degrees or have a radius of less than 6”.
 - a. Where only one equipment frame is located within a room, install a #6 AWG bonding conductor from the equipment frame grounding strip to the TMGB or TGB terminated with two-hole lugs.
 - b. Where multiple equipment frames are located within a room, install a bonding conductor (same size as the TBB) from the TMGB or TGB to the cable tray above the equipment frames. Route the bonding conductor horizontally on the “L” brackets of the cable tray. Install (1) #6 AWG green bonding conductor from each equipment frame grounding strip to the bonding conductor above the equipment frames. Attach the #6 AWG cable to the equipment frame grounding strip using two-hole lugs. Attach opposite end of #6 AWG to the bonding conductor above the equipment frames.
2. Install “L” brackets on cable tray for routing of the bonding conductors for equipment frame grounding. Install “L” bracket every 12”. Fasten bonding conductor on each “L” bracket using wire ties.

G. Installation of Bonding Conductors

1. Shall be routed so to minimize bends and length.
2. Shall be a minimum of #6 AWG.
3. Bonding Conductors shall maintain a horizontal or downward path to the TMGB or TGB. No bend shall form an included angle of more than 90 degrees or have a radius of less than 6”.
4. Use TAP kit to bond the TBB to the TMGB or TGB.

END OF SECTION

SECTION 27 05 28.29

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes discrete J-Hooks, slings and related accessories for supporting low voltage cable bundles above accessible ceilings and below accessible raised floor systems.

1.03 REFERENCES

- A. American National Standards Institute (ANSI)/ Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
 - 1. ANSI/TIA/EIA 568-B.1 Commercial Building Telecommunications Cabling Standard
 - 2. ANSI/TIA/EIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces
 - 3. ANSI/NFPA 70 National Electrical Code
- B. Underwriter's Laboratories, Inc. (UL)
 - 1. UL 2043 Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces
 - 2. UL 2239 Conduit, Tubing and Cable Support Hardware

1.04 DEFINITIONS

UTP	Unshielded twisted pair
Pathway	A series of supports and accessories for placement of low voltage systems cables
Main Pathway	A low voltage systems pathway where the cable count exceeds 30 cables

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

1.05 SUBMITTALS

- A. Provide submittal information in accordance with Section 270500 - Common Work Results For Communications and supplementary requirements described in this specification.
- B. Product Data: Submit product data on all cable support devices and accessories. Indicate materials, finishes, load ratings, dimensions, listings, approvals and attachment methods.
- C. Shop Drawings: For projects where the low voltage systems cable pathways are not shown on the drawings, they are to be contractor designed per Part 3. The contractor shall prepare and submit proposed main pathway layout drawings for review and approval by the Owner's representative prior to installing supports. Shop drawings shall:
 - 1. Indicate pathways on plan view
 - 2. Include elevations and sections to indicate space allocations and coordination with work of other trades
 - 3. Include details to describe the different support configurations, accessories, attaching means and cable groupings
- D. Closeout Submittals
 - 1. Provide complete copy of approved submittal documentation with the O&M Manuals.
 - 2. As-built Drawings: Provide marked up as-built drawings of main pathways

1.06 QUALITY ASSURANCE

- A. Low voltage system cable supports and accessories shall be listed to Underwriter's Laboratories, Inc Standard 2239.
- B. Low voltage system cable supports and accessories shall have the manufacturers name and part number stamped on the part for identification.
- C. Pre-Installation Meetings: Contractor shall set up a pre-installation meeting to discuss low voltage cable support layout work and installation guidelines. Contractor shall organize meeting a minimum of 30 days prior to initiating cable support installation work. Attendees shall include contractor, appropriate subcontractors, low voltage system vendors, architect and engineer. Purpose of meeting shall be to coordinate work between the parties to have a consistent layout for all low voltage system cables, minimize interferences and to make cable system accessibility for future owner modifications and maintenance high priority issue for all installers.

1.07 COORDINATION

- A. Coordinate layout and installation of low voltage cable bundle supports with other construction elements to ensure adequate headroom, working clearance and access. Revise locations and elevations for those indicated as required to suit field conditions and as approved by Engineer.

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

- B. Examine drawings and existing conditions above ceilings and include additional supports in bid price to avoid ducts, pipes, conduits, etc. Installation in existing ceilings if very difficult. Include extra labor time involved in bid price.

PART 2 - PRODUCTS

2.01 WIDE BASE CABLE SUPPORTS

- A. J hooks complying with EIA/TIA 568-B.1 and 569-A structured cabling system requirements. Minimum size is 1-5/16 inch diameter loop for (50) 4-pair UTP or 2 strand fiber optic cable or inner duct. Provide larger size or multiple hooks where required. Minimum 1" width and flared edges where cables enter and leave support. 2 inch diameter loop for (80) 4-pair UTP or 2 strand fiber optic cable or inner duct. 4 inch diameter loop for (300) 4-pair UTP or 2 strand fiber optic cable or inner duct.
- B. Accessories: Provide applicable accessories to independently support "J" hooks from structure. This includes extender bracket for mounting multiple J hooks on a single support, fasteners and clamps for connecting to wall, beams, rods, dedicated support wires and C and Z Purlins as required for specific construction.
- C. Cable Retainers: Provide cable retainers at each "J" hook
- D. Finish
 - 1. Dry Locations, Above Lay-in Ceiling, Below Raised Floor - galvanized
 - 2. Wet and Damp Locations: stainless steel
- E. Manufacturer.
 - 1. ERICO Caddy CableCat™ series
 - 2. Chatsworth RapidTrak™ series
 - 3. Or approved equivalent.

2.02 SOFT CABLE SLING SUPPORTS

- A. Adjustable sling cable supports suitable for plenums and complying with EIA/TIA 568-B.1 and 569-A structured cabling system requirements. 4 inch diameter loop for (220) 4-pair UTP or 2-strand fiber optic cables or inner duct. 6 inch diameter loop for (425) 4-pair UTP or 2-strand fiber optic cables or inner duct.
- B. Accessories: Provide applicable accessories to independently support slings from structure. This includes fasteners and clamps for connecting to walls, beams, rods, ceiling tee bars, dedicated support wires and C and Z Purlins as required for specific construction
- C. Material
 - 1. Construction: Polyethylene strands woven and laminated, reinforced seams, connected steel mounting and fastening hardware.
 - 2. Suitable for plenum location installation

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

- D. Manufacturer.
 - 1. ERICO Caddy CableCat™ 425 series
 - 2. Or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All low voltage systems cables shall be supported. Provide supports along entire Pathway.
- B. Space supports a maximum of 48 inches apart and at each change of direction of the cables.
- C. Hang cable supports from 3/8" all thread rods, dedicated #8 galvanized ceiling drop wire or wall brackets connected directly to structure. Do not support from the ceiling grid or ceiling wire system.
- D. Where main pathways are indicated on the drawings, contractor shall follow the indicated pathways as closely as possible according to field conditions. Pathways for smaller cable counts shall be designed and documented on the as-built drawings by the contractor.
- E. Where specific main pathways are not indicated on the drawings, the cable pathways for all low voltage systems shall be designed by the contractor. The contractor shall coordinate pathways with all other trades to achieve efficient utilization of available space, complete accessibility to allow maintenance of cable plant and economical future adds moves and changes. Contractor shall provide Main pathway shop drawings for review and approval by the Owner's representative
- F. Install support wires, brackets or rods to route cables parallel and perpendicular to building lines.
- G. Provide multiple hooks or slings at each hanger location as required by cable count and cable segregation requirements.
- H. Fill supports with cabling to 50% or less of the manufacturer's recommended fill. Provide multiple supports where required cable count exceeds 50% fill.
- I. Edit the following cable grouping list to fit the specific project requirements
- J. Group cabling in separate supports by the following systems:
 - 1. Voice and Data Cabling
 - 2. CCTV/CATV/Video Systems/ Radio and Satellite Systems
 - 3. Audio
 - 4. Building Automation, Lighting Control Systems
 - 5. Fire Alarm

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HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

6. When total cable count to a small group of work stations or offices is less than 24, the cables may be installed grouped in a single support of appropriate size.
- K. Interface with Other Work: Coordinate installation of supports with mechanical ductwork, piping and sprinkler system piping so that supports remain accessible after installation.
- L. Install low voltage cable support system above accessible ceilings and below accessible raised floor systems only.
- M. Elevation of Cable Supports: Contractor shall coordinate the allocation of ceiling space and the mounting elevations of various systems to allow maintenance and accessibility for future modifications. Low voltage system cable supports shall be as close to the ceiling as possible while allowing ceiling tiles to be removed. Supports shall be located to avoid interference with maintenance access to other equipment.
- N. Cable installation and supports shall comply with applicable provisions of EIA/TIA 569-A and ANSI/NFPA 70.

END OF SECTION

SECTION 27 05 28.33

CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections
 - 1. Section 260533 - Raceways and Boxes for Electrical Systems
 - 2. Section 271500 - Communications Horizontal Cabling.
- C. Other References

EIA/TIA-569A Commercial Building Standard for
Telecommunications Pathways and Spaces

TIA/EIA/ANSI-J-STD-607-A Commercial Building Grounding (Earthing) and
Bonding Requirements for Telecommunications

1.02 DESCRIPTION

- A. Provide raceway systems for the installation of the telephone cables and computer wiring. Installation shall include raceways, outlet boxes, plaster rings, outlet box cover plates and terminal back boards.

PART 2 - PRODUCTS

2.01 WALL OUTLETS

- A. Shall consist of a 5" square, 2-7/8" deep box as manufactured by Randl Corporation.
- B. Surface wall outlets shall be 4" square, 2-3/4" deep (minimum) and shall match and be manufactured by the surface metal raceway manufacturer.

2.02 FLOOR OUTLETS

- A. See Section 260533.10 - Flush Floor Outlets for flush floor outlets.
- B. See Section 260533.20 - Floor Outlet Devices Poke Thru for poke-thru floor outlets.

2.03 OUTLET DEVICE RING

- A. Provide single gang device ring.
- B. Provide two gang device ring.
- C. Coordinate device ring requirements with cable/outlet installer

2.04 DEVICE PLATES

- A. Provide device cover plates for all unwired or "future" outlets. Plates shall match device plates specified in Section 262726 - Wiring Devices except with no device openings.

2.05 PULL WIRE

- A. Shall be plastic having not less than 200-pound tensile strength.

2.06 TELEPHONE TERMINAL BOARDS

- A. Shall be 3/4 inch plywood backboard 8' feet high by 4" wide or as indicated in plans. APA interior grade Douglas Fir A-C. Shall be fire retardant with flame spread rating not more than 25 when tested according to ASTM E84.

2.07 TELECOM GROUND BAR, TELECOM MASTER GROUND BAR (TGB, TMGB)

- A. Copper bus bar, 10 x 4 x 1/4" with a minimum of six (6) 3/8-inch and four (4) 1/2-inch diameter holes on 2-inch centers with screw lugs to secure ground wire terminations. Suggested Product: Universal Bus Bar #10622-010 or similar by Everett Machine Works or as detailed on the drawings. Mount with 4-inch insulated stand-off brackets.

PART 3 - EXECUTION

3.01 WALL OUTLETS IN UNINSULATED INTERIOR WALLS WITH ACCESSABLE CEILINGS

- A. Provide an individual conduit from each outlet location to an accessible ceiling space.
- B. Provide a cut-in ring, a 1" grommeted hole through the wall top plate, and a pull string in wall.
- C. Provide an individual conduit from each communications outlet to an accessible location at cable tray or to a telephone terminal backboard.

3.02 WALL OUTLETS IN UNINSULATED INTERIOR WALLS WITH NON-ACCESIBLE CEILINGS, EXTERIOR WALLS OR INSULATED INTERIOR WALLS

- A. Provide an individual conduit from each outlet location to an accessible ceiling space.
- B. Provide an individual conduit from each communications outlet to an accessible location at cable tray or to a telephone terminal backboard.

3.03 FLOOR MOUNTED OUTLETS

- A. All conduits from floor outlets shall terminate in a space on the same floor as the outlet.
- B. Provide an individual conduit from each outlet location to an accessible ceiling space.
- C. Provide an individual conduit from each communications outlet to an accessible location at cable tray or to a telephone terminal backboard.

3.04 FLOOR OUTLETS/ BOXES IN SLAB ON GRADE

- A. Provide an individual conduit from each outlet box to a consolidation point interior to the building within 25 feet of the point where the conduit exits the slab.
- B. Provide an individual conduit from each outlet box to the serving Telecom Room.

3.05 SYSTEM FURNITURE CONNECTIONS

- A. Provide an individual conduit from each wall connection location to an accessible ceiling space.
- B. Provide an individual conduit from each wall connection outlet to an accessible location at cable tray or to a telephone terminal backboard.
- C. Provide an individual conduit from each furniture system communication/power pole location to an accessible ceiling space.
- D. Provide an individual conduit from each furniture system communication/power pole location at cable tray or to a telephone terminal backboard

3.06 SURFACE METAL RACEWAY CONNECTIONS

- A. Provide an individual conduit from each surface raceway to an accessible ceiling space.
- B. Provide an individual conduit from each surface raceway at cable tray or to a telephone terminal backboard.

3.07 CONDUIT SIZING TABLE

- A. Provide conduits for communications outlets sized as follows:

Wall Phones	1"
Wall Outlets (except wall phones)	1-1/4"
Single Gang Floor Mounted Outlets/Boxes	1-1/4"
Multiple Gang Recessed Floor Outlets/Boxes	1-1/4"
System Furniture - per every (2) workstations	1"
System Furniture - per every (3) workstations	1-1/4"
Surface Metal Raceway - per 12 ft of SMR	1"
Surface Metal Raceway - per 20 ft of SMR	1-1/4"

3.08 RACEWAYS

- A. Shall conform to specification Section 260533 - Raceways and Boxes for Electrical Systems with the additional requirement that no length of run shall exceed 100 feet and shall not contain more than two 90-degree bends or the equivalent without a code size pull box. Provide pull boxes where necessary to comply with these requirements. Locate pull boxes in straight runs only, not as a replacement for an elbow.
- B. Conduits with an internal diameter of two inches or less shall have a bend radius at least 6 times the internal conduit diameter. Conduits greater than two inches shall have a bend radius at least 10 times the internal conduit diameter.
- C. Provide an insulated bushing on all conduits terminated in a cabinet and/ or pullboxes.
- D. Terminate conduits stubbed out above accessible ceiling space so that the conduit is parallel with the ceiling and provide an insulating bushing.
- E. Terminate conduit at cable trays at an accessible location within 6" of tray with an insulated bushing and provide bonding jumper or terminate conduit to the cable tray with an insulated bushing.

3.09 PULL BOXES

- A. Pull boxes shall be sized per the following table:

PULL BOX SIZING (inches)

Conduit Trade Size	Width	Length	Depth	Width increase for additional conduit
1	4	16	3	2
1-1/4	6	20	3	3
1-1/2	8	27	4	4
2	8	36	4	5
2-1/2	10	42	5	6
3	12	48	5	6
3-1/2	12	54	6	6
4	15	60	8	8

3.10 PULL CORDS

- A. Nylon type shall be included in all raceways over 10 feet long. Leave not less than 12 inches of slack at each end of the pull wire.

3.11 GROUNDING

- A. Provide a Telecom Master Grounding Bar in the telecommunications entrance facility
- B. Provide a Telecom Grounding Bar in each telecom room.
- C. Telecom Bonding Conductor and Telecom Bonding Backbone (TBB)
 - 1. Provide a telecom bonding conductor between the building electrical service entrance equipment ground and the telecom main ground bar (TMGB).
 - 2. Provide a telecom bonding backbone conductor (TBB) between the TMGB and each telecom room ground bar (TMB). Unless otherwise indicated on the Grounding Riser, the TBB conductors shall follow the configuration of the telecom backbone.
- D. Panelboard Bonding: For each telecom room, provide a bonding conductor between the ground bus of each panelboard serving electrical equipment within the telecom room and the TGB serving the room.
- E. Structural Steel Bonding: Provide a minimum #6 conductor from the TMGB or TGB to a readily accessible point on a vertical member or permanently electrically bonded horizontal member of the structural steel system of the building.
- F. Pathway Bonding:
 - 1. Bond all metal pathways (conduits, cable tray, and cable runway) within telecom rooms to the TMGB or TGB, with the exception of floor and wall sleeves.
- G. Telecom Grounding/Bonding Conductor Sizing:

Maximum Length	Wire Size (AWG)
4m (13ft)	6
6m (20 ft)	4
8m (26 ft)	3
10m (33 ft)	2
13m (41 ft)	1
16m (52 ft)	1/0
20m (66 ft)	2/0
Over 20m (66 ft)	3/0

- H. Label each grounding and bonding conductor as follows: "IF THIS CONNECTOR OR CABLE IS LOOSE OR REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER."
- I. Refer to Section 260526 - Grounding and Bonding For Electrical Systems, for additional grounding requirements.

3.12 RACEWAY RISER SLEEVES

- A. Riser raceways to be installed through floors with tops 6 inches above each floor to give continuous cable riser capability. Stuff sleeves with an approved non-combustible material such as rock wool to maintain floor fire separation.

3.13 REMODEL SPACES

- A. Remove in active and abandoned telephone and computer conductors that serve spaces remodeled, only after receiving approval from the owner.
- B. Notify owner in writing when active telephone and computer conductors serving occupied spaces and must be relocated due to the remodel.

END OF SECTION

SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.
4. Telecommunications service entrance pathways.
5. Grounding.

- B. Related Sections:

1. Section 271300: Communications Backbone Cabling.
2. Section 271500 Communications Horizontal Cabling.
3. Section 280513 Conductors and Cables for Electronic Safety and Security for voice and data cabling associated with system panels and devices.

1.03 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel not exceeding 6 inches (152 mm) in width.
- D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of a bottom without ventilation openings within integral or separate longitudinal side rails.

- H. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

1.04 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Floor-mounted cabinets and cable pathways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.
- C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- D. Seismic Qualification Certificates: For floor-mounted cabinets, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
 - D. Grounding: Comply with ANSI-J-STD-607-A.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.08 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 2. Record agreements reached in meetings and distribute them to other participants.
 3. 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.
 4. 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.
- B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.01 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.

1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
 2. Support brackets with cable tie slots for fastening cable ties to brackets.
 3. Lacing bars, spools, J-hooks, and D-rings.
 4. Straps and other devices.
- C. Cable Trays:
1. Manufacturers:
 - a. Cablofil Inc.
 - b. GS Metals Corp.
 2. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion.

2.02 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

2.03 EQUIPMENT FRAMES

- A. Manufacturers:
1. Chatsworth
- B. General Frame Requirements:
1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 2. Module Dimension: Width compatible with EIA 310 standard, 19-inch (480-mm) panel mounting.
 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- C. Floor-Mounted Racks: Modular-type, steel or aluminum construction.
1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
 2. Baked-polyester powder coat finish.
- D. Modular Freestanding Cabinets:
1. Removable and lockable side panels.
 2. Hinged and lockable front and rear doors.
 3. Adjustable feet for leveling.
 4. Screened ventilation openings in the roof and rear door.

5. Cable access provisions in the roof and base.
 6. Grounding bus bar.
 7. Power strip.
 8. Baked-polyester powder coat finish.
 9. All cabinets keyed alike.
- E. Cable Management for Equipment Frames:
1. Metal, with integral wire retaining fingers.
 2. Baked-polyester powder coat finish.
 3. Vertical cable management panels shall have front and rear channels, with covers.
 4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.04 POWER STRIPS

- A. Power Strips: Comply with UL 1363.
1. Rack mounting.
 2. [Six] 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
 3. LED indicator lights for power and protection status.
 4. LED indicator lights for reverse polarity and open outlet ground.
 5. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
 6. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
 7. Cord connected with 15-foot (4.5-m)] line cord.
 8. Rocker-type on-off switch, illuminated when in on position.
 9. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
 10. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.

2.05 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
1. Connectors: Mechanical type, cast silicon bronze, solderless exothermal-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with ANSI-J-STD-607-A.

2.06 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.01 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.

3.02 Install underground entrance pathway complying with Section 260543 Underground Ducts and Raceways for Electrical Systems.

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.03 FIRESTOPPING

- A. Comply with requirements in Division 07 Firestopping.
- B. Comply with TIA/EIA-569-A, Annex A, Firestopping.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.04 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.

- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.05 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Section 2630553 Identification for Electrical Systems. Comply with requirements in Division 09 Interior Painting for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- B. See Section 271500 Communications Horizontal Cabling for additional identification requirements. See Evaluations for discussion of TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
- C. Labels shall be preprinted or computer-printed type.

END OF SECTION

COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:

1. Pathways.
2. UTP cable.
3. 50/125-micrometer, optical fiber cabling.
4. Coaxial cable.
5. Cable connecting hardware, patch panels, and cross-connects.
6. Cabling identification products.

- B. Related Sections:

1. Section 281513 Conductors and Cables for Electronic Safety and Security for voice and data cabling associated with system panels and devices.

1.03 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

1.04 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.05 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.06 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For coaxial cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
- C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop, Cabling Administration Drawings, and field testing program development by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: **25** or less.
 - 2. Smoke-Developed Index: **50** or less.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- F. Grounding: Comply with ANSI-J-STD-607-A.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
 - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
 - 3. Test each pair of UTP cable for open and short circuits.

1.09 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and

maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.11 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for one year.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.12 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Patch-Panel Units: One of each type.
 - 2. Connecting Blocks: One of each type.

PART 2 - PRODUCTS

2.01 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- C. Cable Trays:
 - 1. Manufacturers:
 - a. Cablofil Inc.
 - b. GS Metals Corp.

2.02 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

2.03 UTP CABLE

A. Manufacturers

1. AMP.

B. Description: 100-ohm, multiple pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket .

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, [Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG].
 - b. Communications, Plenum Rated: Type CMP complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR, complying with UL 1666.
 - d. Communications, Limited Purpose: Type CMX.
 - e. Multipurpose: Type MP or MPG.
 - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
 - g. Multipurpose, Riser Rated: Type MPR complying with UL 1666.

2.04 UTP CABLE HARDWARE

1. AMP.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable indicated.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, 4-pair cables in 48-inch (1200-mm) lengths; terminated with 8-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 5e performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

2.05 OPTICAL FIBER CABLE

A. Manufacturers:

1. AMP.

B. Description: Multimode, 50/125-micrometer, strand count per Plans, fiber, nonconductive, tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Nonconductive: Type OFN or OFNG.
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or.
 - e. Plenum Rated, Conductive: Type OFCP complying with NFPA 262.
 - f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
5. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
6. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: Aqua for 50/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.06 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers:

B. AMP.

C. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- D. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.
- E. Cable Connecting Hardware:
1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

2.07 COAXIAL CABLE

- A. Manufacturers:
1. Belden CDT Inc.; Electronics Division.
 2. CommScope, Inc.
- B. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- C. RG-11/U: NFPA 70, Type CATV.
1. No. 14 AWG, solid, copper-covered steel conductor.
 2. Gas-injected, foam-PE insulation.
 3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
 4. Jacketed with sunlight-resistant, black PVC or PE.
 5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.
- D. RG59/U: NFPA 70, Type CATVR.
1. No. 20] AWG, solid, silver-plated, copper-covered steel conductor.
 2. Gas-injected, foam-PE insulation.
 3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.
 4. Color-coded PVC jacket.
- E. RG-6/U: NFPA 70, Type CATV or CM.
1. No. **16** AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.

3. Jacketed with black PVC or PE.
 4. Suitable for indoor installations.
- F. RG59/U: NFPA 70, Type CATV.
1. No. 20 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.
 3. PVC jacket.
- G. RG59/U (Plenum Rated): NFPA 70, Type CMP.
1. No. 20 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
 2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.
 3. Copolymer jacket.
- H. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70, "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
1. CATV Cable: Type CATV.
 2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
 3. CATV Riser Rated: Type CATVR, complying with UL 1666.
 4. CATV Limited Rating: Type CATVX.

2.08 COAXIAL CABLE HARDWARE

- A. Manufacturers:
1. Aim Electronics; a brand of Emerson Electric Co.
 2. Leviton Voice & Data Division.
 3. Siemon Co. (The).
- B. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.09 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.10 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.02 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.03 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Section 260533 Raceway and Boxes for Electrical Systems for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 2. Install cable trays to route cables if conduits cannot be located in these positions.
 3. Secure conduits to backboard when entering room from overhead.
 4. Extend conduits 3 inches (76 mm)] above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.04 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
1. Comply with TIA/EIA-568-B.1.
 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 3. Install 110-style IDC termination hardware unless otherwise indicated.
 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
 11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.

2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
 2. Install cabling after the flooring system has been installed in raised floor areas.
 3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.
- G. Outdoor Coaxial Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
 2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).
- H. Group connecting hardware for cables into separate logical fields.
- I. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations 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 (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

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 (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
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 (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.05 FIRESTOPPING

- A. Comply with requirements in Division 07 Firestopping. Comply with TIA/EIA-569-A, Annex A, Firestopping.
- B. 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 ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.07 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 Identification for Electrical Systems.
 1. Administration Class: 4.

2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Division 09 Interior Painting for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
 - C. See Section 271500 Communications Horizontal Cabling for additional identification requirements. See Evaluations for discussion about TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 4 level of administration including optional identification requirements of this standard.
 - D. Comply with requirements in Section 271500 Communications Horizontal Cabling for cable and asset management software.
 - E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
 - F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
 - G. Cable and Wire Identification:
 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 - H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.08 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - 4. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- F. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

END OF SECTION

SECTION 271500

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This section includes the following items for wiring systems used as signal pathways for voice and high speed data transmission:
 - 1. Unshielded twisted-pair cabling
 - 2. Patch cords
 - 3. Termination hardware
 - 4. Workstation outlets
 - 5. Cable supports
 - 6. Cable management hardware
- B. It is the intent of this section for the Contractor to provide a complete workable cabling system ready for the Owner's use in accordance with EIA/TIA 568-B standards to support high speed data applications up to and in excess of 1000Mbps including IEEE system standards based on Twisted Pair Distributed Data Interface (TPDDI), Ethernet, Fast Ethernet, Gigabit Ethernet and Asynchronous Transmission Mode (ATM).
- C. Related Sections
 - 1. 270528.29 - Hangers And Supports For Communications Systems
- D. Related Work to be Provided by Owner or their Representative
 - 1. Installation of workstation devices: computers, terminals, telephones, and similar equipment.
 - 2. Installation of patch cords or cross connect wire to connect workstation devices to network equipment and backbones.

1.03 REFERENCES

- A. American National Standards Institute (ANSI) Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
- B. ANSI/TIA/EIA 568-B.1 Commercial Building Telecommunications Cabling Standard
- C. Building Industry Consulting Services International (BICSI)
- D. Federal Communications Commission (FCC)
- E. Institute of Electrical and Electronics Engineers (IEEE)
- F. National Fire Protection Association (NFPA)
- G. Underwriter's Laboratories, Inc. (UL)

1.04 APPLICABLE CODES AND STANDARDS

- A. Provide the system in compliance with the following:
 - 1. NFPA Codes, Standards and Manuals (latest issue enforced)
 - a. 70 - National Electrical Code
 - 2. Washington Administrative Codes (WAC)
 - a. WAC 296-46 Safety Standards - Installing Electric Wires and Equipment
 - 3. Other Codes
 - a. Local fire code, building code, mechanical code, electrical code, rules and interpretations required by the Authority Having Jurisdiction.

1.05 PRICING

- A. Basic Bid: Include all labor and materials required for the furnishing, installing, testing, and placing in satisfactory and fully operational condition all equipment, materials, devices, and necessary appurtenances to provide a complete telecommunications cabling system for the project as indicated and specified.
- B. Alternate Bids: Each Bidder shall include with his proposal, in the spaces provided therefore in the "Form of Bid," alternate proposals for adding, or substituting, materials and construction to, or for deleting materials and construction from, the Basic Bid. The alternate proposal figure shall indicate the difference in price, or the amount to be added to or deducted from the Basic Bid for the construction or installation of work included in the alternate bid.
- C. Unit Pricing: Provide unit prices including shop drawings, engineering, and any system programming required for each device to add/delete the following:
 - 1. Voice/Data Outlet, per outlet to a maximum of 100 outlets, including:
 - a. (3) Permanent Links, including Cat [5e] [6] cables from Telecom Room to outlet, installed. Nominal length of 280 ft each cable.
 - b. All connectors and terminations at the outlet and in the Telecom Room.
 - c. Faceplate and (pro-rated portion of) 110 block.
 - d. (2) Patch cables - 110 block to data equipment within Telecom Room.
- D. Existing Conditions
 - 1. Existing Systems Maintained: Investigate existing systems and systems adjacent to the work prior to bidding. Repair any damage resulting from performance of work under this contract to assure continuing operation and integrity during and at completion of the project at no increase in contract cost.
 - 2. Existing Wiring: Reroute existing wiring to maintain circuit continuity for devices to remain in service and interrupted by work performed under this contract. Contractor shall assume the risk of maintaining existing systems except relocation of 200 pair cables and above shall be considered an additional cost if not shown to be relocated. If such wiring is found the Contractor shall notify Architect of wiring location, reason it must be removed and cost of relocation and receive the Owner's approval before proceeding with the work.
 - 3. The building will continue operation during the work and it is essential that no systems operation be interrupted unless scheduled with the Architect. Contractor shall assume responsibility for unscheduled interruptions and expedient repair.
 - 4. Inspect the existing installation prior to bidding and include all work required to provide a complete installation as described by the contract documents.

1.06 DEFINITIONS

- A. As Directed: as directed by the Owner or his representative.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

- C. EMI: Electromagnetic interference.
- D. Cable: Telecommunication conductors and sheaths.
- E. Cabling, Cabling System: Cables between and including the telecommunications outlet/connector and the cross connect including all fittings, conductors, connector strips, connections, termination and all other items necessary and/ or required in connection of such work.
- F. Telecommunications Outlet: Connectivity point for telecommunications services, including but not limited to voice, data, DDC, building automation, CCTV, CATV, Nurse Call, AV Systems, and Wireless Access Points.
- G. Concealed: embedded in masonry or other construction, installed behind wall furring or within wall partitions, or installed within hung ceilings.
- H. Exposed: not installed underground or "Concealed" as defined above.
- I. Furnish: Deliver to the jobsite.
- J. Install: To enter permanently into the project and make fully operational including testing.
- K. Permanent Link: the end-to-end cable media transmission path including the cable and termination equipment on each end.

1.07 SUBSTITUTION OF MATERIALS

- A. No Substitute:
 - 1. Where a specified product is indicated "no substitute" it is the intent of this specification to require new materials to be compatible with the existing installation. To this end certain materials and systems no substitution will be allowed.
- B. Approved Manufacturer
 - 1. Where a specified product is indicated "or equivalent by Approved Manufacturer", only the manufacturers listed in the Specification for the item are allowed.
- C. Prior to Bid Opening:
 - 1. Acceptance of products other than those specified as "or equivalent by Approved Manufacturer" will be issued by addendum to the bid documents only after the following requirements are met and the proposed listed material is determined to meet or exceed the requirements:
 - a. Requests for listing to be original material, clearly indicating the product fully complies with contract documents and be neatly marked with yellow felt tip marker to clearly define and describe the product for which listing is requested.
 - b. Samples shall be submitted if requested.
 - c. Requests shall be received 10 days prior to bid opening.
 - 2. Requests containing insufficient information to confirm compliance with contract documents will not be considered.
- D. After Award of Contract:
 - 1. Substitution of products will be considered after award of contract only under the following conditions:
 - a. The Contractor shall have placed orders for specified materials promptly after contract is awarded and the specified products can not be delivered to the project to meet the Owner's construction schedule.

- b. The reason for the unavailability is beyond the Contractor's control, i.e., due to strikes, bankruptcy, discontinuance of manufacturer, acts of God.
 - c. The specified product is no longer manufactured.
 - d. There is compelling economic advantage to the Owner.
- E. In all cases, should a substituted material result in requiring low voltage system or building modifications; the Contractor alone shall pay all costs to provide these modifications including all costs to the Engineer and Owner for redesign, and updating of record drawings required

1.08 SUBMITTALS AND SHOP DRAWINGS

- A. Schedule:
- 1. Schedule so as to allow sufficient time for submittal review and re-reviews before commencement of work, including material procurement. Allow two weeks for review for each submittal and re-submittal. Incomplete submittals and shop drawings which do not comply with these requirements will be returned for correction, revision and re-submittal
 - 2. So as not to delay construction schedule.
 - 3. No later than 60 days after award of contract
- B. Provide (6) copies of all Submittals.
- C. Product Submittals:
- 1. Provide in a three ring binder with hardboard covers.
 - 2. Provide with index and divider tabs by Specification section.
 - 3. Indicate Specification paragraph number on all documents.
 - 4. Review and check all material prior to submittal and stamp "Reviewed and Approved".
 - 5. Submittals shall include:
 - a. Product Data for all items provided under this Section.
 - 1) Indicate materials, finishes, load ratings, dimensions, listings, approvals and attachment methods.
 - 2) Indicate how the components of an item or system are assembled, interconnected, function together and how they will be installed on the project.
 - 3) Highlight with yellow or blue marker, or indicate with arrow stamp, adequate information to demonstrate materials being submitted fully comply with contract documents.
 - 4) Indicate listing by UL or other approved testing agency.
 - b. Manufacturers' Cable Installation Instructions
- D. Shop Drawings
- 1. Provide detailed elevation views (minimum scale 1"=1'-0") of, equipment racks, termination blocks, patch panels, cable paths and workspace requirements for access to equipment and cable connections.
 - 2. Ratings of items.
 - 3. Coordinate with other division shop drawings and submittals. Identify interface points and indicate method of connection.
 - 4. Provide drawings to show evidence of coordination with other trades.
 - 5. Provide plan drawings of each floor of each building showing:
 - a. Routing for all cables installed under this Work.
 - b. Pathways of all cable supports with part number, total capacity, and installed capacity for each support or run of supports.
 - 6. Reports and Schedules
 - a. Provide Cable Termination Schedules for all cables installed under this work, with the following information:

- b. Workstation cable – Building, floor, IDF closet, room number, corridor number (ceiling mount), outlet ID, cable ID, rack number, termination device number and port/cable pair position.
 - 7. Provide sample reports showing the proposed format for cable test reports.
 - 8. Provide a construction schedule showing the various work tasks, time periods, duration and staffing requirements.
- E. Cable Test Reports
- 1. Provide Cable Test Reports per Part 3, this Specification
- F. The Contractor agrees:
- 1. Submittals and shop drawings processed by the Architect or Owner are not change orders.
 - 2. The purpose of submittals and shop drawings by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept.
 - 3. Submittals demonstrate equipment and material Contractor intends to furnish and install and indicate detailing fabrication and installation methods Contractor intends to use.
 - 4. To accept all responsibility for assuring that all materials furnished under this Specification meet, in full, all requirements of the contract documents.
 - 5. To pay for Engineers review cost of submittal review beyond one re-submittal.
- G. The Engineer's review is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Corrections or comments made during this review do not relieve contractor from compliance with the requirements of the drawings and specifications. Contractor is responsible for:
- 1. Dimensions which shall be confirmed and correlated at the job site.
 - 2. Fabrication process and techniques of construction.
 - 3. Coordination of his work with that of all other trades.
 - 4. Performing his work in a safe and satisfactory manner.
- H. Manufacturers' Cable Installation Instructions

1.09 OPERATION AND MAINTENANCE MANUALS

- A. Provide (6) copies of O&M manuals required in plus one manual for Sparling for all equipment furnished under this Specification. Submit a preliminary copy, complete except for the bound cover, 60 days prior to completion of the project for checking and review. Deliver final bound corrected copies plus a copy to Sparling 20 days prior to scheduled instruction periods.
- B. The information included must be the exact equipment installed. Where sheets show the equipment installed and other equipment, the installed equipment shall be neatly and clearly identified on such sheets.
- C. These O&M manuals shall contain all the information needed to operate and maintain all systems and equipment provided in the project. Present and arrange information in a logical manner for efficient use by the Owner's operating personnel. The information provided shall include but not be limited to the following:
 - 1. Equipment manufacturer, make, model number, size, nameplate data, etc.
 - 2. Dimensional and performance data for specific unit provided as appropriate.
 - 3. Complete parts list including reordering information, recommended spares and anticipated useful life (if appropriate). Parts lists shall give full ordering information assigned by the original parts manufacturer. Relabeled and/or renumbered parts information as reassigned by equipment supplier not acceptable.
 - 4. Shop drawings.
 - 5. Wiring diagrams.

6. A complete list of local (nearest) manufacturer representative and distributor contacts for each type of equipment and manufacturer. Include name, company, address, phone, fax, e-mail address, and web site.
7. Provide revised Cable Termination Schedules of all cables installed under the Work. Schedules shall be in printed form and on CD disk and in the version of Microsoft Excel extant at the time of first submission.
8. Cable Test Reports in CD form, including review software.
9. Group the information contained in the manuals in an orderly arrangement by Specification paragraph. Provide a typewritten index and divider sheets between categories with identifying tabs. Bind the completed manuals with hard board covers not exceeding 5" thick. (Provide two or more volumes if required.) Imprint the covers with the name of the job, Owner, Architect, Technology Consultant, Contractor and year of completion. Imprint the back edge with the name of the job, Owner and year of completion. Hard board covers and literature contained may be held together with screw post binding.

1.10 RECORD DRAWINGS:

- A. Continually record the actual cabling system installation on a set of prints kept readily available at the project during construction. These prints shall be used for this purpose alone.
- B. Mark record prints with red erasable pencil. Mark the set to show the actual installation where the installation varies substantially from the work as originally shown.
- C. Include addenda items and revisions made during construction.
- D. Erase conditions not constructed or "X-out" and annotate "not constructed" to clearly convey the actual "as constructed" condition.
- E. Organize record drawings sheets in manageable sets, bind and print suitable titles, dates and other identification on the cover of each set.
- F. Transmit the record drawing set to the Owner at the completion of the work. Final payment to the contractor will not be authorized until these prints have been submitted to and accepted by the Owner.
- G. Transfer the changes marked up on the record prints into AutoCAD Release 14 (or higher) at the completion of the work. Provide two (2) sets of prints, one set of fixed line reproducible drawings and one set of AutoCAD drawing files on Compact Disk. Transmit drawings, CAD files and the record drawing mark-ups to the Owner. Final payment to the contractor will not be authorized until these document have been submitted to and accepted by the Owner

1.11 FINAL ACCEPTANCE REQUIREMENTS

- A. Provide to the Owner, Record Drawings annotated with the changes made during the installation of the Work so as to be a complete set of "As Installed" plans. Drawings shall be in printed form and on CD disk in AutoCAD 2004 format.
- B. Certificate of Compliance:
 1. Provide for Owner's documentation, a completion statement in form stipulated by the Owner and signed by the Contractor, stating that the Work was completed in compliance with the Contract Documents and that the installation was proper for the conditions of application and use.

1.12 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer shall have on staff personnel certified by BICSI.
 - 1. Layout Responsibility: Preparation of Shop Drawings and field testing program development shall be performed by a Registered Communications Distribution Designer (RCDD).
 - 2. Installation Supervision: Installation shall be under the direct supervision of a **[RCDD Registered Technician] [Level 2 Installer]** and shall be present at all times when Work of this section is performed at the Project site.
- B. Source Limitations:
 - 1. Obtain all products except cables through one source from a single manufacturer.
 - 2. All Permanent Link components (including cables) of the workstation cable system shall be the products of one manufacturer.
- C. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the authority having jurisdiction, and marked for intended use.

1.13 COORDINATION OF THE WORK

- A. Carefully check space requirements and the physical confines of the area of work to insure that all material can be installed in the spaces allotted thereto, including conduits and cable supports.
- B. Transmit to other trades in a timely manner all information required for work to be provided under their respective Sections in ample time for installation.
- C. Wherever work interconnects with or contacts the work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment.
- D. Due to the type of installation, a fixed sequence of operation is required to properly install the complete systems. Coordinate project and schedule work with the General Contractor in accordance with the construction sequence. Provide progress status of the installation to the General Contractor to allow them to update their project schedules.
- E. Contractor shall note that the construction schedule may dictate that work must be carried out simultaneously in more than one building and on more than one floor.
- F. Coordinate layout and installation of voice and data communications cabling with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangements with local exchange carrier.
 - 1. Meet jointly with the telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute to other participants.
 - 3. Adjust arrangements and location of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangements and space requirements of the telephone switch and LAN equipment.
- G. Attend all construction meetings, at the project site or other location, as requested by the Owner, Engineer, and/or General Contractor.

- H. The Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper compliance with the design intent.

1.14 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials (except bulk materials) in manufacturer's unopened containers, fully identified with the manufacturer's name, trade name, type, class, grade, size and color.
- B. Store materials suitably sheltered from the elements, but readily accessible for inspection until installed. Store all items subject to moisture damage in dry spaces. Provide space requirements for storage with the submittals. The General Contractor shall assign storage space.

1.15 CERTIFICATION & WARRANTY

- A. Refer to General Conditions of the Contract.
- B. All work and all items of equipment and materials shall be warranted for a minimum period of one year, from the date of acceptance of the work. Where a manufacturer's warranty is longer than one year, the Contractor shall offer the extended warranty. The Contractor shall, upon notification of any defective items, repair or replace such items within 24 hours without cost to the Owner, all to the satisfaction of the Owner/Engineer.
- C. Furnish a manufacturer's "Permanent Link" performance warranty of all EIA/TIA 568-B category 6[5e] [6] cables for a minimum period of twenty-five years, from the date of acceptance of the work. Where a manufacturer's warranty is longer than twenty-five years, the Contractor shall offer the longer warranty.
 - 1. The Permanent Link Performance Warranty shall be issued and signed by the component manufacturer and shall list the owner as the holder of the warranty.
 - 2. The Permanent Link Performance Warranty shall cover the testing and replacement of the labor and material for all "Permanent Link" components.
 - 3. The structured cable system shall be a complete certified system as offered by a single manufacturer. The system and all components shall be performance matched, approved for use with a single manufacturer and guaranteed by the manufacturer. The cable must be approved for use with the manufacturer's system.
 - 4. Provide as part of the bid response, a letter from the manufacturer, stating that the product set offered will meet their requirements to ensure that a Performance Warranty shall be offered to the owner at the completion of the project.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Subject to compliance with requirements, provide products by one of the manufacturers specified herein. Provide telecommunications cable and termination equipment with performance levels and capacities as noted herein.
- B. Part numbers provided in this Specification have been coordinated with the manufacturers' latest available product literature. Part numbers are subject to change without notice by the manufacturers. Where a specific part number is invalid, provide product meeting component description.
- C. Where specific items are called out in the specification or indicated on the drawings for a specific application, use those products or materials, or approved substitutes. Where no specific call outs are made use premium products and materials.

2.02 APPROVED MANUFACTURERS

- A. UTP Cables (Permanent Link) - Approved Manufacturers
 - 1. AMP.
- B. Permanent Link Components - Approved Manufacturers
 - 1. AMP.
- C. Cable Management Devices - Approved Manufacturers
 - 1. Panduit
 - 2. Chatsworth
- D. Wire Management Hardware - Approved Manufacturers
 - 1. Erico Caddy CableCat series
 - 2. Chatsworth RapidTrak series
- E. Identification Labels - Approved Manufacturers
 - 1. Brady Worldwide, Inc.
 - 2. Panduit Corp

2.03 UNSHIELDED TWISTED-PAIR CABLES

- A. 4-Pair Cable Unshielded Twisted Pair (Permanent Link Component)
 - 1. Physical specifications: 4 twisted pair 24 AWG, solid copper conductors, 100-Ohm nominal impedance +/- 15%. Comply with UL 444.
 - 2. Electrical characteristics: Superior to the individual characteristics established in EIA/TIA 568-B.2 for category 5e cable performance.
 - 3. Cable construction: round cable, individually insulated conductors under a common sheath.
 - 4. NFPA 70 type CMG general purpose
 - 5. Cable Jacket Color:

2.04 UNSHIELDED TWISTED_PAIR PATCH CORDS

- A. 8-Pin Modular-to-8-pin Modular UTP Patch Cords (Permanent Link Component)
 - 1. Physical Specifications: 4-pair cable, with male 8-pin modular plugs with insert-molded strain relief on both ends.
 - 2. Performance Characteristics: Superior to the individual characteristics established in EIA/TIA 568-B for category 5e, cable performance.
 - 3. Manufacturer: AMP.

2.05 UTP TERMINATION HARDWARE (PERMANENT LINK COMPONENT)

- A. 8-Pin modular Patch Panel (Permanent Link Component)
 - 1. 19-inch rack mounted patch panel, suitable to terminate 48 UTP 4-pair cables. Comply with EIA/TIA-568-B category 6 performance. Wired with T568-B pinning. Complete with wire management bars and designation strips
 - 2. Manufacturer: AMP.

2.06 OUTLETS (PERMANENT LINK COMPONENT)

- A. Jacks: 100-ohm, balanced, twisted pair connector, four-pair, modular, RJ-45. Comply with TIA/EIA- 658-B.1.category 5e performance. Outlet wired with standards compliant T568-B.
- B. Telephone/ Data Outlets: Dual jack-connector assemblies mounted in single or multigang faceplate.
 - 1. Faceplate: High-impact plastic; **white**

2. Mounting: Flush, unless otherwise indicated
 3. Legend: Machine-printed, adhesive tape label identifying the circuit.
- C. Wall Mounted Telephone Outlet: 8 conductor outlet and face-plate, mounted over a standard electrical j-box.
1. Stainless steel face-plate with two mounting studs to support wall mounted telephone.

2.07 WIRE MANAGEMENT HARDWARE

- A. Wall Mounted
1. Split front distribution (D) rings.
 2. Manufacturer: Siemon Company type S146 (6") Or equivalent by approved manufacturer
- B. Rack Mounted
1. 19-inch rack mount, 3 ½-inch high, horizontal cable management.
 2. Manufacturer: Panduit Corporation type WMPHF2 Or equivalent by approved manufacturer

2.08 IDENTIFICATION LABELS

- A. Comply with TIA/EIA-606-A and applicable requirements in this section.
- B. Machine printed, self-adhesive, smudge resistant labels for cables and face-plates. Labels shall be appropriately sized for cable diameter. Labels shall be appropriately colored for face-plate color contrast. Submit sample labels for approval.

PART 3 - EXECUTION

3.01 INSTALLATION

A.

3.02 GENERAL

- A. Follow manufacturers' instructions for installing components and adjusting all equipment and telecommunications cables. Where no instructions are included with the equipment, follow accepted industry practices and workmanlike installation standards.
- B. Keep all items protected before and after installation, with dust and water proof barrier materials as necessary. The Contractor shall be responsible to ensure the integrity of the protective measures throughout the life of the project.
- C. The Contractor shall protect all telecommunications equipment from damage, at all times during the construction. Do not install equipment in the telecommunications areas until the other trades have completed their work in the areas so that the equipment will not be moved or damaged.
- D. Ensure that safe ingress and egress, from all work areas, are maintained during movement and installation of materials.
- E. Clean up and remove all debris generated by installation activities. Keep the telecommunications areas free of debris at all times.

- F. Deliver to Owner two sets of all special tools specifically needed for proper operation, adjustment and maintenance of cable and cable termination hardware installed under this Contract.

3.03 INSTALLATION STANDARDS

- A. Comply with BICSI TCI, TIA/EIA-568-B.1, TIZ/EIA-568-B.2, TIA/EIA-568-B.3, and TIA/EIA-569-A.

3.04 INSTALLER QUALIFICATIONS

- A. Craft personnel shall be AMP Certified and be qualified to perform the work activities and be knowledgeable of the following:
 1. Color coding of standard UTP cables.
 2. Color coding of optical fiber cables.
 3. Bonding and grounding of cable tray and equipment cabinets
 4. Testing conductors for electrical continuity.
 5. Testing of copper conductors for length, wire mapping, attenuation and NEXT, PS-NEXT, ELFEXT, ACR, PS-ACR at all frequencies up to 100MHz (maximum bandwidth certification) for category 5e cables.
 6. Testing conductor insulation.
 7. Termination or connection of unshielded twisted pair cable on all specified connectors, electrical protection blocks and termination.
 8. Generally accepted industry standards, as well as manufacturers written installation instructions, will be used for in process quality control and final acceptance of the work installation.

3.05 EXAMINATION

- A. Verification of Conditions: Examine the areas to receive the work and the conditions under which the Work would be performed. Contractor shall remedy conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.
- B. Examine pathway elements intended for cables.
 1. Verify proposed routes of pathways. Check raceways, cable trays, 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.

3.06 GENERAL

- A. Follow manufacturers' instructions for installing components and adjusting all equipment and telecommunications cables. Where no instructions are included with the equipment, follow accepted industry practices and workmanlike installation standards.
- B. Keep all items protected before and after installation, with dust and water proof barrier materials as necessary. The Contractor shall be responsible to ensure the integrity of the protective measures throughout the life of the project.

- C. The Contractor shall protect all telecommunications equipment from damage, at all times during the construction. Do not install equipment in the telecommunications areas until the other trades have completed their work in the areas so that the equipment will not be moved or damaged.
- D. Ensure that safe ingress and egress, from all work areas, are maintained during movement and installation of materials.
- E. Clean up and remove all debris generated by installation activities. Keep the telecommunications areas free of debris at all times.
- F. Deliver to Owner two sets of all special tools specifically needed for proper operation, adjustment and maintenance of cable and cable termination hardware installed under this Contract.

3.07 METHODS AND PROCEDURES

A. General

- 1. Install all components in accordance with this Specification, the approved Cable Termination Schedule, the manufacturer's recommendations, and the Telecommunications Distribution Drawings.

B. Cable Installation - General

- 1. Ensure that all telecommunications cable supports (J-hooks, cable tray, conduits, etc.) are fully installed before proceeding with cable installation. At no times shall cables be installed and left unsupported. At no times shall cables be tie-wrapped to any other supporting structure in lieu of specified cable supports. Do not bundle or tie-wrap the cables even within the approved cable supports. Do not allow the cable to sag more than 12-inches.
- 2. Protect all cables at all times during installation, especially on floor(s), including dedicated telecommunication spaces. Provide rigid protection for cables left on floor at any time during construction. Design protection to prevent pressure on cables from walking, equipment placement, or rolled/dragged construction equipment and materials.
- 3. Maintain manufacturer's recommended minimum bend radius of the cables. Do not stretch, stress, tightly coil, bend or crimp the workstation cables during the installation or when leaving them out of the way of other trades during the staging of the work. The Contractor, at the Contractor's expense shall replace all abused or stressed cables.
- 4. After dressing the cable to its final location, remove only enough jacketing to allow the conductors to be splayed and terminated in a neat and uniform fashion. Every effort will be made to maintain jacketing integrity by removing only as much jacketing as is practical, to accomplish termination. For twisted pair cables, maintain the manufacturer's twisting of the wire pairs through to the point of termination.
- 5. Install cable in continuous runs without splices or mechanical couplers between the cable points of origin and termination for the inter-building and intra-building cable, except as shown on Contract Documents.
- 6. Terminate all cables neatly, with enough slack to pull off, test and re-terminate each cable as needed.
- 7. When pulling cables through conduits, leave in-place all drag-lines for future use.

C. UTP Cable Installation

- 1. Do not allow UTP cables to run parallel with electrical cables/conduits, unless they are separated by a minimum of 12 inches. Any telecommunications cables that must cross over electrical cables/conduits shall do so only at 90-degree angles.
- 2. Leave a five (5) foot service loop in each UTP cable, in 'figure 8' configuration, in the cable tray in the Telecom Room.

3. Modular Furniture Connections: Route the UTP cables down the conduit stub-up to a furniture system in-feed or to a floor box. Where in-feeds are provided, route the cables into and within the raceway of the furniture to the outlet location and terminate the cables. Where a floor-box is provided, terminate the cables and mount within the floor-box.
4. Under or Within Slab-on-Grade Connections:
 - a. Consolidation Point: Where under/within slab-on-grade conduits terminate at any location except a Telecom Room, provide OSP cables in the under/within slab conduits, a consolidation point and CMG or CMP cables back to the Telecom Room as required by Code.
 - b. Telecom Room: Where under/within slab-on-grade conduits terminate in a Telecom Room, provide OSP UTP cables from the outlet to the Telecom Room.

D. Cable Supports

1. Support all cables provided under this Section with Cable Supports that are not otherwise supported in conduit or cable tray.
2. Provide supports along entire path of cable.
3. Space supports a maximum of 48 inches apart and at each change of direction of the cables.
4. Hang cable supports from 3/8" all thread rods, dedicated #8 galvanized ceiling drop wire or wall brackets connected directly to structure. Do not support from the ceiling grid or ceiling wire system.
5. Application:
6. Fill cable supports up to the quantities listed below for each support size. Note that the cable fills listed below are 50% of the manufacturer's recommendations to allow for future capacity. Provide larger size or multiple hooks where required.
 - a. Loop size (dia.) Quantity of 4-pair UTP or 2-strand optical fiber cables

1-5/16"		25
2"		40

7. The contractor shall coordinate pathways with all other trades to achieve efficient utilization of available space, complete accessibility to allow maintenance of cable plant and economical future adds moves and changes. Contractor shall provide cable support pathway shop drawings for review and approval by the Owner's representative
8. Install support wires, brackets or rods to route cables parallel and perpendicular to building lines.
9. Provide multiple hooks or slings at each hanger location as required by cable count and cable segregation requirements.
10. Fill supports with cabling to 50% or less of the manufacturer's recommended fill. Provide multiple supports where required cable count exceeds 50% fill.
11. Interface with Other Work: Coordinate installation of supports with mechanical ductwork, piping and sprinkler system piping so that supports remain accessible after installation.
12. Elevation of Cable Supports: Contractor shall coordinate the allocation of ceiling space and the mounting elevations of various systems to allow maintenance and accessibility for future modifications. Low voltage system cable supports shall be as close to the ceiling as possible while allowing ceiling tiles to be removed. Supports shall be located to avoid interference with maintenance access to other equipment.
13. Cable installation and supports shall comply with applicable provisions of EIA/TIA 569-A and ANSI/NFPA 70.

3.08 PATCH CORDS

- A. Provide for Owners use, category 5e 8-pin-modular-to-8-pin-modular patch cords.

1. Length: Sufficient in length to reach from the most distant station termination block to the bottom of the most distant equipment rack in each telecom closet.
2. Quantity: One patch cord for every two installed data station cables.

3.09 CONNECTORS

- A. Provide appropriate category 5e 8-pin modular connectors for the termination of all 4-pair cables. Provide an accompanying faceplate and/or mounting plate at the appropriate outlet location. Install faceplates level and align to adjacent outlet faceplates.

3.10 PATCH PANELS

- A. Provide 8-pin modular patch panels as shown in the Contract Documents for the termination of all workstation cables installed under this Work. Mount the patch panels into the equipment racks. Provide patch panels complete with designation strips.
- B. Provide 8-pin modular patch panels as shown in the Contract Documents for the termination of all wireless-access-point cables installed under this Work. Mount the patch panels into the equipment racks. Provide patch panels complete with designation strips.
- C. Provide horizontal wire management panels in each equipment rack in between the 8-pin modular patch panels installed in each equipment rack

3.11 IDENTIFICATION

- A. Provide on all outlet faceplates installed under this Work, machine-generated labels with the outlet ID, in uppercase lettering. Label shall be of a contrasting color to the faceplate color.
- B. Provide on all termination blocks installed under this Work, machine-generated designation strips with the cable ID and pair number, in uppercase lettering.
- C. Provide on all patch panels installed under this Work, machine-generated label with the cable ID and port number in uppercase lettering.
- D. Provide a machine-generated label on all telecommunications cables installed under this Contract with the cable ID, in black uppercase lettering on a permanent adhesive, white label stock, covered with a permanent water resistant sealer. Labels shall placed on both ends of the cable and no more than 6" from the point at which the cable is broken out into individual copper pairs or strands from the connector or termination block or patch panel. Labels shall be placed parallel with the cable. All labels shall be readily visible.
- E. Hand lettered label stock will not be accepted for final installation. Hand lettered stock is only acceptable for use with temporary labeling required during construction phases.
- F. All cables shall be labeled in accordance with the approved cable termination schedule.
- G. If at any time during the project, the label becomes illegible or removed, the Contractor shall immediately replace it with a duplicate preprinted label.
- H. All cable IDs shall be both physically and visually accessible upon completion of the project.

3.12 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
- B. Category 5e UTP Cabling Tests:

1. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in Annex I, complying with measurement accuracy specified in Annex H. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 2. Provide evidence of testing apparatus calibration at beginning of testing, and for every 1000 channels or links tested.
 3. Provide evidence of replacement of consumable testing apparatus, including modular jacks, per the tester manufacturer's recommendations.
 4. Provide evidence that the testing apparatus software or firmware has been updated to current revision/version.
 5. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 6. Wire-map test that reports open circuits, short circuits, crossed pairs, reversed pairs, split pairs, and improper terminations.
 7. Channel and permanent link tests for cable length, insertion loss, near-end crosstalk loss, power sum near-end crosstalk loss, equal-level far-end crosstalk loss, power sum equal-level far-end crosstalk, return loss, propagation delay, and delay skew. Performance shall comply with minimum criteria in TIA/EIA-568-B.2.
- C. Test Reports:
1. Document data for each measurement.
 2. Provide a summary report that is formatted similar to Table 10.1 in BICSI TDM.
 3. Provide a printed individual cable report for each UTP cable that tests within the instrument tolerance band for any parameter, i.e., for any parameter that would not pass if the instrument tolerance were taken as worst case.
 4. Provide a CD containing all individual cable reports in the native file structure of the test instrument(s).
 5. Provide software to display and print individual and summary cable test reports from the native test files.
- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements. Retest and inspect cabling to determine compliance of replaced or additional work with specified requirements.
- E. After review of the completed test results, the Owner/Engineer reserves the right to retest up to 10 of the installed cables, utilizing the Contractor's tester and the Contractor's labor.
- F. After the installation is complete, in addition to any other required testing as described herein, and at such times as the Owner/Engineer directs, the Contractor shall be present while the Owner conducts an operating test for approval. The installation shall be demonstrated to be in accordance with the requirements of this specification. Any defects revealed shall be corrected promptly at the Contractor's expense and the tests performed again.

END OF SECTION

SECTION 28 05 00

COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This section includes general requirements for all Division 28 work and is supplemental and in addition to the requirements of Division 1.
- B. It is the intention of this Division of the Specifications and the Contract Drawings to describe and provide for the furnishing, installing, testing and placing in satisfactory and fully operational condition all equipment, materials, devices and necessary appurtenances to provide a complete Division 28 systems. Provide all materials, appliances and apparatus not specifically mentioned herein or shown on the drawings, but which are necessary to make a complete, fully operational installation of all Division 28 systems shown on the contract drawings or described herein. Connect equipment and devices furnished and installed under other Divisions of this specification (or the Owner) under this Division.
- C. Workmanship shall be of the best quality and competent and experienced electricians shall be employed and shall be under the supervision of a competent and experienced foreman.
- D. The drawings and specifications are complimentary and what is called for (or shown) in either is required to be provided as if called for in both.
- E. See Division 1 for sequence of work.

1.03 WORK IN OTHER DIVISIONS

- A. See all other specifications for other work which includes but is not limited to:
 - 1. Communications
 - 2. Conveying Systems
 - 3. Cutting and Patching
 - 4. Door Hardware
 - 5. Equipment Wiring
 - 6. Fire Protection
 - 7. Mechanical Control Wiring
 - 8. Painting, Refinishing and Finishes

1.04 CODES, PERMITS, INSPECTION FEES

- A. The following codes and standards are referenced in the Division 28 specifications. Perform all work and provide materials and equipment in accordance with the latest referenced codes and standards of the following organizations:
1. American National Standards Institute (ANSI)
 2. National Electrical Manufacturer's Association (NEMA)
 3. National Fire Protection Association (NFPA)
 4. Underwriter's Laboratories (UL)
- B. Install the Division 28 systems based on the following:
- | | |
|---------|---|
| NFPA 70 | National Electrical Code as adopted and amended by the Local Jurisdiction. |
| IBC | International Building Code as adopted and amended by the Local Jurisdiction. |
- C. The referenced codes establish a minimum level of requirements. Where provision of the various codes conflict with each other, the more stringent provision shall govern. If any conflict occurs between referenced codes and this specification, the codes are to govern. Compliance with code requirements shall not be construed as relieving the Contractor from complying with any requirements of the drawings or specifications which may be in excess of requirements of the governing codes and rules and not contrary to same.
- D. Obtain and pay for all licenses, permits and inspections required by laws, ordinances and rules governing work specified herein. Arrange for inspection of work by the inspectors and give the inspectors all necessary assistance in their work of inspection.

1.05 COORDINATION

- A. Submit Per Section 013113 - Project Coordination and per supplementary information below.
- B. Obtain submittals and shop drawings of all equipment with Division 28 connections furnished under other divisions of the specification and by the Owner. Provide all wiring in accordance with specific equipment requirements. Immediately advise the Architect of any changes which may affect the contract price.
- C. Special attention is called to the following items. Coordinate all conflicts prior to installation:
1. Location of grilles, pipes, sprinkler heads, ducts and other mechanical equipment so that all Division 28 equipment is clear from and in proper relation to these items.
 2. Location of cabinets, counters and doors so that Division 28 equipment is clear from and in proper relation to these items.
 3. Recessing and concealing Division 28 materials in CMU walls, concrete construction and precast construction.
- D. Furnish, install and place in satisfactory condition all raceways, boxes, conductors and connections and all other materials required for the electronic safety and security systems shown or noted in the contract documents to be complete, fully operational and fully tested upon completion of the project. Raceways, boxes and ground connections are shown diagrammatically only and indicate the general character and approximate

location. The layout does not necessarily show the total number of raceways or boxes for the circuits required, nor are the locations of indicated runs intended to show the actual routing of the raceways.

- E. Consult the architectural drawings for the exact height and location of all Division 28 equipment not specified herein or shown on the drawings. Make any minor changes (less than 6'-6" horizontal) in the location of the raceways, outlets, boxes, devices, wiring, etc., from those shown on the drawings without extra charge, where coordination requires or if so directed by the Architect before rough-in.
- F. Provide inserts or sleeves for outlet boxes, conductors, cables and/or raceways as required. Coordinate the installation thereof with other trades.

1.06 WARRANTY

- A. Provide Per Section 017836 - Warranties and per supplementary information below.

1.07 CORRECTION OF WORK

- A. Provide Per Section 017836 - Warranties.

1.08 ITEMIZED SCHEDULE OF COSTS

- A. Complete the Schedule of Values included at the end of this section. This schedule shall be adhered to for the Division 28 contractor to facilitate analysis and approval of the monthly progress billings. Refer to the Supplementary Conditions of General Contract and Division 1 - General Requirements for details, and conform thereto. Provide a copy directly to Sparling.

1.09 SUBMITTALS AND SHOP DRAWINGS

- A. Submit Per Section 013300 - Submittals and per supplementary information below.
- B. Product Data:
 - a. Submit in a three ring binder with hardboard covers
 - b. Indicate Specification Section and Paragraph for each item.
 - c. Indicate listing by UL or other approved testing agency.
- C. The Contractor agrees:
 - 1. Submittals and shop drawings processed by the Architect are not change orders.
 - 2. The purpose of submittals and shop drawings by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept.
 - 3. Submittals demonstrate equipment and material Contractor intends to furnish and install and indicate detailing fabrication and installation methods Contractor intends to use.
 - 4. To accept all responsibility for assuring that all materials furnished under this Division of the specifications meet, in full, all requirements of the contract documents.
 - 5. To pay for Engineers review cost of submittal review beyond one resubmittal.

- D. The Engineer's review is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Corrections or comments made during this review do not relieve contractor from compliance with the requirements of the drawings and specifications. Contractor is responsible for: Dimensions which shall be confirmed and correlated at the job site; fabrication process and techniques of construction; coordination of his work with that of all other trades; performing his work in a safe and satisfactory manner.
- E. Submittals and shop drawings are required per the submittals schedule at the end of this Section.

1.10 DIVISION 28 EQUIPMENT OPERATION AND MAINTENANCE (O&M) MANUALS

- A. Provide preliminary and final O&M manuals as required in Section 017824 - Operations and Maintenance Data and supplementary requirements below:
- B. Provide preliminary and final O&M manuals per Section 017824 plus one manual for Sparling for all equipment furnished under Division 28 - Electronic Safety and Security specifications. Obtain a receipt for the manuals and forward a copy of the receipt to the Engineer with the Job Completion Form.
- C. These O&M manuals shall contain all the information needed to operate and maintain all systems and equipment provided in the project. Present and arrange information in a logical manner for efficient use by the Owner's operating personnel. The information provided shall include but not be limited to the following:
 - 1. Description of system configuration and operation including component identification and interrelations. A master control schematic drawings(s) may be required for this purpose.
 - 2. Shop drawings.
 - 3. Wiring diagrams.
 - 4. Signal equipment submittals shall contain step-by-step circuit description information designed to acquaint maintenance personnel with equipment operation in each mode of operation.
 - 5. A complete list of local (nearest) manufacturer representative and distributor contacts for each type of equipment and manufacturer. Include name, company, address, phone, fax, e-mail address, and web site.
- D. Furnish complete wiring diagrams for each system for the specific system installed under the contract. "Typical" line diagrams will not be acceptable unless revised to indicate the exact field installation.

1.11 RECORD DOCUMENTS

- A. Provide project record documents as required in Section 017839 - Project Record Documents and supplementary requirements below:
- B. General:
 - 1. Mark record prints with red erasable pencil.
 - 2. Accurately locate with exact dimensions all underground and underslab raceways and stub-outs.

3. Note changes of directions and locations, by dimensions and elevations, as utilities are actually installed.
4. Erase conditions not constructed or "X-out" and annotate "not constructed" to clearly convey the actual "as constructed" condition.

1.12 DEMONSTRATION AND TRAINING

- A. Provide demonstration and training as required in Section 017900 - Demonstration and Training and supplementary requirements below:
- B. After substantial completion of the work and 20 days after the O&M manuals have been delivered to the owner and after all tests and final inspection of the work by the Authority(s) Having Jurisdiction; demonstrate the Division 28 systems and instruct the Owner's designated operating and maintenance personnel in the operation and maintenance of the various Division 28 systems.
- C. The Contractor shall arrange scheduled instruction periods with the Owner per Section 017900.
- D. The Contractor's representatives shall be superintendents or foremen knowledgeable in each system and suppliers representatives when so specified. When more than one training session is specified, the second session shall be 30 to 90 days after the first as agreed to by the Owner.
- E. Include in each instruction session an overview of the system..
- F. Include the following scheduled instruction periods:

		1 st Session	2 nd Session
1.	Access Control	2 hours	2 hours
2.	Intrusion Detection	2 hours	2 hours
3.	Infant Security System	2 hours	2 hours
4.	Video Surveillance	2 hours	2 hours
5.	Fire Detection and Alarm	2 hours	2 hours

1.13 PROJECT CLOSE-OUT

- A. Provide per Section 017700 - Closeout Procedures and supplementary information below.
- B. Request For Final Punchlist
 1. To request a final Division 28 punch list, forward a letter to Sparling, Inc. stating; "The Division 28 work on this project is complete, all punch list items to date are complete, items a. - n. in the Punchlist Procure paragraph in Section 280500 - Common Work Results For Electronic Safety and Security are complete and the project is ready for final punch list observation."
 2. Project Punchlist Procedure: Perform the following procedures for project closeout of Division 28 portions of work.
 - a. Provide engraved nameplates on equipment.
 - b. Refinish equipment finishes which are damaged.
 - c. Obtain final electrical permit inspection. Include copies in O & M manual.
 - d. Provide written warranty in O & M per the General Conditions of the Contract.

- e. Furnish Record Drawings per this section. Obtain signature on Job Completion Form.
- f. Furnish O & M Manuals per this section. Obtain signature on Job Completion Form.
- g. Give instruction periods to owner's personnel per this section. Obtain signature on Job Completion Form.
- h. To request final acceptance of project, fill out Job Completion Form in this section and forward to Sparling. Note: If inspectors have not signed form, a copy of signed-off permits will suffice.
- i. Include with Job Completion Form, a copy of the final punch list with the word "DONE", and the date and Contractor's initials after each item on the list.

1.14 FINAL ACCEPTANCE REQUEST

- A. Provide per Section 17700 - Closeout Procedures and supplementary information below.
- B. Submit to the Architect, with a copy to the Sparling Engineer, a Sparling Job Completion Form (form attached in this section) properly filled out prior to the time final acceptance of the Division 28 work is requested.

1.15 DELIVERY, STORAGE AND HANDLING

- A. Provide per Section 16510 - Product Delivery, Storage, and Handling Requirements.

1.16 ABBREVIATIONS AND DEFINITIONS

- A. When the following abbreviations and definitions are used in relation to the work for Division 28 they shall have the following meanings:

<u>Item</u>	<u>Meaning</u>
AHJ	Authority Having Jurisdiction.
Boxes	Outlet, Junction or Pull Boxes.
Code	All applicable codes currently enforced at project location.
Compression	Compressed using a leverage powered (hydraulic or equivalent) crimping tool.
Connection	All materials and labor required for equipment to be fully operational.
Exterior Location	Outside of or penetrating the outer surfaces of the building weather protective membrane.
Fully Operational	Tested, approved, and operating to the satisfaction of the AHJ, manufacturer and contract documents.
Furnish	Deliver to the jobsite
Install	To enter permanently into the project and make fully operational.
Kcml	Thousand circular mils (formerly MCM).
Mfr.	Manufacturer.
NEC	National Electrical Code, National Fire Protection Association, Publication #70.
Noted	Shown or specified in the contract documents.
Provide	Furnish and install.
Required	As required by code, AHJ, contract documents, or manufacturer for the particular installation to be fully operational.
Shown	As indicated on the drawings or details.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All materials and equipment installed shall have been tested and listed by Underwriters Laboratories or other approved testing organization and shall be so labeled unless otherwise permitted by the Authority Having Jurisdiction (Inspector).
- B. All materials to be new, free from defects and not less than quality herein specified. Materials shall be designated to insure satisfactory operation and operational life in the environmental conditions which will prevail where they are being installed.
- C. Each type of materials furnished shall be of the same make, be standard products of manufacturers regularly engaged in production of such materials and be the manufacturer's latest standard design.
- D. All materials, equipment and systems furnished that include provisions for storing, displaying, reporting, interfacing, inputting, or functioning using date specific information shall perform properly in all respects regardless of the century. Any interface to other new or existing materials, equipment or systems shall function properly and shall be century compliant, both in regards to information sent and received.

2.02 SUBSTITUTION OF MATERIALS

- A. See Section 012500 for Bidding and Construction phase substitution requirements.

2.03 NAMEPLATES

- A. Provide nameplates per Section 260553 - Identification for Electrical Systems.

PART 3 - EXECUTION

3.01 CUTTING BUILDING CONSTRUCTION

- A. Obtain permission from the Architect and coordinate with other trades prior to cutting. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. Cut concrete with diamond core drills or concrete saws except where space limitations prevent the use of such tools.
- B. All construction materials damaged or cut into during the installation of this work must be repaired or replaced with materials of like kind and quality as original materials by skilled labor experienced in that particular building trade.

3.02 FIRESTOPPING

- A. Apply firestopping to Division 28 penetrations of fire rated floor and wall assemblies to maintain fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 section "Firestopping".

3.03 PAINTING

- A. Items furnished under this Division that are scratched or marred in shipment or installation shall be refinished with touchup paint selected to match installed equipment finish.

3.04 EQUIPMENT CONNECTION

- A. For equipment furnished under this or other Divisions of the specifications, or by owner, provide complete all Division 28 connections necessary to serve such equipment and provide required control connections to all equipment so that the equipment is fully operational upon completion of the project. Provide disconnect switch as required by code whenever an equipment connection is shown on the drawings.
- B. Investigate existing equipment to be relocated and provide new connections as required.

3.05 CLEAN UP

- A. Contractor shall continually remove debris, cuttings, crates, cartons, etc., created by his work. Such clean up shall be done daily and at sufficient frequency to eliminate hazard to the public, other workmen, the building or the Owner's employees. Before acceptance of the installation, Contractor shall carefully clean cabinets, panels, lighting fixtures, wiring devices, cover plates, etc., to remove dirt, cuttings, paint, plaster, mortar, concrete, etc. Blemishes to finished surfaces of apparatus shall be removed and new finish equal to the original applied.
 - 1. Wipe surfaces of Division 28 equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

3.06 TESTING AND DEMONSTRATION

- A. Demonstrate that all Division 28 equipment operates as specified and in accordance with manufacturer's instructions. Perform tests in the presence of the Architect, Owner or Engineer. Provide all instruments, manufacturer's operating instructions and personnel required to conduct the tests. Repair or replace any Division 28 equipment that fails to operate as specified and or in accordance with manufacturer's requirements.

SPARLING DIVISION 28 JOB COMPLETION FORM

PROJECT NAME: <Insert Project Name Here>
 PROJECT LOCATION: _____
 DATE: _____

A. Electrical Inspectors Final Acceptance (Copy of certificate attached.)

Name	Agency	Date
------	--------	------

B. Fire Marshal's Final Acceptance of Fire Alarm System (Copy of certificate attached.)

Name	Agency	Date
------	--------	------

C. The following systems have been demonstrated to Owner's representative.

1. Access Control	Owner's Rep.	Date
2. Intrusion Detection	Owner's Rep	Date
3. Infant Security System	Owner's Rep	Date
4. Video Surveillance	Owner's Rep	Date
5. Fire Detection and Alarm	Owner's Rep	Date

D. Record Drawings

Attached Transmitted previously to _____
 Date

E. O & M Manuals

Attached Transmitted previously to _____

F. Test

Reports
 Attached Transmitted previously to _____
 Date

G. The work is complete in accordance with contract documents and authorized changes except for

_____ and the architect/engineer's representative is requested to meet with

_____ at _____ on _____
 Supervisor of Division 28 Work Time Date

 Contractors Rep. Signature Date

Sparling Schedule of Values for <Insert Project Name Here>

Description of Work	Amount
Device Rough-in (boxes and raceways) - Material and Labor	
Circuit Conductors and Terminations - Material and Labor	
Devices (detectors, switches, equip. connections) - Labor & Materials	
Testing, Demonstration (AHJ approvals)	
Training	
Close Out (Record Drawings, O&M, etc.) - Materials & Labor	
TOTAL DIVISION 28	

SPARLING SUBMITTAL LIST <Insert Project Name Here>

SECTION	DESCRIPTION	SUBMIT RECEIVE DATE	STATUS
281300	ACCESS CONTROL		
281310	DOOR CONTROL		
281600	INTRUSION DETECTION		
281610	INFANT SECURITY SYSTEM		
282300	VIDEO SURVEILLANCE		
283100	FIRE DETECTION AND ALARM		

END OF SECTION

SECTION 28 05 13

CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. 50/125 micrometer, multimode optical fiber cabling.
 - 2. Coaxial cabling.
 - 3. RS-232 cabling.
 - 4. RS-485 cabling.
 - 5. Low-voltage control cabling.
 - 6. Control-circuit conductors.
 - 7. Identification products.

1.03 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- G. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- H. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- I. RCDD: Registered Communications Distribution Designer.
- J. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

- K. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- L. UTP: Unshielded twisted pair.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For coaxial cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings: Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - 1. Vertical and horizontal offsets and transitions.
 - 2. Clearances for access above and to side of cable trays.
 - 3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - 4. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
- C. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Maintenance Data: For wire and cable to include in maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: [25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
 - 2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
 - 3. Test each pair of UTP cable for open and short circuits.

1.07 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.01 PATHWAYS

- A. Conduit and Boxes: Comply with requirements in Division 28 Section "Raceway and Boxes for Electronic Safety and Security."
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.02 OPTICAL FIBER CABLE

- A. Manufacturers:
 - 1. Berk-Tek; a Nexans company.
 - 2. CommScope, Inc.
 - 3. Corning Cable Systems.
 - 4. General Cable Technologies Corporation.
 - 5. Mohawk; a division of Belden CDT.
 - 6. Nordex/CDT; a subsidiary of Cable Design Technologies.
 - 7. Optical Connectivity Solutions Division; Emerson Network Power.
 - 8. Superior Essex Inc.
 - 9. SYSTIMAX Solutions; a CommScope, Inc. brand.
 - 10. 3M.
 - 11. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. Description: Multimode, 50/125-micrometer, fiber count per plans, tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.
 2. Comply with TIA/EIA-568-B.3 for performance specifications.
 3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Nonconductive: Type OFN or OFNG.
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or OFCG.
 - e. Plenum Rated, Conductive: Type OFCP complying with NFPA 262.
 - f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
 5. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
 6. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- C. Jacket:
1. Jacket Color: Aqua.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.03 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers:
1. ADC.
 2. American Technology Systems Industries, Inc.
 3. Berk-Tek; a Nexans company.
 4. Corning Cable Systems.
 5. Dynacom Corporation.
 6. Hubbell Premise Wiring.
 7. Molex Premise Networks; a division of Molex, Inc.
 8. Nordex/CDT; a subsidiary of Cable Design Technologies.
 9. Optical Connectivity Solutions Division; Emerson Network Power.
 10. Simon Co. (The).

- B. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 - 1. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
 - 2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.04 COAXIAL CABLE

- A. Manufacturers:
 - 1. Alpha Wire Company.
 - 2. Belden CDT Inc.; Electronics Division.
 - 3. Coleman Cable, Inc.
 - 4. CommScope, Inc.
 - 5. Draka USA.
- B. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- C. RG-11/U: NFPA 70, Type CATV.
 - 1. No. 14 AWG, solid, copper-covered steel conductor.
 - 2. Gas-injected, foam-PE insulation.
 - 3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
 - 4. Jacketed with sunlight-resistant, black PVC or PE.
 - 5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.
- D. RG59/U: NFPA 70, Type CATVR.
 - 1. No. 20 AWG, solid, silver-plated, copper-covered steel conductor.
 - 2. Gas-injected, foam-PE insulation.
 - 3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.
 - 4. Color-coded PVC jacket.
- E. RG-6/U: NFPA 70, Type CATV or CM.
 - 1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.

2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
 3. Jacketed with black PVC or PE.
 4. Suitable for indoor installations.
- F. RG59/U: NFPA 70, Type CATV.
1. No. 20 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.
 3. PVC jacket.
- G. RG59/U (Plenum Rated): NFPA 70, Type CMP.
1. No. 20 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
 2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.
 3. Copolymer jacket.
- H. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655, and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
1. CATV Cable: Type CATV.
 2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
 3. CATV Riser Rated: Type CATVR, complying with UL 1666.
 4. CATV Limited Rating: Type CATVX.

2.05 COAXIAL CABLE HARDWARE

- A. Manufacturers:
1. Aim Electronics; a brand of Emerson Electric Co.
 2. Leviton Voice & Data Division.
 3. Siemon Co. (The).
- B. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.06 RS-232 CABLE

- A. Standard Cable: NFPA 70, Type CM.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 2. Polypropylene insulation.

3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 4. PVC jacket.
 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 6. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 2. Plastic insulation.
 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 4. Plastic jacket.
 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 6. Flame Resistance: Comply with NFPA 262.

2.07 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CM[or CMG].
1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 2. Fluorinated ethylene propylene insulation.
 3. Unshielded.
 4. Fluorinated ethylene propylene jacket.
 5. Flame Resistance: NFPA 262, Flame Test.

2.08 LOW-VOLTAGE CONTROL CABLE

- A. Paired Lock Cable: NFPA 70, Type CMG.
1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
 2. PVC insulation.
 3. Unshielded.

4. PVC jacket.
 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with NFPA 262.
- C. Paired Lock Cable: NFPA 70, Type CMG.
1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with UL 1581.
- D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
 2. Fluorinated ethylene propylene insulation.
 3. Unshielded.
 4. Plastic jacket.
 5. Flame Resistance: NFPA 262, Flame Test.

2.09 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.10 IDENTIFICATION PRODUCTS

- A. Manufacturers:
 1. Brady Corporation
 2. HellermannTyton.
 3. Kroy LLC.

- 4. Panduit Corp.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- D. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 28 Section "Raceway and Boxes for Electronic Safety and Security." for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches (75 mm)] above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.02 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 9. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. **Optical Fiber Cable Installation:**
 - 1. Comply with TIA/EIA-568-B.3.
 - 2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.
- D. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - 2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.
 - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Outdoor Coaxial Cable Installation:
 - 1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.

2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations 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 (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
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 (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
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 (75 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.03 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.

3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.04 CONNECTIONS

- A. Comply with requirements in Division 28 Section "Intrusion Detection" for connecting, terminating, and identifying wires and cables.
- B. Comply with requirements in Division 28 Section "Access Control" for connecting, terminating, and identifying wires and cables.
- C. Comply with requirements in Division 28 Section "Video Surveillance" for connecting, terminating, and identifying wires and cables.

3.05 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.06 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.07 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.08 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Visually inspect optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 3. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:

- 1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
- 2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

- D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION

SECTION 28 05 33

RACEWAYS AND BOXES FOR SECURITY SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes raceways, fittings, boxes, enclosures and cabinets for electrical wiring.
- B. Substitutions: Substitute products will be considered only under the terms and conditions of Section 280500 - Common Work Results For Safety and Security.

1.03 REFERENCES

- A. American National Standards Institute (ANSI)
- B. National Electrical Manufacturers Association (NEMA)
- C. Underwriters Laboratories, Inc. (UL)
- D. National Fire Protection Association (NFPA)

1.04 SUBMITTALS

- A. Make submittals in accordance with Section 280500 - Common Work Results For Electronic Safety and Security. Submit product data only for surface raceways and fittings, wireways, enclosures and cabinets.

1.05 COORDINATION

- A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.01 RIGID METAL CONDUIT (RMC)

- A. Rigid Steel Conduit: ANSI C80.1, UL 6.
- B. Intermediate Metal Conduit: ANSI C80.6, UL 1242.
- C. Fittings: NEMA FB1, UL 514B, galvanized malleable iron or non-corrosive alloy threaded fittings. Erickson and watertight split couplings are permitted. Set screw and running thread fittings are not permitted.
- D. Conduit Bodies and Fittings Manufacturers: American Electric; Construction Materials Group, Crouse-Hinds; Div. of Cooper Industries, Emerson Electric Co.; Appleton Electric Co., Hubbell, Inc.; Killark Electric Manufacturing Co., Lamson & Sessions; Carlon

Electrical Products, O-Z/Gedney; Unit of General Signal, Scott Fetzer Co.; Adalet-PLM, Spring City Electrical Manufacturing Co., Link Seal, Thomas & Betts.

- E. Rigid Aluminum Conduit: ANSI C80.5.
- F. Plastic Coated Rigid Steel Intermediate Metal Conduit: NEMA RN1.

2.02 ELECTRIC METALLIC TUBING (EMT)

- A. Hot dip galvanized, electrogalvanized or sherardized, steel tubing, ANSI C80.3, UL 797.
- B. Fittings: NEMA FB1 UL 514B, steel or malleable iron, compression or set screw. Indentor, drive-on, die cast or pressure cast fittings not permitted.
- C. Conduit Bodies and Fittings Manufacturers: American Electric; Bridgeport, Construction Materials Group, Crouse-Hinds; Div. of Cooper Industries, Emerson Electric Co.; Appleton Electric Co., Hubbell, Inc.; Killark Electric Manufacturing Co., Lamson & Sessions; Carlon Electrical Products, O-Z/Gedney; Unit of General Signal, Scott Fetzer Co.; Adalet-PLM, Spring City Electrical Manufacturing Co., Link Seal, Thomas & Betts.

2.03 RIGID NON-METALLIC CONDUIT (RNC)

- A. Schedule 40 and 80: UL 651.
- B. Type EB and B: UL 651, NEMA TC6.
- C. Fittings: NEMA TC3.

2.04 ELECTRICAL NON-METALLIC TUBING (ENT)

- A. NEMA TC-13.

2.05 EXPANSION FITTINGS

- A. Malleable iron, hot dip galvanized allowing 4"(100mm) (+/- 2" (50mm)) conduit movement. OZ/Gedney AX Series or equivalent by manufacturer listed in 2.1.D.

2.06 RACEWAY PENETRATION SEALS

- A. Thruwall and Floor Seals: New construction - OZ/Gedney FSK Series. Existing construction - OZ/Gedney CSM Series or equivalent by manufacturer lists in 2.1.D.

2.07 ENCLOSURES AND CABINETS

- A. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
- B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

2.08 OUTLET JUNCTION AND PULL BOXES

A. Interior Wiring:

1. Outlet and Pull Boxes. Pressed steel, zinc coated with plaster ring where applicable. NEMA OS1, UL 514A.
2. Large Junction and Pull Boxes. Fabricated sheet steel, zinc coated or baked enamel finish, with return flange and screw retained cover.
3. Concrete and Masonry. Specifically designed boxes for casting in concrete or mounting in masonry walls for that purpose.
4. Mounting. Provide boxes with fan side box support Caddy J1A series or Caddy quick mount H series.

B. Exterior Wiring:

1. Above Grade:
 - a. Outlet and junction boxes: Cast or malleable iron or cast of corrosion resistant alloy, complete with conduit hubs, compatible with raceway to which it is connected. NEMA FB1.
 - b. Pull boxes: Fabricated steel and hot dipped galvanized complete with malleable iron hubs.
 - c. All boxes labeled for damp (NEMA 3R) or wet (NEMA 4) locations as applicable.
2. Below Grade:
 - a. Where exposed to earth: Constructed of precast concrete with size, configuration, cover, grates and reinforcing as required by the particular installation. Manufacturer: Utility Vault or Renton Concrete Products.
 - b. Where exposed to earth: Constructed of fiberglass or plastic with size, configuration, and cover as required by the particular installation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 WIRING METHODS

A. Interior: Use the following wiring methods:

1. Exposed: Electric Metallic Tubing.
2. Exposed Subject to Damage (i.e. from vehicles, carts and moving pallets including stubups in concrete): Rigid Steel or Intermediate Metal Conduit.
3. Concealed: Electric Metallic Tubing.

4. Connection to Vibrating Equipment (including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): Flexible Metal Conduit, (except in wet or damp locations, use Liquidtight Flexible Metal Conduit) with 90° loop, maximum 6 feet long.
- B. Exterior: Use the following wiring methods:
1. Exposed: Rigid Steel Conduit or Intermediate Metal Conduit.
 2. Concealed: Rigid Steel Conduit, Intermediate Metal Conduit, or Rigid Nonmetallic Conduit.
 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): Liquidtight Flexible Metal Conduit.
 4. Boxes and Enclosures: NEMA 250, NEMA type 3R or type 4.
- C. Raceway Embedded in Slabs
1. Install in middle third of slab thickness and leave at least 1-inch (25-mm) concrete cover.
 2. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 3. Space raceways laterally to prevent voids in concrete.
 4. Protect stub-ups from damage where conduits rise through floor slabs. Transition from nonmetallic conduit to rigid steel conduit, or IMC before rising above floor. Arrange so curved portion of bends is not visible above the finished slab.
- D. Raceways Underground
1. Rigid Nonmetallic Conduit, schedule 40 except use extra heavy-duty schedule 80 for road crossings where not encased in concrete.
 2. Arrange and slope raceways entering building to drain away from building.
 3. Provide marker tape over underground raceways. Marker tape to read "Caution - Electric Line Buried Below". Install 1'-0" (300mm) below grade.
 4. Install underground raceways a minimum of 24" (600mm) below final grade (36" (910mm) on public property) unless otherwise noted or required.
 5. Provide backfill around underground raceways. Use 3/4" (20mm) minus material 6" (150mm) above and below rigid steel conduit and intermediate metal conduit. Use clean sand 6" (150mm) above and below PVC raceways. Backfill above 6" (150mm) free of debris or rocks greater than 1" (25mm) in diameter. Space raceways 7-1/2" (190mm) minimum between centers and 3" (80mm) minimum between raceways.
 6. Anchor raceways encased in concrete to prevent floating during pour.

3.03 INSTALLATION

- A. Provide raceways concealed in construction unless noted otherwise or unless specifically authorized by the Architect.

- B. Install raceways level and square and at proper elevations. Provide not less than 6'-6" (200cm) headroom. Where raceways are installed in exit pathways provide not less than 7'-0" headroom. Do not block access to junction boxes, valves, mechanical equipment or prevent removal of ceiling panels, etc.
- C. Complete raceway installation before starting conductor installation.
- D. Use raceway fittings compatible with raceways and suitable for use and location.
- E. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members and follow the surface contours.
 - 1. Run parallel or banked raceways together, on common supports where practical.
 - 2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- F. Join raceways with fittings designed and approved for the purpose and make joints tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
- G. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box. Provide bushings on all raceways 1-1/2" (40mm) and larger.
- H. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- I. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.
- J. Size raceways not sized on the drawings per manufacturers shop drawings, applicable standards or other section of this specification.
- K. Maintain 12" (300mm) minimum clearance to high temperature (greater than 90°C) surfaces.
- L. When construction involves masonry work, assemble and install raceways at the same time as the wall is erected. Avoid surface cut masonry units whenever such units are to remain unplastered or uncovered in completed construction.

3.04 RIGID METAL AND INTERMEDIATE METAL CONDUIT

- A. All connections watertight.
- B. Provide plastic coated rigid steel or IMC conduit for all exposed exterior raceways. Use only fittings approved for use with PVC coated raceways. Patch all nicks and scrapes in PVC coating after installing conduits.

3.05 RIGID NONMETALLIC CONDUIT

- A. May be used where permitted by code and as specified in 3.2 above. Exception: Use rigid steel for elbows, penetrations through floors and walls and stub ups. Raceway size

may need to be increased to include code required ground wire. Field bends limited to less than 44 degrees, formed with manufacturer's recommended heater.

3.06 RACEWAY PENETRATION SEALS

- A. Exterior wall surfaces above grade: Provide watertight seal around all raceways. For concrete construction above ground level, cast raceway in wall or core drill wall and hard pack with a mixture of equal parts of sand and cement. For other types of construction use method acceptable to Architect.
- B. Exterior surfaces below grade: Provide watertight seal around all raceways. Cast raceway into wall (or floor) or use manufactured seal assembly.
- C. Roofs: Provide flashed and hot mopped weatherproof seal, or a pitch pan filled and sealed to be weatherproof where raceway penetrates roof membrane. Provide a weatherhead on all raceway stubups penetrating roof.
- D. Fire rated construction: Seal penetrations to maintain fire rating of construction penetrated as specified in Division 7 Firestopping.

3.07 RACEWAYS SEALING FITTINGS

- A. Provide watertight seal in the interior of all raceways which pass through building roof, ground floor slab or through outside walls of the building above or below grade. Seal on the end inside the building, using raceway sealing fittings manufactured for the purpose. Locate fittings at suitable accessible locations. For concealed raceways install each fitting in a flush steel box with a blank coverplate to match finish of adjacent plates or surfaces.

Exception: Sealing fittings are not required on raceways through the floor slab when the raceway does not extend beyond the building footprint.

- B. Provide sealing fittings or duct seal in j-box for all raceways entering freezers and refrigeration units.

3.08 HANGERS FOR RACEWAYS

- A. Raceways 1" and larger: Provide lay-in pipe hangers on 1/4" (6mm) or larger all threaded rods attached to metal ceiling inserts or to structural members at not greater than 10'-0" (3m) on center and within 12" (300mm) of each change in direction.
- B. When more than two raceways will use the same routing, group together on a channel trapeze support system supported by 3/8" (9.5mm) (minimum) threaded rods attached to metal ceiling inserts or structural members. Size supports for multiple raceways for 25% future capacity.
- C. Suspended ceiling systems: Do not attach raceways to ceiling suspension system hangers. Raceways 3/4" (20mm) and smaller serving equipment located within ceiling cavity or mounted on or supported by the ceiling grid system may be supported by dedicated #12 ga. galvanized, soft annealed mild steel wire hangers. Two raceways maximum per hanger. Attach raceways with clips manufactured for the purpose.

3.09 EXPANSION FITTINGS

- A. Provide expansion fittings for raceways crossing expansion joints, building separation walls, and seismic joints. Provide bonding jumper.

3.10 STUB-UP CONNECTIONS

- A. Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches (150 mm) above the floor. For future equipment connections install threaded plugs flush with floor.

3.11 OUTLET AND JUNCTION BOXES

- A. Firmly anchor boxes directly or with concealed bracing to building studs or joists. Boxes must be so attached that they will not "rock" or "shift" when devices are operated.
- B. Flush Mounting: Install front edge (box or plaster ring) even with the finished surface of the wall or ceiling, except for those mounted above accessible ceilings or where drawings indicate surface mounting is permitted.
- C. Do not mount flush boxes back-to-back. Provide 6" (150mm) minimum horizontal separation between closest edges of the boxes. Option: Use sound isolation pads or other sound proofing method acceptable to Architect.
- D. When boxes are installed in fire resistive walls and partitions provide 24" (600mm) horizontal separation between boxes on opposite sides of a wall in accordance with IBC 712.3.2. In addition, limit penetrations to 16 square inches (103 square centimeters) per penetration and not to exceed a total of 100 square inches per 100 square feet (9.3 square meters) of wall area. Option: Apply fire stop putty pads acceptable to the fire marshal.

3.12 CONNECTION TO EQUIPMENT

- A. Provide outlet boxes of sizes and at locations necessary to serve equipment furnished under this or other Divisions and provide final connections to all equipment.
- B. Outlet box required if equipment has pigtail wires for external connection, does not have space to accommodate circuit wiring or requires a wire with insulation rating different from circuit wiring used.
- C. Study equipment details to assure proper coordination.

3.13 BLANK COVERS

- A. Provide blank covers or plates to match coverplates specified in section 16140 over all boxes that do not contain devices or are not covered by equipment.

3.14 JUNCTION OR PULL BOXES

- A. Pull and junction boxes: Install as shown, or as necessary to facilitate pulling of wire and to limit the number of bends within code requirements.
- B. Permanently accessible.
- C. The drawings do not necessarily show every pull or junction box required. Add all required boxes.

3.15 BOXES IN EARTH

- A. Provide for all wire splices and as required to pull conductors. Set boxes (handholes) smaller than 3' x 3' (910mm x 910mm) in place on a 3" (80mm) sand or pea gravel bed. Set larger boxes with a 6" (150mm) bed.
- B. Set boxes so that coverplates match the slope of, and are flush with the final surface grade.

3.16 COLOR CODING

- A. Color Code all junction boxes installed in accessible ceiling spaces and exposed in unfinished areas using spray paint on the box and entire cover in the following manner:

Telephone	Black
Electronic Safety and Security	Gray
Intercom	White

END OF SECTION

SECTION 28 13 00

ACCESS CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Coordinate the installation with Section 282400 - Video Surveillance System.

1.02 SUMMARY

- A. This section includes specifications for a complete integrated building Access Control system. The System shall include:
 - 1. An Access Control System including:
 - a. Sub-control panels/door controllers with spare capacity
 - b. Intelligent field interface panels
 - c. Card readers
 - d. Door position indicators
 - e. Request-to-exit devices
 - f. Power supplies for electric strikes and locks
 - g. Electrical connections
 - h. Wire and cable.
 - B. All requirements of this Specification, including software modules, computer hardware, etc. shall be provided with this phase, although some may be applied or utilized in a future phase.
 - C. Coordinate with the Door Hardware supplier to ensure that the Access Control interface requirements are accurately shown on the Wiring Diagrams provided by the General Contractor under Division 8. Coordinate with the General Contractor and make final connections for the Access Control portion of the door hardware control wiring.
 - D. Related Work:
 - 1. Electric Door Locks, Electric Door Switches, Division 8.

1.03 CODES AND STANDARDS

- A. Refer to Section 280500 - Common Work Results For Electronic Safety and Security, for applicable codes.
 - B. The system shall be listed by Underwriters' Laboratories, Inc., for meeting the requirements of UL-294, "Standards for Access Control System Control Units".
 - C. In addition Codes referenced in Section 280500, the following codes shall apply:
 - International Conference of Building Officials

- UBC, *Uniform Building Code*, as adopted and amended by the Owner.
- National Fire Protection Association (NFPA):
- NFPA 70 (NEC), *National Electrical Code*, as adopted and amended by the Owner.
- NEC Article 725
- Federal Communications Commission (FCC) Rules Part 15, Subpart B, Class A Compliant, and Part 68
- FCC Rules and Regulations, Part 76, *Cable Television Service*
- Underwriters Laboratories:
- UL 13, *Power-Limited Circuit Cables*
- UL 50, *Enclosures for Electrical Equipment*
- UL 83, *Thermoplastic-Insulated Wires and Cables*
- UL 444, *Communications Cables*
- UL 452, *Antenna-Discharge Units*
- UL 467, *Grounding and Bonding Equipment*
- UL 497, *Protectors for Paired Conductor Communications Circuits*
- UL 497A, *Secondary Protectors for Communications Circuits*
- UL 497B, *Protectors for Data Communication and Fire Alarm Circuits*
- UL 910, *Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air*
- UL 1270, *Radio Receivers, Audio Systems, and Accessories*
- UL 1283, *Electromagnetic Interference Filters*
- UL 1310, *Class 2 Power Units*
- UL 1409, *Low-Voltage Video Products Without Cathode-Ray Tube Displays*
- UL 1585, *Class 2 and Class 3 Transformers*
- UL 1685, *Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables*
- UL 3044, *Surveillance Closed Circuit Television Equipment*
- Institute of Electrical and Electronics Engineers, Inc. (IEEE) Standards:
- IEEE C62.41-1991, *Guide for Surge Voltages in Low-Voltage AC Power Circuits.*
- IEEE Std 142, *IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.*
- IEEE Std 241, *IEEE Recommended Practice for Electric Power Systems in Commercial Buildings.*
- IEEE Std 242, *IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.*
- IEEE Std 446, *IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications.*
- IEEE Std 1100, *IEEE Recommended Practice for Power and Grounding Sensitive Electronic Equipment.*

1.04 DEFINITIONS

- A. The following definitions shall be applied to this project, as stated herein:
- *A/R: As Required*
 - *ACMS: Access Control and Monitoring System*
 - *AHJ: The local authority having jurisdiction, with regards to building codes.*
 - *Contractor: The respondent to this Specification, the Systems Integrator who shall provide the systems described herein*
 - *Consultant: Sparling, the Owner's consultant and preparer of this Specification*
 - *Data Rate: The maximum rate of speed of a digital transmission system or device*
 - *dB: decibel: 10 times the common logarithm of a power ratio*
 - *Owner: THE OWNER*
 - *FCC: Federal Communications Commission*
 - *Fully Operational: Tested, approved, and operating to the satisfaction of the Owner, Consultant, AHJ, manufacturers, and contract documents.*
 - *Furnish: Deliver to the job site.*
 - *Install: To enter permanently into the project and make fully operational.*
 - *IMUX: Intelligent Multiplexer, Intelligent System Controller (ISC), Data Gathering Panel (DGP) – Field installed control panel controlling and allowing stand-alone operation of the input/output points .*
 - *MACC: Maximum allowable cost of construction*
 - *Provide: Design, prepare, submit, furnish, install, integrate, configure, program, test, conduct training, support, and warrant.*
 - *Required: As required by code, AHJ, contract documents, specification, design documents, or manufacturer for the particular installation to be fully operational.*

1.05 QUALIFICATIONS

- A. Supplier and/or subcontractor shall:
1. Have been in the business of installing and maintaining the specific type of system equipment under the present firm name for at least five years.
 2. Have been distributing and/or installing the specific brand and model line of system equipment for at least three years prior to the date on the contract documents.
 3. Have the capability of dispatching a maintenance or repair truck with a qualified repairman to the job site within four (4) hours of a request for service on the equipment.

1.06 SUBMITTALS

- A. Product data including but not limited to:
- Intelligent Controller
 - Control Relays
 - Control Wiring
 - Shop Drawings
 -
- B. Floor Plans: Prepare CAD based shop drawings to show device locations, raceway routing and sizes, and color coded wiring between devices.
- -
 -
 -

1. Riser. Provide diagram showing vertical wiring between components.
2. Control Schematics. Provide a control schematic showing interface circuits for each piece of equipment, termination and connection diagrams including wire numbers.
3. Recessed Mounted Card Reader. Provide card reader cut out size and mounting information to the appropriate subcontractor.
4. Prepare drawings of the equipment racks.
5. Release of CAD Files: Contractor may request to utilize Sparling CAD files for assistance in producing shop drawings. Request shall be made by signing Sparling's "Agreement for Release of CAD Files" letter.

1.07 CONTRACT DRAWINGS

- A. The contract drawings indicate the general nature of the system layout, but do not show all components required. Raceways, routing and wiring are not shown on the drawings. Contractor shall provide per system requirements and shop drawings.
- B. Contractor shall coordinate outlet box requirements with system supplier. Notify Architect prior to installation if conflicts occur between required box depth and wall thickness.

PART 2 - PRODUCTS

2.01 ACCESS CONTROL SYSTEM

- A. Equipment
 1. Equipment shall be the standard product of one manufacturer. One manufacturer or system assembler and installer shall be responsible for the entire system.
 2. The descriptions herein outline the functions of the Access Control System; location of devices shall be as shown on the shop drawings. Provide all equipment necessary for a complete and fully operational system
- B. Spare Equipment Capacity
 1. Provide at least 10% spare ports at each door controller location to allow connection of future additional door. Provide power supply sized for full door controller buildout.
- C. Manufacturers:
 1. GE - Cassi-Rusco to match Owner's existing system - No Substitutions.
- D. System Operation
 1. Entrances. During access hours (operator adjustable time zone), the entrances shall be unlocked. During service hours, the door shall electrically unlock for an adjustable time of 1 to 15 seconds when a valid authorized access card is inserted into the card reader. During off hours if the door is kept open for more

than 30 seconds, as monitored by the door switch, an alarm shall sound at the central control unit. The alarm shall print time and location.

2.02 CARD READERS

- A. Personnel Door Proximity Card Readers. Flush mounted to 4x4 box, HID Standard ProPro 4" x 4" Proximity Reader or equivalent. Coordinate locations with Architect.

2.03 24 VDC LOCK POWER SUPPLY

- A. Lock Power Supply: 24 VDC power supply to be used exclusively to power electric lock hardware. Sized for power requirements of electric lock hardware. Power supply to be as manufactured by Altronix to match Owner's existing system.
- B. When primary power is present, power supply shall continuously maintain a charge on standby batteries. Power supply shall be capable of recharging batteries while providing full lock output.
- C. Provide each 24 VDC power supply with sufficient 12 VDC 7 gelled electrolyte, sealed lead acid batteries to power locks for 90 minutes on power outage.
- D. Provide battery wiring harness as needed to properly connect batteries to power supply.
- E. Provide with relay to supply dry-contact power fault output.

2.04 UPS

- A. Provide a UPS in Equipment Rack for each Access Control System Intelligent Controller:
 - 1. Rating: 980 Watts / 1440 VA.
 - 2. Batteries:
 - a. 7.4 minutes (980 Watts)
 - b. Sealed lead-acid, leakproof, maintenance free.
 - c. Hot swappable
 - d. Battery management
 - 3. Input: 120V NEMA 5-15P
 - 4. Outputs
 - a. (6) 120V, 15A, NEMA 5-15R
 - 5. Interface Ports: DB-9, RS-232; 8-pin modular, 10/100 Base T Ethernet.
 - 6. Features:
 - a. Automatic self test.
 - b. Automatic voltage regulation.
 - c. Web/SNMP management.
 - d. Line interactive.
 - e. Load meter.
 - f. Line power conditioning.
 - g. Rack mount.
 - 7. Manufacturer: APC Smart-UPS SUA1500RM2U

2.05 CIRCUITRY

- A. All wiring shall be contained in steel raceways. Wiring insulation shall be one of the types required by NEC 725-4 and shall be consistently color coded throughout the system. All terminations shall be T & B "Sta-Kon" (or equivalent) spade type lugs where connected at screw type terminals. Wiring in terminal cabinets shall be neatly arranged and bundled with Tytraps (or equivalent). Provide numbered wire markers on each terminal end of all wires, (pressure sensitive or sleeve type).

2.06 WIRE AND CABLE

- A. General: Provide wire and cable, including communication media.
- B. Communication Cables:
 - 1. Communication cable shall be a minimum of 22 AWG and shall conform to REA PE20 for indoor cable.
- C. Control Wiring:
 - 1. Control wiring for digital functions shall be 18 AWG minimum with 600-volt insulation.
 - 2. Control wiring for analog functions shall be 18 AWG minimum with 600-volt insulation, twisted and shielded, 2- or 3-wire to match analog function hardware.

2.07 INTERFACE MODULE

- A. Shall consist of control relays, timers and transformer as required to provide operation indicated.

2.08 CONTROL RELAY

- A. General: Control relay contacts shall be rated for the application, with a minimum of two sets of Form C contacts, enclosed in a dust proof enclosure. Relays shall have silver-cadmium contacts with a minimum life span rating of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression limiting transients to nondamaging levels.
- B. Time Delay Relays: Time delay relay contacts shall be rated for the application with a minimum of two sets of Form C contacts enclosed in a dust proof enclosure. Relays shall have silver-cadmium contacts with a minimum life span rating of one million operations. Relays shall be equipped with coil transient suppression devices to limit transients to nondamaging levels. Delayed contact opening or closing shall be adjustable from one to 60 seconds with a minimum accuracy of plus or minus 2 percent of setting.
- C. Latching Relays: Latching relay contacts shall be rated for the application with a minimum of two sets of Form C contacts enclosed in a dust proof enclosure. Relays shall have silver-cadmium contacts with a minimum life span rating of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to nondamaging levels.

- D. Reed Relays: Reed relays shall be encapsulated in a glass-type container housed in a plastic or epoxy case. Contacts shall be rated for the application. Operating and release times shall be one milli- second or less. Reed relays shall have a minimum life span rating of 10 million operations.
- E. Solid-State Relays: Input-output isolation shall be greater than 1000 megohms with a breakdown voltage of 1500V RMS or greater at 60 Hz. The contact life shall be 10 million operations or greater. The ambient temperature range shall be minus 20 degrees to plus 140 degrees F. Input impedance shall not be less than 500 ohms. Relays shall be rated for the application. Operating and release time shall be one millisecond or less. Transient suppression shall be provided as an integral part of the relay to limit transients to nondamaging levels.
- F. The scope of system shall include all features and functions described herein and all equipment shown on the plans. System shall be capable of adding optional features and components listed in the specifications, even if not initially included or shown on the plans.
- G. Complete and operational systems shall be provided.

PART 3 - .EXECUTION

3.01 SYSTEM SUPPLIER AND/OR SUBCONTRACTOR REQUIREMENTS

- A. Provide and/or supervise all wiring, wire terminations and connections.
- B. Provide and/or supervise all equipment installation.
- C. Perform and/or supervise all testing during and after installation.
- D. Certify in writing to the Architect (copy to Engineer) at completion stating that system has been inspected, tested and is complete and fully operational in accordance with contract documents.

3.02 GENERAL

- A. Install components in accordance with the specifications, submittals, manufacturer's instructions and local codes and standards.
- B. Coordinate with other trades for installation of access control system interfaces with work by others.
- C. No equipment shall be delivered to the jobsite until shop drawings have been reviewed. A reviewed shop drawing set shall be continuously available at the jobsite during construction.
- D. Auxiliary Controls. Conductors and power supplies of sufficient size shall be installed to minimize voltage drop consistent with the proper operation of all devices. Limited energy circuits shall be routed separately from line voltage circuits as required by Code (NEC Article 725).

3.03 WIRING

- A. Provide all wiring complete per system requirements, including 10% spare conductors not less than two (2). Install all conductors in raceway, unless noted otherwise. Provide numbered wire markers on each terminal end of all wires, in accordance with shop drawings using permanent pressure sensitive or sleeve type markers.
- B. Provide all 120 volt circuits on the emergency power distribution system.

3.04 OPERATION AND MAINTENANCE MANUALS

- A. Operating Manuals. Provide in accordance with 16010. Manuals shall contain a preventive maintenance program and service instructions for components of the system as a whole and each component, function and operation in detail. Manuals shall be written to aid in training of new security and operating personnel and as guide clarifying operational procedures.
- B. Maintenance Manuals. Provide in accordance with 16010. Manuals shall contain a preventive maintenance program and service instruction for all components of the system. Manuals shall include illustrations, mounting instructions, wiring diagrams, parts lists, operating instructions and a trouble-shooting chart for the system, including a list of troubles, causes and recommended remedies. Include wiring diagram showing all components.
- C. Spare Parts List. Submit list of spare parts and components of critical items for consideration of purchase by Owner.

3.05 TESTING

- A. The completed system shall be tested and after one subsequent week (minimum) "on-line" operation demonstrated to operate satisfactorily in the presence of the Architect and Owner. Tests shall include the following:
 - 1. An operation of each card reader.
 - 2. Operation of each elevator.
 - 3. Operation of all features of the systems under all time zones and manual operation.
 - 4. Operation of all safety features of the systems.
 - 5. Operation of system under power failure conditions.
 - 6. Operation of system under central control unit failure.

3.06 INSTRUCTION

- A. Security Personnel Instruction. Provide a minimum of four training sessions of four hours each program for security personnel. Sessions shall be scheduled to be coordinated with building management. Training program shall be conducted by a qualified installation engineer, fully familiar with the entire system as it pertains to this project. The sessions shall be clarified by the use of operating manuals.

- B. Maintenance Personnel Instruction. Provide a minimum of 4 hours training. Total time shall be scheduled in sessions to be coordinated with building management. Training program shall be conducted by qualified installation engineer, fully familiar with the entire system as it pertains to this project. The sessions shall demonstrate locations and interconnection of system components, wiring paths and connections, and troubleshooting techniques. Demonstrations shall be clarified by the use of shop drawings, and operation and maintenance manuals.

3.07 MAINTENANCE AND SERVICE

- A. General Requirements: Provide all services, materials, and equipment necessary for the successful operation of the entire system for a period of one year after completion of the operational acceptance test. Provide necessary material required for the work. Minimize impacts on facility operations when performing scheduled adjustments and nonscheduled work.
- B. Description of Work: The adjustment and repair of system includes all computer equipment, software updates, transmission equipment, card readers, and all control devices. Provide the manufacturer's required adjustments and all other work necessary.
- C. Emergency Service: The Owner will initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the complete system. Furnish the Owner with a telephone number where the service supervisor can be reached at all times. Service personnel shall be at the site within 8 hours for life safety related issues and 24 hours for all other issues after receiving a request for service. Restore the control system to proper operating condition within 3 days.

END OF SECTION

SECTION 28 16 00

INTRUSION DETECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 DESCRIPTION

- A. Provide rough-in and conductors for an Owner installed Intrusion Detection System.

1.03 QUALIFICATIONS

Supplier and/or subcontractor shall:

- A. Have been in the business of installing and maintaining the specific type of system equipment under the present firm name for at least five years.
- B. Have been distributing and/or installing the specific brand and model line of system equipment for at least three years prior to the date on the contract documents.
- C. Have the capability of dispatching a maintenance or repair truck with a qualified repairman to the job site within four (4) hours of a request for service on the equipment.

1.04 CONTRACT DRAWINGS

- A. The contract documents indicate the general nature of the intrusion alarm system required and are intended to aid the contractor and/or subcontractor and/or supplier in providing the complete system required. Raceways, routing and wiring are not shown on the drawings. Contractor shall provide per system requirements and shop drawings.
- B. Contractor shall coordinate outlet box requirements with system supplier. Notify Architect prior to installation if conflicts occur between required box depth and wall thickness.

1.05 SHOP DRAWINGS

- A. Floor Plans: Prepare CAD based shop drawings to show device locations, raceway routing and sizes, and color coded wiring between devices.
- B. Detail Plans: Prepare original drawings showing termination and connection diagrams including wire numbers.
- C. Release of CAD Files: Contractor may request to utilize Sparling CAD files for assistance in producing shop drawings. Request shall be made by signing Sparling's "Agreement for Release of CAD Files" letter.

PART 2 - PRODUCTS

2.01 WIRING

- A. Provide one pair, twisted shielded #16 cable to each motion detector and door switch, routed back to the Security Room and terminated on terminal strips.

2.02 DOOR SWITCHES

- A. High security balance magnetic switch, UL listed for Safe and Vault applications. Weatherproof for outdoor locations.

2.03 MOTION DETECTORS

- A. Proximity and Infrared
- B. Manufacturer: Visonic to match Owner's existing system. No Substitutions.

2.04 UPS

- A. Provide a floor mounted UPS for Owner's Intrusion Detection System:
 - 1. Rating: 980 Watts / 1440 VA.
 - 2. Batteries:
 - a. 7.4 minutes (980 Watts)
 - b. Sealed lead-acid, leakproof, maintenance free.
 - c. Hot swappable
 - d. Battery management
 - 3. Input: 120V NEMA 5-15P
 - 4. Outputs
 - a. (6) 120V, 15A, NEMA 5-15R
 - 5. Interface Ports: DB-9, RS-232; 8-pin modular, 10/100 Base T Ethernet.
 - 6. Features:
 - a. Automatic self test.
 - b. Automatic voltage regulation.
 - c. Web/SNMP management.
 - d. Line interactive.
 - e. Load meter.
 - f. Line power conditioning.
 - 7. Manufacturer: APC Smart-UPS SUA1500RM2U

PART 3 - EXECUTION

3.01 APPROVED EQUIPMENT AND PERMIT

- A. No equipment shall be delivered to the jobsite until shop drawings and conductor samples have been reviewed and AHJ approved. A reviewed and AHJ approved shop drawing set shall be continuously available at the jobsite during construction.
- B. Obtain a permit from the local AHJ prior to installation of equipment as required.

- C. Install all detectors away from false alarm causing conditions. Aim and adjust detectors to give proper operation.

3.02 SYSTEM SUPPLIER AND/OR SUBCONTRACTOR REQUIREMENTS

- A. Provide and/or supervise all wiring, wire terminations and connections.
- B. Provide and/or supervise all equipment installation.
- C. Perform and/or supervise all testing during and after installation.
- D. Certify in writing to the Architect (copy to Engineer) at completion stating that system has been inspected, tested and is complete and ready for Owner's connections in accordance with contract documents.

3.03 WIRING

- A. Provide all wiring complete per system requirements. All wiring shall be contained in steel raceways. Conductors and power supplies shall be of sufficient size and be installed to minimize voltage drop consistent with the proper operation of all devices. Wiring insulation shall be AHJ approved and shall be one of the types required by NEC 725-16 and shall be consistently color coded throughout the system. Permanent wire markers shall be affixed to all conductors at terminations and splices. Numbering system shall be consistent with shop drawings. (Color schedule shall be reviewed by the Engineer prior to delivery of wire to the project.) All terminations shall be T&B "Sta-Kon" (or equivalent) self insulated, flanged or forked tongue lugs where connected at screw type terminals. Wiring in main control cabinet shall be neatly arranged and bundled with Tyraps (or equivalent).

3.04 TESTING

- A. The completed system shall be totally tested conductor continuity.

3.05 INSTRUCTION

- A. The Contractor shall (after one week (minimum) written notification to Architect) conduct an instruction session during which the cable locations and number for the system will be described and demonstrated to personnel selected by the Owner. The session shall be conducted by a Contractor's representative thoroughly familiar with the characteristics of the system.

3.06 RECORD DRAWINGS

- A. Provide per Section 280500 - Common Work Results For Electronic Safety and Security. Record drawings shall clearly indicate:
 - 1. Actual routing of all raceways.
 - 2. Actual cable type, numbers and routing.

END OF SECTION