SECTION 27 11 00 – COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all labor, materials, and equipment for the complete installation of Work called for in the Contract Documents.

B. This section includes the minimum requirements for the installation of cabinets, racks, frames and enclosures in data centers, computer rooms and communications equipment rooms.

C. Included in this section are the minimum composition requirements and installation methods for the following:
1. Freestanding Equipment Cabinets
2. Wall Mounted Equipment Cabinets/Racks
3. Freestanding Co-Location Equipment Cabinets
4. Freestanding Equipment Racks
5. Vertical Wire Management
6. Horizontal Wire Management
7. Ladder Rack & Accessories
8. Fiber Raceway

1.2 DEFINITIONS AND TERMS

A. Trade association names and communications terminology are frequently abbreviated. The following acronyms or abbreviations may be referenced within this Section:
1. AHJ Authority Having Jurisdiction
2. ANSI American National Standards Institute
3. ASTM American Society for Testing and Materials International
4. AWG American Wire Gauge
5. BICSI Building Industry Consulting Service International
6. CBP US Customs and Border Protection
7. CR Communications Room
8. DFW Dallas Fort Worth International Airport
9. ECA Electronic Components Association
10. NEC National Electric Code
11. NEMA National Electric Manufacturers Association
12. NFPA National Fire Protection Association
13. OAR Owner’s Authorized Representative
14. RCDD Registered Communications Distribution Designer
15. RU Rack Unit
16. STD Standard
17. TGB Telecommunications Grounding Busbar
18. TIA Telecommunications Industry Association
19. TMGB Telecommunications Main Ground Bus Bar
20. UL Underwriters Laboratories

1.3 QUALITY ASSURANCE

A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the OAR.

B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, or a substitution is requested, equipment shall be equivalent in every way to that of the equipment specified. All substitutions are subject to the control and approval of the OAR.

C. Strictly adhere to all BICSI and TIA recommended installation practices when installing the products specified in this section.

D. Contractor’s Qualifications:
   1. Firms regularly engaged in the installation of Data Communications cabling and that have five (5) years of installation experience with systems similar to that required for this project.
   2. Provide references to include client names, phone numbers and a summary of project details. These references will be checked, and the clients will be asked questions relative to the performance of your company.
   3. Provide verification that installation personnel responsible have been properly trained to install the products described in this Section.
   4. Provide a BICSI RCDD certified professional for oversight on this project. This person does not have to be working on-site but must be accessible to answer questions and provide weekly status reports. The RCDD shall be a full-time employee of the contractor.
   5. Provide full time project manager with a minimum of ten (10) years field experience in installation of communications systems and infrastructures. Project manager shall be assigned for the duration of the project and shall not be replaced without written consent from the OAR.

E. Manufacturer’s Qualifications:
   1. Firms regularly engaged in manufacture of products of the types, ratings and capacities required for this project; whose products have been in satisfactory use in similar service for not less than five (5) years, with production capabilities per applicable NEMA standards.

F. Material and Work specified herein shall comply with the applicable requirements of:
   1. NECA 1 – Standard Practice of Good Workmanship in Electrical Construction, 2015
   2. ANSI/NECA/BICSI-568 – Standard for Installing Commercial Building Telecommunications Cabling, 2006
   3. ANSI/TIA-568.0-D – Generic Telecommunications Cabling for Customer Premises, 2015
   4. ANSI/TIA-568.0-D-1 – Generic Telecommunications Cabling for Customer Premises – Addendum 1, 2017
   5. ANSI/TIA-569-D – Commercial Building Standard for Telecommunications Pathways and Spaces, 2015
   6. ANSI/TIA-606-C – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, 2017
   7. ANSI-J-STD-607-C – Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2015
   8. ANSI/TIA-942-B – Telecommunications Infrastructure Standard for Data Centers, 2017
   9. NFPA 70 – National Electric Code, 2017
   10. BICSI – Telecommunications Distribution Methods Manual, 13th Edition
   11. NEMA – VE 1 – Metal Cable Tray Systems, 2009
   12. NEMA – VE 2 – Metal Cable Tray Installation Guidelines, 2006
   13. DFW Airport Design Criteria Manual
   14. US Customs and Border protection Airport Technical Design Standard, 2017

15. Applicable codes and directives of authorities having jurisdiction

G. Work:
1. The Work shall be performed in compliance with the applicable manufacturer's installation instructions, Standards, and certifications listed herein, the Contract Documents, and governing codes and regulations of the authorities having jurisdiction.
2. The drawing and specification requirements govern where they exceed Code and Regulation requirements.
3. Where requirements between governing Codes and Regulations vary, the more restrictive provision applies.
4. Nothing in the Contract Documents grants authority or permission to disregard or violate any legal requirements.

1.4 CONFLICTS

A. This installation shall be made in strict accordance with the Specifications, Drawings, any applicable codes, referenced publications and standards. In case of conflicts between the aforementioned, notify the OAR in writing prior to commencement of affected work.

1.5 SCHEDULING

A. The Contractor shall comply with all scheduling requests established by OAR, both prior to commencing Work, and during construction. The Contractor shall provide a detailed schedule of work to be performed.

1.6 REQUIREMENTS

A. All references to manufacturers, model numbers and other pertinent information herein are intended to establish standards of performance and quality of construction. The OAR must approve material submittal and substitutions in writing.

B. Verification that all the components specified and installed meet the criteria specified by the respective component manufacturer, supplier and designer is the responsibility of the Contractor.

C. All installation tools, special equipment and testing apparatus required to accomplish field connections and related work as described herein shall be furnished by the Contractor at no additional cost.

D. The requirements as given in this document are to be adhered to unless revised by the OAR in writing.

E. The Owner reserves the right to waive these requirements at any time.

1.7 SUBMITTALS

A. Comply with provisions of Division 01.

B. Comply with provisions of Section 27 05 00.

C. Produce Shop Drawings for ALL (tele)communications rooms which shall include dimensions, rack/cabinet placement, cable tray/ladder racking placement, rack/cabinet elevations, and each wall within the space.

D. Provide all submittal requirements under this section as a single package.

E. Provide product data for the following:
   1. Product data consisting of manufacturers specifications for each type of product to be installed, all applicable certifications and elevation/plan documents supporting compliance with stated Specifications.
   2. Proposed format of as-built documentation.

1.8 CONTRACTOR CLOSE OUT SUBMITTALS

A. Submit Closeout documentation in accordance with Division 01 of the Project Manual and any applicable supplements. The number of submittal sets required is the greater of either the requirements of Division 01 of the Project Manual, or a minimum of four (4) sets.
   1. Segregate documents into separate binders containing data relevant to operational, maintenance, and warranty issues.
   2. Provide above closeout documentation as an electronic file in PDF format.
   3. Laminated as-built drawing sheet of CR service area representing each level, with a scale of not less than 1/8 inch, mounted on the wall of each CR.

B. Warranty and Maintenance:
   1. Record drawings of final room configurations

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials factory-packaged in containers or reels and handle in accordance with manufacturer’s recommendations. Store in a clean, dry space and protect products from damaging fumes and traffic. Handle materials carefully to avoid damage.

B. Storage space on project site may be limited. Contractor shall coordinate delivery and arrange storage of materials and equipment with the OAR.

C. Components sensitive to damage in a harsh environment shall be stored off-site and delivered as needed.

D. Provide protective covering during construction to prevent damage or entrance of foreign matter.

E. Contractor is responsible for on-site security of tools, test equipment and materials.

F. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.

1.10 PROJECT CONDITIONS

A. Verify conditions on the job site are applicable to this Work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.

B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install Work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the Work may be installed.

1.11 WARRANTY

A. Warrant labor and product to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics, following Contractor Warranty requirements defined in Division 01. Repair or replace defects occurring in labor or product within the Warranty period without charge.

B. All surplus parts and pieces to the installation shall be maintained as a spare parts inventory at the building site. Parts replaced during the warranty period shall have a warranty matching that of the original part from date of replacement.

PART 2 - PRODUCTS

2.1 GENERAL

A. The products specified in this document do not necessarily constitute the exhaustive list of products required to complete the statement of work. Except where described in the SUMMARY subpart of this document, the contractor is responsible for providing any other parts and materials needed to deliver a complete and working system.

2.2 EQUIPMENT CABINETS

A. Free-standing Equipment Cabinets (DFW)
   1. Provide equipment cabinets for each Communications Room.
   2. Cabinet shall have the following features:
      1) A proven frame design, heavy-gauge mounting rails, and heavy-duty casters provide for 3000 lb (1364 kg) static and 2250 lb. (1023 kg) dynamic load ratings.
      2) The roof, side panels and front and rear doors shall be grounded to the frame of the enclosure. Additional electrical grounding inserts shall be located on the frame for external grounding.
      3) APC AR7252 Network roof for high density cabling
      4) AR8105BLK Provide (1) vented rack mount shelf for each cabinet to be used as needed.
      5) Shipped standard with both leveling feet and castors.
      6) Vendor-neutral mounting for guaranteed compatibility with all ECA-310 compliant 19-inch equipment.
      7) Integrated and adjustable rear channel providing zero U mounting locations for accessories.
      8) The vertical mounting rails can be adjusted in 1/4 in (6.4 mm) increments covering virtually any mounting requirement for IT equipment. U positions are numbered front and back for rapid installation of equipment.
      9) Split rear doors.
   3. Provide joining hardware to join enclosures in a row and provide additional stability.
   4. Place a vertical grounding busbar with isolation on the backside of each cabinet.

5. Place two (2) sets of cable-ring vertical management on the backside of each cabinet.
6. Include equipment mounting cage nuts and screws.
7. Acceptable products:

    1) APC AR3157 NetShelter SX 48U 750mm Wide x 1070mm Deep Enclosure.
    2) APC AR7375 Side Panel with Cable Pass-Thru Slots
    3) APC AR7252 Network Cabinet Top
    4) B-Line Grounding Busbar Kit, part number SBVB72
    5) CPI Insulator Block, part number 40157-050
    6) APC AR8442 Cable Ring Vertical Management Kit
    7) AR8105BLK Provide (1) vented rack mount shelf for each cabinet to be used as needed.

    Owner approved equivalent.

B. Vertical Cable Management
1. Provide vertical cable managers for both sides of the front of each cabinet
2. Cable management shall be for the total height of the cabinet.
3. Shall have Smooth plastic fingers provide proper bend radius.
4. Provide two kits with (2) cable managers for each cabinet.
5. Include hinged covers for each cable manager associated with the 750mm wide cabinet.
6. Acceptable products:

    APC AR7580 Vertical Cable Manager for NetShelter 42U SX 750mm Wide Cabinet.

    1) APC AR7581 Hinged Covers for APC AR7580.

    APC AR7588 Vertical Cable Manager for NetShelter 48U SX 750mm Wide Cabinet

    2) APC AR7589 Hinged Covers for APC AR7588.

    Owner approved equivalent

C. Horizontal Cable Management
1. Provide single sided horizontal cable managers as depicted in the rack elevation drawings. Typically;

    1) At the top of each cabinet,
    2) Above and below each patch panel,
    3) Below each fiber enclosure,
    4) Above and below each Ethernet switch,
    5) Above and below each group of patch panels.

    In all cases;

    1) Four units of 1U horizontal cable managers per cabinet to be used as owner decides.

    2) Two units of 2U horizontal cable managers per cabinet to be used as owner decides
2. Wire manager shall be single-sided.
3. The minimum depth shall be 4 inches.
4. Acceptable products:

    1) APC AR8600 Horizontal Cable Manager, 2U Single Side with Cover
    2) APC AR8602 Horizontal Cable Manager, 1U Single Side with Cover

    Owner approved equivalent.

D. Strain Relief Bars
1. Provide one seven-inch deep strain relief bars behind each 24 ports of a patch panel.

2. Provide two straight strain relief bars per cabinet to manage cabling and power cords behind the equipment.
3. Provide (two) two-inch strain relief bars per cabinet to manage cabling and power cords behind the equipment.
4. Provide two five-inch strain relief bars per cabinet to manage cabling and power cords behind the equipment.
5. Acceptable products:

    1) Panduit SRB19D7BL Deep Strain Relief Bar
    2) Panduit SRBS19BL-XY Straight Strain Relief Bar
    3) Panduit SRB19BLY 2” Strain Relief Bar

    Owner approved equivalent.

E. Power Distribution
1. Provide two vertical power strips for each equipment cabinet.
2. Power strip shall have a 120V, 30A input with a NEMA L5 - 30P input.
3. Power strip shall have a quantity of (24) NEMA 5-20R outputs.
4. Acceptable products:

    1) APC AP8832 Metered Rack PDU, 30A, 120V

    Owner approved equivalent.

F. Cabinet Top-Panel Cable Partitions
1. Provide two cable partitions for installation on the top panel of each cabinet.
2. Partitions shall be approximately 4.8” high and 29.4” long.
3. Partitions shall provide tool-less connection into the cabinet’s top panel.
4. Partitions shall include grounding accessories, as required.
5. Acceptable products:

    1) APC AR8173BLK Data Cable Partition

    Owner approved equivalent.

G. Airflow Blank Panel
1. Provide blank airflow panels for ALL unused cabinet rack spaces. Prior to installation, coordinate with Owner to leave spaces for any owner-furnished equipment.
2. Panels shall prevent air recirculation by occupying unused rack spaces.
3. Panels shall provide tool-less installation.
4. Acceptable products:

    1) APC AR8136BLK Blank Filler Panel, 1U (Qty 10)
    2) APC AR8136BLK200 Blank Filler Panel, 1U (Qty 200)

    Owner approved equivalent.

2.3 EQUIPMENT RACKS (AMERICAN AIRLINES AND TSA)

A. Free-standing Equipment Racks
1. Racks shall be manufactured from aluminum extrusion.
2. Each rack will have two L-shaped top angles, two L-shaped base angles and two C-shaped equipment-mounting channels. The rack will assemble with nut and bolt hardware. The base angles will be pre-punched for attachment to the floor.
3. Equipment mounting channels will be 3” deep and punched on the front and rear flange with the EIA-310-D universal hole pattern to provide 45 rack-mount spaces for equipment. Each mounting space will be marked and numbered on the mounting channel.

4. When assembled with top and bottom angles, equipment-mounting channels will be spaced to allow attachment of 19” EIA rack-mount equipment. Attachment points will be threaded with 12-24 roll-formed threads. The rack will include assembly and equipment-mounting hardware. Racks will include 50 each combination pan head, pilot point mounting screws.
5. The assembled rack outside dimensions will be 7’ (84”) high, 20” wide and 15” deep. The sides (webs) of the equipment-mounting channels will be punched to allow attachment of vertical cable managers along the sides of the rack or for rack-to-rack baying.
6. The rack will be rated for 1,000 lb. of equipment.
7. The rack will be UL Listed.
8. Finish shall be epoxy-polyester hybrid powder coat in the color black.
9. Acceptable products:

   Chatsworth Products, Inc. (CPI)

   1) 55053-703, Standard Rack, 19” x 7’, Black, UL Listed.
   2) 40605-005, Equipment Mounting Screws, #12-24, 50 pack, Black
   3) 40604-003, Rack Installation Kit, Concrete Slab, Zinc
   4) 11231-719, Double Sided Vented Shelf
   5) 12816-704, Flush Mount Plug Strip with NEMA L5-15P, and Surge Protection (provide two per rack)

   Owner Approved Equivalent.

B. Vertical Wire Managers
1. Every rack/frame shall have a minimum of one vertical cable manager. The vertical cable manager shall create a space for storing and organizing cables along the side of the rack/frame. The cable manager shall maintain separation between patch/equipment/jumper cords and premise cables.
2. The vertical cable manager shall match the height of the rack(s)/frame(s).
3. The vertical cable manager shall bolt to the side of racks/frames with included hardware.
4. The cable manager shall be sized to match cabling requirements. Maximum cable fill shall be calculated by dividing 50% of the usable area within the cable manager by the area of a single cable.
5. A single vertical cable manager may be used in between bayed racks/frames if it is sized to match cable requirements for both racks/frames.
6. The single-sided vertical cable manager shall be a C-shaped trough with a front door. The single-sided trough shall provide a single cable pathway. The front sides of the cable manager shall have T-shaped cable guides separated by openings that align with each U space on the rack. The back of the manager shall be mostly open to allow easy cable pass-through. Three fixed position accessory mounting panels shall allow attachment of cable management accessories at the back of the manager.
7. The double-sided vertical cable manager shall be a double-sided H-shaped trough with a front door and a rear door. The double-sided trough shall provide independent front and rear cable pathways. The front and rear sides of the cable manager shall have T-shaped cable guides separated by openings that align with each U space on the rack. The middle of the managers shall be mostly open to allow easy cable pass-through. Three movable mid-sections shall allow attachment of cable management accessories inside the cable manager. The movable mid-sections shall adjust front-to-rear to allow a 40/60, 50/50 or 60/40 front/rear split of the interior cable management space.
8. The combination vertical cable manager shall be a single-sided C-shaped trough with a front door and individual cable rings on the rear side. The single-sided trough and cable rings shall provide independent front and rear cable pathways. The front sides of the cable manager shall have T-shaped cable guides separated by openings that align with each U space on the rack. The back of the manager shall have individual rings with plastic spin-open latches. The rings will provide attachment points for cable management accessories

inside the cable management trough. Openings between the rings will allow easy cable pass-through.

9. The door shall be removable, hinged to open from the right or left side, with a two-point latch and a single knob on the right and left side to secure the door in the closed position. The front door shall have a two-tone finish: black with a vertical aluminum panel at the center. The rear door on double-sided cable managers shall be flat with a black finish.
10. The T-shaped cable guides shall be made from a composite plastic material (not metal) and shall have rounded edges to protect cables. Openings between the T-shaped guides will be evenly spaced. When the cable manager is attached to a rack/frame, each cable opening shall align with a rack-mount space (U) on the rack/frame. Each opening shall pass a minimum of 24 each .25" OD patch cords.
11. The cable manager shall be delivered individually boxed, and available in several widths as specified below and in the contract documents.
12. The vertical cable manager shall be manufactured from steel, aluminum and plastic.
13. Finish shall be epoxy-polyester hybrid powder coat paint in the color as specified below and in the contract documents. T-shaped cable guides and latch hardware is black.
14. Optional internal cable management accessories will include cable management spools that attach to the panels/mid-sections to provide slack management for patch cords; a cable lashing bar kit to provide tie points for cable bundles at the rear/mid of the manager; and a fiber segregation kit that creates a separate pathway inside the manager to separate fiber from other cables.
15. Acceptable products:

    Chatsworth Products, Inc. (CPI), Velocity™ Cable Management:

    1) Part Number 35571-703, Evolution g3 Combination Vertical Cable Manager, 7' High x 6" Wide x 20.2" Deep (2.1 m x 150 mm x 513 mm), Black.
    2) Part Number 15008-001, Cable Distribution Spools, Pack of 4, Black.
    3) Part Number 35475-701, Fiber Segregation Kit, for Evolution Vertical Cable Managers, 3.8" Wide x 4.3" Deep (97 mm x 109 mm), Black.
    4) Part Number 35473-703, Cable Lashing Bar Kit, for Evolution Vertical Cable Managers, Zinc-Plate (Silver-Colored).

    Owner Approved Equivalent.

C. Horizontal Wire Managers
1. Place horizontal cable managers above and below each patch panel on/in each rack/frame. The horizontal cable manager will guide patch/equipment cords between the vertical cable manager and individual network port connections.
2. The horizontal cable manager shall match the rack-mount width of the rack(s)/frame(s).
3. The horizontal cable manager shall attach to the front or rear of the rack/frame with screws and shall be sized to fit in standard EIA-310-D or EIA-310-E Universal rack-mount spacing (1-3/4" high U).
4. The horizontal cable manager shall be sized to match cabling requirements. Provide a minimum of 1U of horizontal cable management for every 2U of connectivity. Cables must be able to access the cable manager so that no ports are blocked by the cables.
5. A single horizontal cable manager may be used to support multiple patch panels as long as it is sized to match cable fill requirements. Cables must be able to access the cable manager so that no ports are blocked by the cables.
6. The horizontal cable manager shall be a single-sided C-shaped trough with a cover. 2U and 3U high cable managers shall have three edge-protected oval openings at the rear to facilitate front-to-rear cabling through the horizontal manager. The front of the cable manager shall have T-shaped cable guides along the top and bottom surfaces of the cable manager. Evenly spaced cable openings in between the T-shaped cable guides shall allow cables to enter/exit the cable manager from/into the rack-mount space. The cover shall be

removable, hinged to open up or down and shall snap on to secure the cover in the closed position.

7. The horizontal cable manager shall be delivered individually boxed, and available in the width(s) and height(s) as specified below and in the contract documents.
8. The horizontal cable manager shall be manufactured from steel, aluminum and plastic.
9. Finish shall be epoxy-polyester hybrid powder coat paint in the color as specified below and in the contract documents. Edge-protectors, T-shaped cable guides and latch hardware is black.
10. Acceptable products:

    Chatsworth Products, Inc. (CPI), Velocity™ Horizontal Cable Management:

    1) Part Number 35441-702, Evolution Single-Sided Horizontal Cable Manager, 2U x 19”EIA x 8.2” Deep (208 mm), Black.

    Owner Approved Equivalent

D. Strain Relief Bars
1. Install a 7" deep strain relief bar behind each 24 ports of each patch panel.

   Approved products:

   1) Panduit SRB19D7BL Deep Strain Relief Bar
   2) Owner approved equivalent.

2.4 EQUIPMENT CABINETS (AMERICAN AIRLINES AND TSA)

A. Free-standing Equipment Cabinets
1. Cabinets: Provide freestanding equipment cabinets to store networking switches and equipment in the data centers, computer rooms and equipment rooms. Each cabinet enclosure shall have a rectangular frame with removable top panel, side panels and doors. Installed cabinets shall include thermal, power, and cable management accessories that control airflow through the cabinet and keep network and power cables separate and organized.
2. Cabinet Frame: The cabinet frame shall be rectangular with four corner posts, manufactured from steel with welded frame construction. The sides of the frame shall be punched at the top and bottom with a hole pattern to allow attachment of equipment mounting rails and thermal, cable and power management accessories. The cabinet frame shall support 2500 lb (1134 kg) of equipment. The side panels and doors shall be supported by cast aluminum standoffs attached to the corners of the cabinet frame so that there is additional space for cable management and airflow between the frame and the doors and side panels. The cabinet shall be 27.6” wide by 36.3” deep by 83.5” high when doors, top panel and side panels are installed.
3. Equipment Mounting Rails: Each cabinet shall include two pairs of equipment mounting rails. Cabinets have adjustable front and rear rails. The rear pair of mounting rails shall bolt to the side of the cabinet frame at the top and bottom of the frame and shall be adjustable in depth to provide front and rear support for equipment. Equipment Mounting Rails shall be spaced horizontally to support 19” wide EIA-310-D compliant rack-mount equipment and shall provide up to 23.6” of rail-to-rail depth for equipment. Mounting rails shall be square-punched according to the EIA-310-D Universal hole pattern with equipment mounting holes on alternating 5/8” – 5/8” – 1/2“ vertical hole centers. Square-punched holes shall accept cage nut hardware with various threads. Rack mount spaces or units (RMU) shall be 1-3/4” high and shall be marked and numbered on the mounting rails. Numbering shall start at the bottom of the rail. Mounting rails shall provide 45 RMU for equipment.

4. Top Panel: The cabinet shall include a five-piece top panel, one center panel and four perimeter panels (front, rear and sides). The center panel shall attach to the top of the cabinet frame and shall be a solid top panel with four 2.75” (70 mm) diameter grommet-protected ports located near the corners of the panel. The perimeter panels shall cover the space between the cabinet frame and the doors and side panels and shall be solid with 3.1” x 5.3” (79 mm x 135 mm) cable knockouts. The side perimeter top panels shall be removable to allow larger cable bundles to enter the cabinet.
5. Side Panels: The cabinet shall include two locking solid side panels with keyed latches for easy installation and removal. Contractor shall install side panels only on each end of bayed equipment cabinets. Side panels shall be removed between equipment cabinets that are bayed together.
6. Front Door: The cabinet shall include a single front door with a perforated metal panel, hidden tamper-resistant hinges with quick-release hinge pins and a swing handle. The door shall be removable. The front door shall have a two-point cam latch with a combination and keyed lock.
7. Rear Door: The cabinet shall include a double perforated metal rear door with a swing handle. The door shall be removable. The rear door shall have a two-point cam latch with a combination and keyed lock.
8. Integrated Cable Management: Cabinets have two sets of T-shaped cable guides and ten cable spools. The T-shaped cable guides shall attach to the front of the cabinet frame and shall have openings that align with each RMU space in the cabinet. The cable spools shall attach to the side of the cabinet frame.
9. Casters: Cabinets that must be pulled away from a wall to gain access to the rear shall have a caster set.
10. Material/Construction: The cabinet frame, top panel and side panel shall be manufactured from steel. The door frames shall be manufactured from steel and aluminum. Door panels shall be steel. The door handle, side panel latches and rear door hinges shall be plastic. The cabinet frame and rear door shall be welded. The front door shall be welded and bolted. Cabinet components shall assemble with hardware.
11. Color/Finish. The metal components of the cabinet frame, top panel, side panels, and doors shall be painted black with epoxy-polyester hybrid powder coat paint. The mounting rails shall be zinc-plated and silver-colored. Plastic components shall be black.
12. Included Hardware: The cabinet shall include (4) leveling feet, (4) clamps for securing the leveling feet to the floor, a baying kit, and a means for bonding the cabinet to the Telecommunications Grounding Busbar. The manufacturer of the cabinet shall sell compatible casters and equipment mounting hardware as an accessory.
13. Acceptable products:

    Chatsworth Products, Inc. (CPI), F-Series TeraFrame™ Network Cabinet:

    1) FF2B-113C-C21, F-Series TeraFrame Network Cabinet, 27.6” wide x 36.3” deep x 83.5” high cabinet, 19” EIA x 45 RMU, Square-Punched Equipment Mounting Rails, Top Panel, One Solid Side Panels, Single Perforated Metal Front Door, Double Perforated Metal Rear Door, Two-Point Cam Latches, Keyed Locks, Black.

    Owner Approved Equivalent.
14. Power Distribution

    Provide two vertical power strips for each equipment cabinet.
    Provide mounting brackets
    Power strip shall have a 120V, 20A input with a NEMA L5 - 20P input.
    Power strip shall have a quantity of (20) NEMA 5-20R outputs.
    Approved products:

    1) CPI 12848-758 Metered Vertical Rack PDU, 20A, 120V
    2) Owner approved equivalent.

B. Wall Mount Equipment Cabinets

1. Wall-mounted cabinets shall be manufactured from steel sheet.
2. Each cabinet will have a rear panel that attaches to the wall, a hinged cabinet body that swings open from the rear panel providing easy access to the rear of equipment and a locking front door.
3. The rear panel will be 5” (130 mm) deep and will provide cable access with pre-punched knockouts for conduit along the top and bottom edges of the panel. There will be a minimum of (4) combination 1/2” and 3/4” conduit knockouts (2 top/2 bottom) and (8) combination 2-1/2” and 3” knockouts (4 top/4 bottom). The back edge of the knockouts will be located 1-5/8” (41 mm) from the back surface of the panel (cabinet/wall) allowing conduit to be attached to the wall with auxiliary framing strut. The cabinet will include rubberized or plastic/composite grommets that fit within the 3” knockouts to protect cables when conduit is not used to route cables. There will also be one 6” (150 mm) high by 6” (150 mm) wide cutout in the back of the rear panel so that cables can enter the panel through the wall. The rear panel will provide attachment points for accessory equipment mounting brackets and cable tie points within the panel (cabinet). The manufacturer of the cabinet will sell compatible equipment mounting brackets and cable ties as separate accessories.
4. The cabinet body will include a single pair of vertical 19”EIA equipment mounting rails. The mounting rails will be EIA-310-D compliant with the Universal hole pattern. Mounting holes will be spaced vertically on alternating 5/8”-5/8”-1/2” (15.9 mm – 15.9 mm – 12.7 mm) centers and will be roll-formed with #12-24 threads. Mounting rails will provide 12, 18, or 26 rack-mount unit (U) spaces for equipment as indicated in the drawing set.
5. Mounting rails will be adjustable in depth so that they can be positioned at any point within the cabinet body. The design of all cabinets will allow an additional pair of mounting rails (for a total of two pairs of mounting rails per cabinet) to be added to the cabinet. The manufacturer of the cabinet will sell compatible mounting rails as a separate accessory.
6. Mounting rails will bolt in place directly to the cabinet frame. The mounting rails will be L-shaped. The side of the mounting rails will be punched to provide lacing points for cables.
7. The hinge design that attaches the cabinet body and the rear panel will allow the rear panel to be removed during installation.
8. The hinge that attaches the cabinet body and the rear panel will allow the cabinet body to open at least 90°. The hasp used to secure the rear panel and the cabinet body together will assist in drawing the components together during the locking action.
9. The cabinet body will include vents that are designed to accept fan kits. The manufacturer of the cabinet will sell compatible fan and filter kits as separate accessories.
10. The front door will be hinged and locking. The front door and rear panel will be keyed alike. The front door will have rounded edges and corners. The cabinet body will allow the front door to be attached so that it will swing open from the right or left. The front door will be solid or have a tinted window, as specified below.
11. Finish shall be epoxy-polyester hybrid powder coat (paint) in the color(s) specified below. Tinted windows in doors shall be bronze acrylic (not clear) with a UL flammability classification of 94HB or better.
12. The cabinet shall be delivered fully assembled and will include installation hardware (hex lag screws) for wood studs and 50 each #12-24 equipment mounting screws.
13. Load bearing capacity for cabinets will be 200 pounds (90.7 kg) per cabinet. Load bearing capacity will be stated in the manufacturer’s product literature.
14. Cabinets will be UL Listed under category NWIN to standard UL 60950. UL Listing will be stated in the manufacturer’s product literature.
15. Acceptable products:

    Chatsworth Products, Inc. (CPI), CUBE-iT PLUS Cabinet System

    1) 11900-724, CUBE-IT PLUS Wall-Mount Cabinet, 24” (610 mm) High x 24” (610 mm) Wide x 24” (610 mm) Deep Exterior, 12U x 19”EIA x 22.8” (579 mm) Deep Interior, Tinted Window Front Door, Black.

2) 11900-736, CUBE-IT PLUS Wall-Mount Cabinet, 36" (910 mm) High x 24" (610 mm) Wide x 24" (610 mm) Deep Exterior, 18U x 19"EIA x 22.8" (579 mm) Deep Interior, Tinted Window Front Door, Black.
3) 11900-748, CUBE-IT PLUS Wall-Mount Cabinet, 48" (1220 mm) High x 24" (610 mm) Wide x 24" (610 mm) Deep Exterior, 26U x 19"EIA x 22.8" (579 mm) Deep Interior, Tinted Window Front Door, Black.

Owner Approved Equivalent.

C. Wall Mounted Equipment Rack (DFW Quad Closets)
1. Wall-mounted cabinets shall be manufactured from steel sheet.
2. The cabinet body will include a single pair of vertical 19"EIA equipment mounting rails. The mounting rails will be EIA-310-D compliant with the Universal hole pattern. Mounting holes will be spaced vertically on alternating 5/8"-5/8"-1/2" (15.9 mm – 15.9 mm – 12.7 mm) centers and will be roll-formed with #12-24 threads. Mounting rails will provide 12, 18, or 26 rack-mount unit (U) spaces for equipment as indicated in the drawing set.
3. Mounting rails will be adjustable in depth so that they can be positioned at any point within the cabinet body. The design of all cabinets will allow an additional pair of mounting rails (for a total of two pairs of mounting rails per cabinet) to be added to the cabinet. The manufacturer of the cabinet will sell compatible mounting rails as a separate accessory.
4. Mounting rails will bolt in place directly to the cabinet frame. The mounting rails will be L-shaped. The side of the mounting rails will be punched to provide lacing points for cables.
5. The cabinet shall be delivered fully assembled and will include installation hardware (hex lag screws) for wood studs and 50 each #12-24 equipment mounting screws.
6. Load bearing capacity for cabinets will be 200 pounds (90.7 kg) per cabinet. Load bearing capacity will be stated in the manufacturer's product literature.
7. Acceptable Products:

   Chatsworth Products, Inc. (CPI), Standard Swing Gate Wall Rack.

   1) 11807-725, Standard Swing Gate Wall Rack, 24" High x 22" Wide x 24" Deep, 26 U x19"EIA.
   2) Owner Approved Equivalent
8. Power Distribution

   Provide two horizontal power strips for each equipment rack.
   Power strip shall have a 120V, 20A input with a NEMA L5 - 20P input.
   Power strip shall have a quantity of (6) NEMA 5-20R outputs.
   Approved products:

   1) 12816-704 15A 120V Horizontal Rack Mount Single Phase Surge Protected power strip.
   2) Owner Approved Equivalent

2.5 LADDER RACK, SUPPORTS, AND ACCESSORIES

A. Ladder Rack (Cable Runway)
1. Ladder rack shall be manufactured from 3/8-inch wide by 1-1/2-inch high tubular steel.
2. Ladder rack (side stringers) will be 9 feet, 11½ inches long. Cross members will be welded in between stringers on maximum 12-inch centers beginning 5-3/4 inches from one end so that there are a minimum 10 cross members per ladder rack. There will be a maximum 10-1/2 inches of open space in between each cross member.
3. Finish shall be epoxy-polyester hybrid powder coat (paint) in the color(s) specified below.

   Black
4. Refer to the drawing set to determine the width.
5. Acceptable products: ("xx" denotes nominal width)

Chatsworth 10250-7xx
Cooper B-Line SB17TxxBFB
Owner Approved Equivalent

B. Horizontal 90-degree Turns
1. Horizontal 90-degree turns shall be manufactured from 3/8-inch wide, by 1-1/2-inch high tubular steel with 0.065 inch wall thickness.
2. Stringers (sides) will be formed in a 90-degree arc. Cross members will be welded in between stringers on approximate 23-degree increments so that there are 5 cross members per turn. The welded assembly will have a 15-inch inside radius and will create a smooth horizontal 90-degree turn.
3. Horizontal 90-degree turns will be available in the width(s) specified below.
4. Finish shall be epoxy-polyester hybrid powder coat (paint) in the color(s) specified below.

   Black
5. Acceptable products: (“xx” denotes nominal width)

   Chatsworth 10822-7xx
   Cooper B-Line SB17HRBxxFB
   Owner Approved Equivalent

C. Vertical-To-Horizontal 90-degree Turns
1. Vertical-to-horizontal 90-degree turns shall be manufactured from 3/8-inch wide by 1-1/2-inch high tubular steel with 0.065-inch wall thickness.
2. Stringers (sides) will be formed in a 90-degree arc with a 12-1/2-inch outside radius. Cross members will be welded in between stringers on approximate 23-degree increments so that there are 3 cross members per turn. The welded assembly will create a smooth 90-degree vertical-to-horizontal turn.
3. Finish shall be epoxy-polyester hybrid powder coat (paint) in the color(s) specified below.

   Black
4. Acceptable products: (“xx” denotes nominal width)

   Chatsworth 10724-7xx
   Cooper B-Line SB16VRBxxFB
   Owner Approved Equivalent

D. Corner Brackets
1. Corner brackets shall be manufactured from 3/8-inch wide by 1-1/2-inch high tubular steel with 0.065-inch wall thickness.
2. The inside stringers of the corner bracket will be formed at 90-degree with a small chamfer at the vertex. The outside stringer of the corner bracket will be formed in a 90-degree arc with either a 15-inch or 24-inch radius. A single cross member will connect the chamfered portion of the inside stringer to the outside stringer. The welded assembly will create a smooth 90-degree turn within the L-shaped corner created by two intersecting ladder racks.
3. Corner brackets will be available in the size(s) specified below. Installation hardware will be included with the corner bracket. Corner bracket installation hardware does not include the junction splice kit required to form the L-shaped intersection between two ladder racks.
4. Finish shall be epoxy-polyester hybrid powder coat (paint) in the color specified below.

   Black
5. Acceptable products: (“xx” denotes nominal radius)

   Chatsworth 11959-7xx
   Cooper B-Line SB2104FB
   Owner Approved Equivalent

E. Ladder Rack Splices

1. Provide splice kits to mechanically connecting ladder rack sections and turns together, end-to-end or side-to-end, to form a continuous pathway for cables.
2. Grounding kits shall be provided for bonding ladder rack sections and turns together, independent of the pathway splices.

   The grounding kit should be constructed of UL Listed components.
   The preferred solution is a #6 AWG green insulated stranded copper conductor connected on both ends to ladder rack using two-hole compression lugs and stainless steel hardware.
3. Include insulator bar kits to provide a means of electrically isolating individual ladder rack sections

   The preferred solution is a 3/8-inch wide, by 1-1/2-inch high, by 5-1/2-inch long polyoxymethylene insulator bar.
4. Splices shall be manufactured from steel.

   Finish shall be powder coated black in color, with zinc plated hardware.
5. Splice, grounding and insulator bar kits will include installation hardware.
6. Acceptable products:

   Chatsworth Products, Inc. (CPI)

   1) 11301-701 Butt Splice Kit
   2) 11302-701 Junction Splice Kit

   Cooper B-Line

   3) SB2107BZ Butt Splice Kit
   4) SB2101ABZ Junction Splice Kit

   Owner Approved Equivalent

F. Ladder Rack Supports
1. Supports will be sized to match the width of the ladder rack that is supported. Some supports will Work with all widths of ladder rack.
2. Each support will include a means of securing ladder rack to the support.
3. Supports will be manufactured from steel or aluminum.
4. Finish shall be powder coated black in color, with zinc plated hardware.

   Black
5. Acceptable products:

   Chatsworth Products, Inc. (CPI) (“xx” denotes nominal width)

   1) 11312-7xx Triangular Support Bracket
   2) 11421-7xx Wall Angle Support Kit
   3) 11310-001 Threaded Ceiling Kit, 3/8-inch Rod
   4) 10595-7xx Rack-To-Runway Mounting Plate

   Cooper B-Line

   5) SB213xxKFB Triangular Support Bracket
   6) SB2113xxFB Wall Angle Support Kit
   7) SB2221BZ Threaded Ceiling Kit, 3/8-inch Rod
   8) SB2133xxFB Rack-To-Runway Mounting Plate

   Owner Approved Equivalent

G. Ladder Rack Accessories
1. Provide end caps to cover exposed ladder rack ends.

   End caps shall be manufactured from a black fire-retardant rubberized material.
   Caps shall be sized for 3/8-inch wide by 1-1/2-inch high side stingers.

2. Provide two radius drop for each rack and cabinet.

   Radius drops used to create a radius to form cables over as the cables exit or enter the ladder rack will be manufactured from aluminum extrusion. The extrusion shall be formed in a 90-degree arc with a minimum bend radius of 3 inches.
   Radius drops shall attach to either the side stringer or the cross member of the ladder rack using a clevis pin.
   Radius drops will include 1-1/2-inch high cable spools that attach to the top of the radius drop to guide cables.
3. Provide moveable cross members, as required.

   Movable cross members used to support cross member radius drops in between welded cross members on ladder rack will be manufactured from 3/8-inch by 1-1/2-inch aluminum bar.
   Movable cross members shall attach to ladder rack at the side stringers with included hardware so that the location of the movable cross member can be adjusted.
   Moveable cross member shall support a cross member radius drop.
4. Touch-up paint used on ladder rack and ladder rack system components shall be color-matched to the finish on the ladder rack or component.
5. Unless otherwise noted, finish on all metal components shall be epoxy-polyester hybrid powder coat (paint) in the color(s) specified below. Hardware shall be zinc plated.

   Black
6. Acceptable products: (“xx” denotes nominal width)

   Chatsworth Products, Inc. (CPI)

   1) 10642-001 Cable Runway Protective End Caps
   2) 12100-7xx Radius Drop, Cross Member
   3) 12101-7xx Radius Drop, Stringer
   4) 12115-7xx Moveable Cross Member

   Cooper B-Line

   5) SB110A1B Cable Runway Protective End Caps
   6) SB2129xxFB Radius Drop, Cross Member
   7) SB2120DSxxFB Radius Drop, Stringer
   8) SB17RKxxFB Moveable Cross Member

2.6 RAISED FLOOR GROMMETS

A. Rectangular Raised Floor Grommets
   1. Provide rectangular raised floor grommets where indicated in the drawing set.
   2. Grommet seals the space around cables with two layers of brush closure.
   3. Acceptable products:

      Upsite Technologies KOLDLOK 10012 Extended 3" Brush Grommet
      Chatsworth 13674-001 Extended 3" Brush Grommet
      Owner approved equivalent.

B. Round Raised Floor Grommets
   1. Provide round raised floor grommets where indicated in the drawing set.
   2. Grommet seals the space around cables with a layer of brush closure.
   3. Grommet to be 4" diameter with a usable area of 9.6 in².
   4. Acceptable products:

      Upsite Technologies KOLDLOK 40001 Round 4"
      Chatsworth TS1011570 Round 4"

Owner approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The installation recommendations contained within ANSI/TIA-568-B, ANSI/TIA-569 and the BICSI Telecommunications Distribution Methods Manual (TDMM), including the Manufacturer's recommended installation methods or practices for a Standards-based Structured Cabling System, are mandatory minimum standards and requirements.

B. Mount equipment and enclosures plumb and level. Permanently installed equipment to be firmly and safely held in place. Equipment supports must support loads imposed with a safety factor of at least five.

C. Free-standing Equipment Cabinets
   1. Provide all components of the cabinet system (cabinet, mounting rails, shelves, cable managers, power strips, environmental sensors, and thermal management accessories) from a single manufacturer.
   2. Install and adjust to position all accessories including vertical cable managers, vertical power strips, equipment-mounting rails, airflow baffles using the manufacturer's installation instructions prior to baying and/or placing the cabinet for attachment to the building. Shelves, horizontal cable managers and filler panels, if used, may be installed after the cabinet is placed.
   3. Cabinets shall be secured to the structural floor using manufacturer's installation instructions and appropriate hardware as defined by local code or the authority having jurisdiction (AHJ). Installers shall provide installation hardware. When placed over a raised floor, secure the cabinet to the structural floor through the raised floor panels using threaded rod.
   4. Where Cabinets must be moved away from a wall to gain access to the rear of the cabinet a Caster set shall be used. The Cable Harness must be 42 inches in length and run from the wall along the floor into the Cabinet. A Nylon Split Loom shall be used to protect the Cable Harness.
   5. When used in a multi-cabinet bay, cabinets shall be attached side-by-side using included baying kits according to the manufacturer's instructions.
   6. Attach overhead ladder rack or cable tray to the ceiling, independent of the cabinet. A 3 inch (75 mm) minimum clearance between the top of the cabinet and the bottom of the ladder rack/cable tray shall be maintained. Ladder rack/cable tray shall be positioned so that it does not interfere with hot air exhaust through the cabinet's top panel. Use radius drops where cable enters/exits the ladder rack/cable tray. Alternately, attach ladder rack/cable tray to the top of cabinets using an elevation kit so that ladder rack/cable tray is a minimum of 3 inches (75 mm) above the cabinet.
   7. Cabinets shall be securely bonded to the Telecommunications Grounding Busbar (TGB) by using a vertical grounding busbar kit. Attach a bonding conductor sized as defined in J-STD-607-A and as defined by local code or the authority having jurisdiction (AHJ) between the Telecommunications Grounding Busbar and the cabinet. Attach the bonding conductor to the cabinet using included hardware according to the manufacturer's installation instructions. The installer shall provide the bonding conductor and other necessary hardware required to make the connections between the cabinet and the Telecommunications Grounding Busbar.

D. Vertical Cable Managers

1. When more than one cable manager is used on a rack/frame or group of racks/frames, use the same make, style and size of vertical cable manager on the rack/frame or in between racks/frames.
2. The color of the rack(s)/frame(s) and cable manager(s) must match.
3. Attach vertical cable managers to the side of the rack/frame using the manufacturer's installation instructions and included hardware.
4. When a single vertical cable manager is used in between two racks/frames, attach the vertical cable manager to both racks/frames.
5. Dress cables through the openings in between the T-shaped guides on the manager so that cables make gradual bends as they exit or enter the cable manager into the rack-mount space (U). Do not twist, coil or make sharp bends in cables.
6. Doors shall be attached to the cable manager and in the closed position after cabling is complete.

E. Horizontal Cable Managers
1. When more than one horizontal cable manager is used on a rack/frame or group of racks/frames, use the same make and style of cable manager on the rack/frame or racks/frames.
2. The color of the rack(s)/frame(s) and cable manager(s) must match.
3. Attach horizontal cable managers to the rack/frame with four screws according to the manufacturer's installation instructions. Each cable manager shall be centered within the allocated rack-mount space (U).
4. Horizontal managers shall be located so that the number of ports (cables) that each manager supports shall not exceed each cable manager's cable fill capacity.
5. Dress cables through the openings in between the T-shaped guides on the cable manager so that cables make gradual bends as they exit or enter the cable manager into the rack-mount space (U). Do not twist, coil or make sharp bends in cables.
6. Covers shall be attached to the cable manager and in the closed position after cabling is complete.

F. Cable Tray and Ladder Rack
1. Provide all components of the ladder rack system (ladder rack, turns, splices, supports, and accessories) from a single manufacturer.
2. Ladder rack shall be installed with side stringers facing down so that the ladder forms an inverted U-shape and so that welds between the stringers (sides) and cross members (middle) face away from cables.
3. Ladder rack shall be secured to the structural ceiling, building truss system, wall, and the tops of equipment racks and/or cabinets using the manufacturer's recommended supports and appropriate installation hardware and methods as defined by local code or the authority having jurisdiction (AHJ).
4. Ladder rack splices will be made in mid-span, not over a support, with the manufacturer's recommended splice hardware.
5. Ladder rack shall be supported every 5 feet or less in accordance with TIA-569-B. Ladder rack shall be supported within 2 feet of every splice and within 2 feet on both/all sides of every intersection. Support ladder rack within 2 feet on both sides of every change in elevation. Support ladder rack every 2 feet when attached vertically to a wall.
6. Heavy-duty splices are recommended for ladder rack in excess of 18 inches in width (18 inch wide ladder rack). Heavy-duty splices are required for any splice formed in the vertical orientation including changes in elevation formed using vertical-to-horizontal 90° turns or horizontal-to-vertical 90° turns. Use heavy-duty splices to secure all overhead turns to the overhead horizontal pathway(s).
7. When the pathway is overhead, ladder rack shall be installed with a minimum clearance of 12 inches above the ladder rack. Leave a minimum of 12 inches in between ladder rack and ceiling/building truss structure. Leave a minimum of 3 inches in between ladder rack and the tops of equipment racks and/or cabinets. Multiple tiers of ladder rack shall be

installed with a minimum clearance of 12 inches in between each tier of ladder rack. When located above an acoustical drop ceiling, leave a minimum of 3 inches clearance between the top of the drop ceiling tiles and the bottom of the ladder rack.

8. When installed under a raised floor, ladder rack shall be installed with a minimum 3 inches clearance between the top of the ladder rack and the bottom of the floor tiles or floor system stringers, whichever is lower in elevation. Maintain a 3 inch clearance between ladder racks wherever ladder racks cross.
9. Within each telecommunications room, ladder rack should be bonded together, electrically continuous, and bonded to the TGB, unless otherwise noted in the specifications and contract documents. Ladder rack and turns shall be bonded across each splice with a bonding kit. Ladder rack shall be bonded to the Telecommunications Grounding Busbar (TGB) using an approved ground lug on the ladder rack and a minimum #6 grounding wire or as recommended by the AHJ. Remove paint from the ladder rack where bonding/ground lugs contact the ladder rack so that the lug will contact bare metal. Use antioxidant joint compound in between the bare metal on the ladder rack and ground lug. Use antioxidant joint compound in between the bus bar and the ground lug. Verify continuity through the bonds at splices and intersections between individual ladder rack sections and turns and through the bond to the TGB.
10. The quantity of cables within the ladder rack will not exceed a whole number value equal to 50% of the interior area of the ladder rack divided by the cross-sectional area of the cable. The interior area of ladder rack will be considered to be the width of the ladder rack multiplied by a height of 2 inches, unless cable retaining posts are added to the ladder rack. The interior area of ladder rack equipped with cable retaining posts will be considered to be the width of the ladder rack multiplied by a height of 6 inches. Actual cable fill for ladder rack that is not equipped with cable retaining posts will not exceed 2 inches in height. Actual cable fill for ladder rack equipped with cable retaining posts will not exceed 6 inches in height.
11. The combined weight of cables within the ladder rack will not exceed the stated load capacity of the ladder rack as stated in the manufacturer’s product specifications or load/design tables.
12. Cables (cable bundles) will be secured to the cross members of ladder rack with 3/4-inch wide reusable straps. Straps are not required when ladder rack is equipped with cable retaining posts.
13. Add 8 inch high cable retaining posts to the open sides of ladder rack when cable fill exceeds 2 inches in height or when cable bundles cannot be secured directly to the ladder rack cross members with a strap. Cable fill within any ladder rack should not exceed 6 inches in height.
14. When a single ladder rack supports different types of cable media, the cable media will be separated within the pathway by cable spools that attach to the cross members on the ladder rack. Treat each type of cable media and divided area of the ladder rack separately when determining cable fill limits.
15. Use a radius drop to guide cables wherever cable exits overhead ladder rack to access a rack, frame, cabinet or wall-mounted rack, cabinet or termination field. If necessary, provide a moveable cross member also to attach and align the radius drop in between the welded cross members of a ladder rack.
16. Cover the exposed ends of cable runway that do not terminate against a wall, the floor or the ceiling with end caps or an end closing kit.
17. Use auxiliary support brackets that attach to the side stringer of the ladder rack to support interconnect cabling (patch cords, equipment cords, jumper cords) that is routed between racks using the ladder rack. Auxiliary support brackets can be used to support other conductors that should be physically separated from cables within the ladder rack as defined by local code or the authority having jurisdiction (AHJ).
18. Whenever possible, maintain a 2 foot separation between ladder rack used for communications cables and pathways for other utilities or building services.

19. The installer will provide touch-up paint color-matched to the finish on the ladder rack and will correct any minor cosmetic damage (chips, small scratches, etc.) resulting from normal handling during the installation process prior to delivery to the owner. If a component is cosmetically damaged to the extent that correction in the field is obvious against the factory finish, the component will be replaced with a new component finished from the factory. If a component is physically damaged due to mishandling or modification during the installation process, it shall not be used as part of the ladder rack system.

3.2 AC POWER AND GROUNDING

A. Coordinate and verify final connection of related electrical power, TMGB and TMB Grounding Busbar and ground conductors.

B. Provide ground system compliant with the reference ANSI-J-607-C Standard, ANSI/NFPA-70 and authorities having jurisdiction.

C. Ground equipment chassis not having a three-wire power cord, other metal enclosures, and equipment rack frames in the CR and IDF room(s) to the ground bus bar in that room using # 6 AWG insulated conductor and bonding with 10/32 nuts, bolts and lock-washers.

D. Remove any finish and make-bare any metallic surface at the point where grounding wire is connected to and or terminated on equipment frames, racks or devices.

END OF SECTION 27 11 00