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1. GENERAL

1.1. Introduction

1.1.1 The Installation Supplier shall ensure, as part of the evaluation of the installation, that all equipment added, rearranged or modified is properly installed and in conformance with AT&T installation specifications.

1.1.2 The Installation Supplier shall ensure, as part of the evaluation of the installation, that all work has been done in accordance with the detail specifications or approved changes to the detail specifications.

1.1.3 This section provides general and workmanship requirements pertaining to cable installation.

1.1.4 Changes in this issue of Section J are summarized in Table J-1.

1.1.5 Refer to the respective sections of ATT-TP-76300 for additional requirements for fire and smoke stoppage (Section F), power cable (Section M), CO grounding cable (Section H) and fiber optic cable (Section O).

1.2. General Requirements

1.2.1 Standing on or applying excessive stress/pressure to cable on racks or equipment is not acceptable when installing, removing or securing cable and wire. Walking on top of installed cables shall be avoided.

1.2.2 Only tinned copper cable shall be installed in the Carrier Communications Space. Untinned wire is not approved for use in the central office except for TIA / EIA 568B Categorized cable and RS232 cables.

1.3. General Cable Routing
1.3.1 No deviations shall be made from the job cable running list without the approval of the AT&T Equipment Engineer.

1.3.2 Storing excess cable on or in cable racks, compartments or ducts shall be avoided, except for the following reasons:

   a) When the excess cable is five feet or less.

   b) When the excess cable is required for proper equipment operation the excess cable shall be distributed on or in cable racks, compartments or ducts so the pile-up is not concentrated at a single location.

   c) When the excess cable is associated with equipment located in temporary locations and the excess cable will be used when the equipment is moved to its ultimate location, the excess cable shall be coiled banded, identified and secured to the cable rack above the equipment frame. This type of stored cable shall be repositioned on subsequent cabling operations to avoid burial.

   d) When cable is equipped with apparatus that cannot be disconnected and reterminated in the field.

   e) When storing all cable designated “Future” on the cable rack. Provide adequate length for ultimate termination.

1.3.3 On factory connectorized cable runs of less than 300ft, allowable slack shall be no more than 10% of the overall length of the run or rounded up to the next 10ft increment. Factory connectorized cable runs greater than 300ft, allowable slack shall be no more than 30ft.

1.3.4 For formed or connectorized cable, the Installation Supplier shall install the connectorized or formed end of the cable first; then trim excess cable to the measured length for the route of the installed cable.

1.3.5 For bulk cable, the Installation Supplier shall install the cable and cut off the excess to the proper length.

1.3.6 Excess cable associated with installation of equipment in a temporary location (such as in preparation for a hot slide) shall be stored or removed as directed by the Implementation Engineer.

1.3.7 Cable slack shall not be stored on or near cable racks over distributing frames or DSX frames.

1.3.8 Cable shall be dressed away from sharp corners or edges and/or heat producing devices, and shall not interfere with the addition of future equipment.

1.3.9 Switchboard and power cables installed on vertical cable racks shall be limited so that the cable is not closer than 3 inches from the side of the cable hole.

1.3.10 The Installation Supplier shall support cable at cable rack breakoffs such that the maximum length of unsupported cable does not exceed 3 feet, except as follows:
a) Where cable to a distributing frame passes through a floor opening immediately under the frame, an unsupported length of not more than 4 feet measured along the shortest cable is permissible.

b) Vertical cables in floor openings do not require support within the opening.

c) Cable dropping off cable rack above distributing frames may be unsupported for a maximum length of 4 feet.

1.3.11 Cables shall not run over building obstacles (such as water pipes, conduit, air ducts, etc.).

1.3.12 Existing non-standard transitions created under legacy company's policies may be used until the feeding and receiving cable paths reach their designed fill capacities.

1.3.13 Cables routed using cable rack or basket tray shall enter/exit the routing system via its side (stringer or side wall) and not pass through its base (between rungs or wire mesh).

Exception:

a) The remote patch panel end of a fiber trunk cable routed within an AIC Structured Cable Management system is allowed to pass through the cable rack. Refer to ATT-C-60000-E-09 for detail.

b) Routing of power cables as stated in ATT-TP-76300, Section M, Paragraph 1.5.

1.4. Cable Diversity Requirements

1.4.1 When diversity is required, cable shall be routed as per customer or service requirements demand.

1.4.2 Diverse leads run vertically within a bay/cabinet shall be run down opposite sides of the bay/cabinet.

a) When the manufacture designed the equipment to terminate diverse power leads on the same side of the shelf, the Installer Supplier may run diverse power leads on the same side of the bay/cabinet.

1.4.3 Diverse leads, to the same network element, shall not cross at any point if physically possible.

1.5. Temporary Installations

1.5.1 All temporary cabling and wiring shall be supported as required so as to not jeopardize service or personnel.

1.5.2 Cabling shall not be suspended by lacing cord or nylon cable ties at any locations.

1.5.3 All temporary fiber optic cables shall be run using temporary raceways (spiral wrap, split harness protective sheathing, etc.; will be acceptable for this application). Cables shall not be run over auxiliary bars, ladder tracks, light fixtures, threaded rods, etc.

2. CABLING REQUIREMENTS
2.1. **Common Items**

2.1.1 Cable shall be formed and dressed so as not to allow cables to protrude out past the footprint of the bay.

2.1.2 Installed cables, hanging unterminated in equipment areas, shall be neatly coiled above the floor level and have their exposed ends insulated.

2.1.3 Cable and wire shall be installed neatly within the stringers of the cable rack.

2.1.4 P-wire and switchboard cable shall not be installed on dedicated power cable racks unless directly associated with power circuits.

2.1.5 The Installation Supplier shall remove all cable tags before job completion, except tags designated “future” or tags left as directed by the AT&T Equipment Engineer.

2.1.6 Fiber jumper/patch cord type cable shall not be installed on cable rack; wire basket tray or a Fiber Protection System shall be used (interbay cable routing).

2.1.7 Cable entering equipment frames shall enter the framework in a manner that will not block access of future cable.

2.1.8 Cables within an equipment unit (i.e.; switch, etc.) shall meet the manufacturer’s requirements.

2.1.9 Shop cabling requirements within the “foot print of the equipment” shall be as defined by the manufacturer. If these requirements conflict with the requirements given in ATT-TP-76300, the manufacturer’s requirements shall apply.

2.1.10 Transitional devices installed on grounding and power cables shall be placed between cable rack straps, and shall not be adjacent to each other, but staggered, so the transition device shall not rest against metal or another transition device. The portion of the heat shrink that covers the cable insulation may overlap with the portion of the heat shrink that covers the cable insulation of an adjacent cable. Each layer of power cables shall alternate the set of cable rack straps where the transition devices are placed, so that one layer of transition devices are not resting directly upon the lower layer. See Figure J-8.

2.1.11 Cables shall not be installed on blocked cable racks or runs.

2.1.12 All cable butt connections on coaxial and switchboard type cable shall be taped or have heat shrink placed around the butt. The tape and heat shrink shall be placed a minimum of 1 inch above and below the butt.

2.2. **Cable Protection**

2.2.1 When installing cable (power, signal, grounding, etc.), the Installation Supplier shall provide adequate protection to prevent:

a) damage to new and existing cable and equipment

b) harm to personnel

c) electrical damage/short
2.2.2 When cable and wire come in contact with sharp metal edges, the Installation Supplier shall use formed fiber or two layers of sheet fiber to protect against damage at the point of contact.

2.2.3 The Installation Supplier shall protect all cable at break-offs when attached directly to the cable rack stringers with formed fiber or two layers of sheet fiber.

2.2.4 Cable rack straps shall be protected with formed fiber or two layers of sheet fiber where power cables drop through a cable rack. See AT&T-TP-76300 Section M for cases where power cables may pass through a cable rack.

2.2.5 When rubber, neoprene and other non-textile jacketed power cable are secured, 2 wraps of insulating fiber protection shall be applied to the cable sheath at each secured or banded location. This requirement does not apply to power wire or cable within a bay.

2.2.6 Fiber protection shall be placed on the cable rack cross straps at outside bends or offsets in cable racks.

2.2.7 Cable shall be protected with fiber at points of contact with the flange side of cable rack cross straps. This condition may be encountered where inverted cable racks are used, or where cable must be placed on the flange side of cable racks.

2.2.8 Individual 735C type coaxial cables (see Table J-4 or J-5) shall be protected where they are to be secured or banded if 9-ply cord is to be used. This protection shall be accomplished by the use of two layers of sheet fiber or one layer of outer sheathing from multiple coaxial cables (i.e., six-pack or twelve-pack). Coaxial cables within a multiple cable package (i.e., six-pack or twelve-pack) and individual 734C type cables do not require this additional protection, since the outer sheathing of the package provides sufficient protection.

2.2.9 Under no circumstances shall the securing stitch, strap or cable tie be pulled so tightly as to deform the cable sheathing.

2.3 Damaged Cables

2.3.1 Damaged cable sheathing shall be repaired with electrical tape. The tape shall be applied in two half lapped layers with the final two wraps applied without tension and over lapping. The tape shall extend a minimum of 2 inches past the damaged section in both directions.

2.3.2 Seriously damaged sections of cable sheathing shall be repaired by removing the damaged section and replacing it with the covering from a similar cable. Apply a single half lapped layer of electrical tape over the new section to secure it in place.

2.3.3 Damaged power cable sheathing shall be repaired by wrapping with a minimum of two half lapped layers of rubber tape then two half lapped layers of electrical tape. The rubber and electrical tape shall extend a minimum of 2 inches past the damaged section in both directions.
2.3.4 A run of cable shall be replaced if the number of damaged or spliced conductors exceeds 5% of total conductors.

2.3.5 TIA / EIA 568B Categorized cable with damaged sheathing shall be replaced.

2.4. **Securing Cable and Bundling**

2.4.1 Method for securing cable is to use 9 ply polyester twine. Securing of cable has a structural member providing support passing through the loop of the securing device.

2.4.2 Methods of bundling cable include the use of 9 ply polyester twine or hook and loop tape. Bundling of cables does not have a structural member passing through the loop of the bundling device.

2.4.3 Hook and loop tape (e.g. Velcro™ tie wrap)

   a) May be used to bundle all braided coaxial cable types, Power Distribution Unit AC service cables, and fiber trunk/jumper/patch cord type cables.

   b) Shall not be used to secure interbay DC power, switchboard, or fiber cables.

   Exception: Hook and loop tape maybe used for securing of fiber cables upon entry into a cable management glide or spacer.

   c) Only AT&T approved hook and loop tape shall be used. The tape shall meet a minimum of UL-94 V-2 fire rating and have a minimum width of ½ inches.

   d) Hook and loop tape overlap shall be the greater of an inch or half of the bundled diameter.

2.4.4 When shielded cables are bundled, bundling shall facilitate cable management and cable identification and shall meet all cable installation requirements, including minimum cable bend radius. Cable bundles shall not be greater than 1 ½” diameter or 4 ¾” circumferences, bend radius, support, identification, and management.

2.4.5 Cables and wires on horizontal cable racks shall be secured at the first and last strap, and at intervals not to exceed 3 feet. See Table J-4.

   a) Legacy non-standard stitching spacing and patterns may be continued for additions to established cable racks.

2.4.6 Chicago or Kansas City stitches shall be used when securing cable with 9 ply polyester twine. See Figures J-3 through J-6.

2.4.7 Cable installed on horizontal ladder type cable racks shall be secured at break-off.

2.4.8 On vertical and inverted horizontal cable racks, cables shall be secured at every strap. See Table J-5.

2.4.9 All cables shall be dressed to avoid congestion and to permit accessibility to equipment.

2.4.10 All cables and wires shall be secured at the first support of frame or bay.
2.4.11 All cables shall be secured at the butt location of the cable. If the butt is not within 1 inch of the cable bracket, it shall be banded to the existing cables in the form.

2.4.12 When the cable butt is located below the lowest cable bracket in an equipment frame or bay, the length between the butt and the last bracket shall be no more than 10 inches.

2.4.13 The cables shall be secured at all cable brackets provided with the manufacturer’s equipment.

2.4.14 If cable is terminated at a point above the top bracket in the bay, the cable shall be banded to the other cables at the point of break off, at the top of the bay or an L-type securing bracket.

2.4.15 Cable and wire shall be banded halfway between the cable rack and top support on the frame or bay when distances exceed 3 feet.

2.4.16 On cable rack with horns and pans the cable and wire shall be sewn only at break-off.

2.4.17 P-wire on panned cable racks shall be banded every 5 to 6 feet to prevent curling or drooping, and at points where the wire changes direction.

2.4.18 Cables on ladder type cable racks having retaining brackets used to separate high and low level transmission leads in carrier systems, shall not be secured, except at turn-off points.

2.4.19 Excess 9-ply polyester twine shall be trimmed to a maximum length of 1/2 inch.

2.4.20 The Installation Supplier shall secure cables to the cable securing brackets, if provided, at the rear of the shelf as required for proper cable management. This is required for cables traversing across the back of the shelf.

2.4.21 The installation supplier shall secure cables as shown in Tables J-2 through J-5.

2.4.22 Cable runs on vertical cable rack shall have cables secured at each cross strap. Cable clamps may be used as supplemental support when required. Cable clamps shall be provided when vertical cable racks of 15 inches and wider extend between more than two floors.

   a) Where the runs are in exposed locations, one set of clamps shall be installed per floor. The clamps shall be located near the ceiling and the cable shall be secured at each alternate cable strap.

   b) Where the runs are located in shafts or other enclosures, two sets of clamps shall be installed per floor, one just above the cable hole sheathing and the other about half the distance to the ceiling. The upper clamp shall not be less than 7 feet from the floor. Cables shall be secured in an orderly manner immediately above each clamp.

   c) Clamps are not required if vertical cable runs are secured by sewing with twine at every cable rack cross strap.
2.4.23 Inverted horizontal cable racks shall be equipped with supplemental cable support. These supplemental supports shall clamp the cables firmly but not so tight as to distort the cables. The supports shall be placed along the run at approximately 10-foot intervals for runs that can ultimately contain less than 100 square inches of cable and at approximately 6-foot intervals for larger runs of cables.

2.5. Coaxial Cables

2.5.1 Coax cables on panned cable racks with cable horns are not required to be secured to cable rack cross straps. Bundling of cables may be necessary and cables can be grouped on cable racks.

2.5.2 Coaxial cable runs in cabinets shall be secured.

2.5.3 Coaxial cables in supported vertical runs shall be secured as per Table J-5.

2.5.4 Coaxial cables in unsupported vertical runs shall be bundled a minimum of every 9 inches.

2.5.5 Coaxial cable shall not be unsupported for greater than 30 vertical inches except when installed in conduit.

2.5.6 Coaxial cables are to be secured and protected with sheet fiber where they waterfall off cable rack. They are to be formed in a loop fashion to adhere to the required bend radius.

2.5.7 Coaxial cables on unpanned cable racks without horns shall be secured to cross straps as per Tables J-4 & J-5.

2.5.8 Adjacent cable bundles may be fastened together.

2.5.9 Coaxial cables (i.e.; 500, 625, etc) mounted on antenna masts, towers or other vertical structures shall be secured using a Valmont type cushion hanger and appropriate standoff hardware. Cushion sleeve shall be provided with holes sized to outside diameter of cable where all cables will not be overly tight or possess any play between cushion and cable.

2.5.10 Coaxial cables (i.e.; RG6, RG11, etc.) mounted on antenna masts, towers or other vertical structures shall be secured using a coated stainless steel strap and cushion sleeve. The supplier shall install the maximum width strap available. Coaxial cables shall first be bundled using the coated stainless steel strap and cushion sleeve, then the bundle shall be secured to the vertical structure using the coated stainless steel and cushion sleeve. When securing the bundle to the structure, the securing strap shall be 1 inch above or below the bundle strap.

2.5.11 The installation supplier shall use the manufacturer’s recommended installation tools for the installation of the coated stainless steel straps. The installation supplier shall not exceed the manufacturer’s recommended tensioning specification nor shall the installation supplier deform the outer sheath of the cable(s). Hardware securing straps affixed to the tower shall not require drilling, cutting or cause deformation of structural members of the tower.
2.5.12 Cable management systems the transition coaxial cables from antenna masts, towers or other vertical structures to their entry point within the site shall be provided with a rigid weather-resistant, wind-resistant cover for protection of cables from weather and falling debris.

2.6. AC Power Cords in Equipment

2.6.1 All power cords in cabinets shall be bundled for management purposes.

2.7. Distributing Frame Distributing Frame

2.7.1 On distributing frames (vertical side) having transverse arms on 13-inch vertical centers, cable shall be secured at all transverse arms.

2.7.2 On distributing frames (vertical side) having transverse arms on less than 13-inch vertical centers, cable shall be secured at the first (top or bottom) transverse arm where cable enters the frame and at alternate arms, counting from the first arm. Also secure the cables which butt or turn-off at the arm before the butt or turn-off.

2.7.3 On distributing frames (vertical side) the cable shall be butted 1/2 inch below the transverse arm and place the cable butt in the fanning ring. If fanning rings are not used, secure the cable butt. The cable sheath shall be left in place to within 2 inches of the connecting block. Where this is not practical, exposed wire from the cable shall be secured as appropriate to within 2 inches of connecting block and neatly dressed.

2.7.4 On distributing frames (horizontal side) cable and wire shall be secured at three places on the transverse arm: near the stiffening bar, at the center and near the butt location. On transverse arms 12 inches or less in length, cable shall be secured at two places.

2.7.5 On distributing frames (horizontal side) the cable shall be butted no more than 2 inches from the rear of the terminal strip. Cables that cannot be butted 2" or less from the terminal strip or serve multiple terminal strips shall have the wires neatly dressed and the cable butt secured.

2.7.6 Cables transitioning from the vertical to the horizontal side of the distributing frame shall break off at the transverse arm directly above the transverse arm the cable is to be terminated.

2.7.7 On distributing frames the cable shall be neatly dressed at the rear of the block or terminal strip. No cable shall protrude beyond the side of the block or terminal strip, (vertical side), nor below the block or terminal strip (horizontal side).

2.8. Formed Cable

2.8.1 Formed cable shall be secured at a level that affords access to the equipment.

2.8.2 Internal framework cable bundles shall be secured:

a) To the framework cable management no more than twelve inches from the entrance to the framework.
b) At intervals not to exceed twelve inches within the framework.

c) Formed and dressed to maintain proper cable support, management and bend radius.

2.9. **Nylon Cable Ties**

2.9.1 Nylon cable ties may be used for temporary securing during the job. Upon completion of installation without prior approval, nylon cable ties SHALL NOT be used for:

a) Securing cables to distributing frames

b) Banding or securing cable on cable racks

c) Banding together of cable installed in compartmentalized troughs/racks.

d) Banding or securing of coaxial cables

e) Banding or securing fiber optic jumpers

f) Securing cable to the top cable securing bracket on equipment frames

g) Securing battery and battery return cables at any location.

2.9.2 Nylon cable ties shall be of an adequate size, type, strength, etc. for the particular application.

2.9.3 Except where reusable nylon cable ties are provided by the manufacturer, tails of nylon cable ties shall be trimmed to within 1/32 of an inch.

2.9.4 The Installation Supplier shall use a tool specifically designed for tensioning and cutting of nylon cable ties. Side cutters or equivalent shall not be used.

2.9.5 Nylon cable ties shall be tensioned around cable or wire forms tightly enough to hold the cables or wire together and/or properly positioned, but not so tightly or at such angles so as to cause possible damage to the insulation of the cable or wire.

2.9.6 Nylon cable ties, banded around cables or wire, shall be capable of being rotated with slight to moderate pressure applied with the thumb to the head of the tie. If banded cables or wire, under and/or adjacent to the nylon cable tie, twist or deform when pressure is applied to the head of the tie, then the tie has been applied too tightly.

2.9.7 Under no circumstances shall nylon cable ties have sharp or jagged cut ends protruding from the locking head. A nylon cable tie is considered to have sharp or jagged ends when it is sharp to the touch.

2.9.8 The locking head of nylon cable ties shall be positioned so as not to interfere with the installation or removal of apparatus or equipment.

2.9.9 When cables/wire is added to a bundle secured with nylon cable ties, the existing tie shall be removed and the entire bundle secured with a new tie, 9-ply polyester twine or Hook and Loop straps. This requirement does not apply to firestopping banding requirements (see Section F).
2.9.10 Where cable or wire forms are secured to cable securing brackets, the locking head of nylon cable ties shall be positioned on the side of the bracket opposite the side on which the cables or wire are installed.

2.9.11 Adhesive-backed tie wrap bases that rely only on the adhesive backing to attach to walls, columns, equipment, auxiliary framing, etc., shall not be used to secure cable or wire outside the confines of a frame.

2.10. Bending Radius

2.10.1 Cables shall not be sharply bent or twisted during a forming operation.

2.10.2 The minimum inside bending radius of switchboard, shielded and twin conductor cable is 5 times the cable diameter.

2.10.3 The minimum inside bending radius of non-bundled coaxial cable and bundled 734 type coaxial cable is 7 times the cable/bundle diameter.

2.10.4 The minimum inside bending radius of bundled coax (735 type) cable is 10 times the bundle diameter.

2.10.5 The minimum inside bending radius of power wire and cable is 7 times the cable diameter.

2.10.6 The minimum inside bending radius of fiber optic cable, jumpers or patch cords is 1 inches.

2.10.7 The minimum inside bending radius of fiber optic trunk cable (OFNR) is 1 inch or 10 times the cable diameter, whatever is larger.

2.10.8 The minimum inside bending radius of Jacketed Metallic Clad (JMC) cable is five times the diameter of the cable measured on the inner side of the bend.

2.10.9 The minimum inside bending radius of 1505A, 1694A and 1855A non-bundled and bundled Video type coaxial cables is 10 times the cable/bundle diameter.

2.10.10 CO grounding system conductors shall be installed with a minimum radius of one foot. If the one foot radius objective can not be met, a smaller radius is acceptable based on the following conditions:

   a) For the #2 AWG peripheral conductor at a radio site the minimum bend radius shall be 6 inches.

   b) For all other conductors, the minimum bend radius shall not be less than 5 times the finished diameter of the cable. Table J-8 provides the minimum bending radius, rounded up to the nearest inch, for the most common grounding conductor sizes based on the approximate diameter for rubber-covered wire (type, RHH, RHW).

2.10.11 The Installation Supplier shall adhere to the NFPA 70 and NEC for the bend radius and insulation/covering types as pertains to AC power cords/cables.

3. POWER CABLELING
3.1. General

3.1.1 Where possible, the Installation Supplier shall install all leads in continuous lengths from the power source to the equipment termination. Where the size of the power cable is too large for the termination connection, in-line reduction (barrel) splices shall be used to terminate the power cable.

3.1.2 Exposed ends of power cables, while being installed, or transitioned, shall be insulated with an electrical tape secured heat shrink cap or a heat shrink cap that has been heat shrunk onto the end of the cable(s).

3.1.3 For special synchronization power requirements, see Section T of ATT-TP-76300.

3.1.4 Power Plant battery voltage sense leads shall be cabled on auxiliary framing “J” hooks or “L” brackets or on a cable rack where auxiliary framing or cable racking is available; otherwise, metallic conduit may be used as an alternative to run voltage sense leads between the battery string and power plant. If the metallic conduit will be in close proximity to bus bar (less than 1 foot), up to 18” of PVC electrical conduit shall be used at either end of the metallic conduit as required to provide nonconductive clearance between the conduit and bus bar.

3.2. Sewing And Securing

3.2.1 Power cable leaving cable racks, supports, and entering frames, racks or other equipment shall be supported at least every 3 feet.

3.2.2 The Installation Supplier shall comply with Table J-2 and Table J-3 for sewing power cable to the cable racks. The requirements apply to uniform size leads.

3.2.3 DC Power cable shall be secured on unpanned cable rack:

   a) immediately before and after turns

   b) immediately before and after changes in elevation

   c) at every strap or flat bar at every turn

3.2.4 For vertical power cable runs, the Installation Supplier shall install one power cable clamp per floor where three or more floors are involved. No clamps are required when power cable runs are one or two floors.

3.2.5 The Installation Supplier shall insulate the cables from the clamping bar by using an angle type insulator or by wrapping the cables with two (2) wraps of insulating fiber at the clamp.

3.2.6 DC Power cable terminations shall be supported and/or secured in such a manner as to prevent stress on the connection.

3.2.7 Secondary power feeds that are installed on panned cable racking shall be banded every six feet.

3.2.8 Primary and secondary power cables shall be secured no more than 18 inches before and after a transition device (i.e., 3 feet maximum span).
3.3. DC Power Cable Routing

3.3.1 When connecting battery return cables to the return bus bar in BDFBs/SPDUs, Power Boards (PBDs etc.), the Installation Supplier shall terminate the cables in such a manner as to allow future access for cable connections to the bus bar.

3.3.2 When connecting to BDFD/SPDU fuse position studs, the Installation Supplier shall arrange cables in such a manner so as to not block access of future terminations.

3.3.3 Unfused battery and battery return leads shall be run on unpanned (ladder type) dedicated power cable racks. The rack shall be designated accordingly.

3.3.4 Unfused battery conductors between the batteries and power boards shall have properly sized redundant leads to allow routine battery maintenance.

3.3.5 Primary battery and battery return leads shall be run on unpanned (ladder-type) dedicated power cable rack.

3.3.6 Secondary power leads shall be run on dedicated secondary power cable racks (unpanned). On a new BDFB, the Transport OTV shall add the dedicated secondary cable rack (unpanned). If dedicated secondary power cable rack is not possible:

   a) Secondary power leads may be run on existing non-dedicated cable rack, which already contain transport cable. In these cases, secondary power cable shall be segregated from transport cable as best possible.

   b) Within 10 feet of an existing SPDU / BDFB that was not engineered with a dedicated secondary power cable rack, secondary power cable may be run on existing dedicated primary power cable rack. In these cases, secondary and primary power cables shall be segregated as best possible to permit future addition of primary power feeds.

3.3.7 Battery and battery return leads are a pair and shall be installed closely coupled except when being referenced to the Ground Window.

3.3.8 The BDFB/SPDU battery conductor need not be paired with the battery return conductor for the portion of the run to and from the MGB if a significant amount of additional cable for the battery conductor is required to maintain pairing. See Figure J-2 (b) and (c). The return conductor shall be closely coupled (to itself) along the route to and from the point where it leaves the route of the battery conductor and the connection to the MGB. Where significant conductor length is not a factor, the battery and battery return conductors shall remain paired. See Figure J-2 (a).

   Note: When the battery return conductor is longer than the battery conductor, the size of the battery return conductor shall be adjusted, if necessary, to meet any voltage drop requirements.

3.3.9 The battery return conductors of a circuit serving common bonding network equipment may be connected directly to the Common Bond Network (CBN) side MGB as in Figure J-2 (b) or, to save space on the MGB, they may be bonded to the MGB with a conductor not exceeding 3 feet in length. This is shown in Figure J-2 (a) and (c).
Note-1: One bonding conductor may be serially connected, using crimp type parallel connectors (H-Tap), to more than one battery return conductor, provided the bonding conductor is no longer than 3 feet.

Note-2: The bonding conductor shall be the same size as the battery return conductor for sizes up to #1/0 AWG. Larger conductors may be bonded using a #1/0 AWG.

3.3.10 All new BDFBs / SPDUs shall have the return bus bar insulated from the framework.

3.4. **AC Cable**

3.4.1 See ATT-TP-76300 Section M for AC cabling requirements.

4. **CABLE RACK LOADING**

4.1. **Blocked Cable Runs**

4.1.1 When blocked cable runs in cable racks or cable penetrations are encountered, the Installation Supplier shall contact the detail engineer for instructions.

4.1.2 A cable hole shall not be filled beyond 75 percent of its capacity, and cables shall not be placed closer than 3 inches from edges. The Installation Supplier is to notify the Implementation Engineer when 75% of the cable hole capacity has been reached.

4.1.3 When a cable hole reaches capacity no more cable shall be run through the cable hole and the cable hole shall be marked to reflect blocked condition.

4.1.4 The Installation Supplier shall report a blocked cable hole to the AT&T Engineer and the AT&T Space Planner, fill out a JIM reporting the blocked condition and place a copy of the JIM in the Electronic Job Folder.

4.2. **Cable Pileup**

4.2.1 Installation Suppliers shall immediately notify the AT&T equipment engineer when 75 percent of the cable pileup capacity of a cable rack or a portion of a cable rack has been reached. Cable racks shall be CLOSED when 100 percent of the cable pileup capacity of a cable rack or a portion of a cable rack has been reached. See Tables J-6 & J-7.

4.2.2 Cable horns shall be sized to allow for 100 percent fill capacity of the cable rack as defined in Tables J-6 & J-7. Shorter cable horns shall only be used when physical obstructions or the racking plan design limits the maximum fill of the cable rack.

4.2.3 Cables run on panned racking equipped with cable horns shall not exceed the height of the cable horn or the requirements that are stated in Tables J-6 & J-7, whichever is less. Cable rack horn extensions shall not be installed. Cable horn extensions are devices such as pipes applied over existing cable horns to increase their length. New cable horn shall be added to the existing cable racks when possible to allow for the maximum fill as defined in Table J-7.
4.2.4 No new applications of Bar-type cable rack shall be installed in offices or reapplied in other parts of office. Existing Bar-type cable racks shall be used with cable pileups below height of side bar. At intersections of Bar-type cable racks, side bars extending through the intersection and in path of cables shall be cut off and remaining stub covered with firmly secured rubber cap or the bar may be bent out of way of cables.

5. GROUNDING CONDUCTORS

5.1 Grounding Conductors – DC Powered Systems

5.1.1 All grounding system conductors shall be routed on and secured to:
   a) A cable rack or cable bracket containing only grounding conductors
   b) The side or bottom of ironwork details or cable rack containing other cable types
   c) The surface of ceilings, columns, or permanent walls.

   Note-1: Grounding conductors may be placed on the same cable brackets used to support other cables if the grounding conductors are secured to the surface of the bracket opposite that used to secure the other cables.

   Note-2: Some equipment manufacturers allow grounding conductors routed within their equipment systems to be routed with other conductors, typically dc power conductors. When a system is approved for use, the routing requirements of the equipment vendor may apply.

5.1.2 When grounding conductors are routed on the side or bottom of cable racks or other ironwork or surface of ceilings, columns or walls, the conductors shall be secured at an interval of 12 inches maximum. When cable brackets are used for support, they shall be placed at an interval of 20 inches maximum.

5.1.3 When a horizontally run grounding conductor is placed on or under a cable bracket or other support detail, the conductor shall be secured to each bracket or support detail. (See Figure J-1): In addition:
   a) Grounding conductors up to and including #1/0 AWG may be secured to the sides of cable rack stringers, auxiliary framing bars, threaded rods and other ironwork details with nylon cable ties or 9-ply waxed polyester twine.
   b) Grounding conductors larger than #1/0 AWG shall be secured to the sides of cable rack stringers, auxiliary framing bars, threaded rods and other ironwork details with 9-ply waxed polyester twine.

5.1.4 Grounding conductors secured to the underside of cable racks shall be secured to alternate cross straps.

5.1.5 The exterior surface of conduits or raceways containing AC power conductors shall not be used to support grounding system conductors.

5.1.6 Several methods of supporting grounding conductors, including vertical and horizontal equalizers, and typical material are shown in ATT-TP-76416, Grounding and Bonding.
Requirements for Network Facilities. The use of support methods similar to those shown in this document is acceptable.

5.1.7 Unless expressly required by local code, CO grounding system conductors (other than ACEG conductors) shall not be run in metallic conduit. If a CO grounding system conductor is placed in metallic conduit, raceway or sleeve more than three feet in length, it shall be bonded to the conduit, raceway or sleeve at each end with a minimum #6 AWG conductor.

5.1.8 When metal clamps are used to support or secure CO grounding conductors, the clamps shall not completely encircle the conductor. The metallic continuity shall be interrupted by non-metallic hardware, a cable tie or 9-ply waxed polyester twine. The phrase completely encircle applies primarily to ferrous metal cable clamps. It does not apply to an opening or “ring” formed by a combination of interconnected metallic objects such as cable racks, auxiliary framing, threaded rods, etc., unless the length (l) of this opening is more than 3 times its diameter (D). Examples of openings that do not create complete encirclement of a grounding conductor are:

a) Where the conductor is routed through a metal cable hole cover instead of a floor sleeve (l is typically < ¼", D is typically > 1 ½")

b) Where the conductor is on a cable rack and passes through the opening formed by the cable rack’s stringers and straps (l is typically <3", D is typically > 18")

c) Where the conductor passes through as interior wall constructed with sheet metal studs (l is typically < 8", D is typically > 48”)

d) Arrangements similar to (a) through (c) above.

5.1.9 The DC Electrical Ground (DCEG) conductor for BDFBs/SPDUs shall be a minimum #1/0 AWG conductor, and shall be connected directly to a CO GRD bus bar or tapped to a horizontal equalizer of equal or greater size.
### TABLE J-2--HORIZONTAL RESTING RUNS (POWER)

<table>
<thead>
<tr>
<th>Size of Copper Cable</th>
<th>Sew at Strap</th>
<th>Number of Cord Strands</th>
<th>Ultimate Number of layer</th>
<th>Cable Per Stitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 MCM-750 MCM</td>
<td>alternate</td>
<td>4</td>
<td>any number</td>
<td>2</td>
</tr>
<tr>
<td>No. 1/0-350 MCM</td>
<td>alternate</td>
<td>2</td>
<td>any number</td>
<td>2</td>
</tr>
<tr>
<td>No. 6-1</td>
<td>every</td>
<td>2</td>
<td>any number</td>
<td>4</td>
</tr>
<tr>
<td>No. 14-8</td>
<td>every</td>
<td>2</td>
<td>any number</td>
<td>any number</td>
</tr>
</tbody>
</table>

### TABLE J-3--VERTICAL RUNS AND/OR INVERTED HORIZONTAL RUNS (POWER)

<table>
<thead>
<tr>
<th>Size of Copper Cable</th>
<th>Sew at Strap</th>
<th>Number of Cord Strands</th>
<th>Ultimate Number of layer</th>
<th>Cable Per Stitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 MCM-750 MCM</td>
<td>every</td>
<td>4</td>
<td>any number</td>
<td>1</td>
</tr>
<tr>
<td>No. 1/0-4/0</td>
<td>every</td>
<td>4</td>
<td>any number</td>
<td>1</td>
</tr>
<tr>
<td>No. 6-1</td>
<td>every</td>
<td>2</td>
<td>any number</td>
<td>2</td>
</tr>
<tr>
<td>No. 14-8</td>
<td>every</td>
<td>2</td>
<td>any number</td>
<td>1 inch diameter bundle max</td>
</tr>
</tbody>
</table>

### TABLE J-4--HORIZONTAL RESTING RUNS (SWITCHBOARD AND COAXIAL)

<table>
<thead>
<tr>
<th>Diameter of Cable</th>
<th>Type</th>
<th>Sew at Strap</th>
<th>Number of Cord Strands</th>
<th>Cable Per Stitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1/2”</td>
<td>round</td>
<td>every fourth</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>over 1/2” to 3/4”</td>
<td>round</td>
<td>every fourth</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>over 3/4” to 1”</td>
<td>round</td>
<td>every fourth</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>over 1”</td>
<td>round</td>
<td>every fourth</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>(735 type)</td>
<td>mini-coax</td>
<td>every fourth</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>(734 type)</td>
<td>coax</td>
<td>every fourth</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>
### TABLE J-5--VERTICAL RUNS AND/OR INVERTED HORIZONTAL RUNS  
(SWITCHBOARD AND COAXIAL)

<table>
<thead>
<tr>
<th>Diameter of Cable</th>
<th>Type</th>
<th>Sew at Strap</th>
<th>Number of Cord Strands</th>
<th>Cable Per Stitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1/2&quot;</td>
<td>round</td>
<td>every</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>over 1/2&quot; to 3/4&quot;</td>
<td>round</td>
<td>every</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>over 3/4&quot;</td>
<td>round</td>
<td>every</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>(735 type)</td>
<td>mini-coax</td>
<td>every</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>(734 type)</td>
<td>coax</td>
<td>every</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

### TABLE J-6--CABLE CAPACITY OF STANDARD CABLE RACKS (5'-0" Support Spacing)  
(SWITCHBOARD AND COAXIAL CABLES)

<table>
<thead>
<tr>
<th>Rack Width</th>
<th>Normal Capacity</th>
<th>75% Rule Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Capacity (In.²)</td>
<td>Pileup (inches)</td>
</tr>
<tr>
<td></td>
<td>Sec.</td>
<td>Unsec.</td>
</tr>
<tr>
<td>1'-0&quot;</td>
<td>132</td>
<td>132</td>
</tr>
<tr>
<td>1'-3&quot;</td>
<td>168</td>
<td>210</td>
</tr>
<tr>
<td>1'-8&quot;</td>
<td>228</td>
<td>285</td>
</tr>
<tr>
<td>2'-1&quot;</td>
<td>288</td>
<td>360</td>
</tr>
</tbody>
</table>

Note (1) In.² capacity is based on the rack width minus 1" for stringer attachment hardware.

Note (2) According to the above a new switch or other equipment entity having 500 In.² of secured interconnecting cable to other network elements requires a minimum of three 1'-8" via cable rack paths (500/171 = 2.9 racks @ 75% capacity).
### Table J-7 -- Permissible Cable Pileups On Horizontal Racks Suspended Grid System

<table>
<thead>
<tr>
<th>Secured Power Cable</th>
<th>5' Centers</th>
<th>6' Centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rack Width</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width Of Rack</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1'-0&quot; to 1'-8&quot;</td>
<td>7&quot;</td>
<td>6&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsecured Switchboard Cable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supports On</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rack Width</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5&quot; to 1'-0&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width Of Rack</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1'-3&quot; to 2'-1&quot;</td>
<td>15&quot;</td>
<td>12&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Secured Switchboard Cable</th>
<th>5' Centers</th>
<th>6' Centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rack Width</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width Of Rack</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1'-0&quot; to 2'-1&quot;</td>
<td>12&quot;</td>
<td>10&quot;</td>
</tr>
</tbody>
</table>

### TABLE J-8 – MINIMUM BENDING RADIUS FOR GROUNDING CONDUCTORS

<table>
<thead>
<tr>
<th>Grounding Conductor Size</th>
<th>Minimum Bending Radius (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 AWG</td>
<td>2</td>
</tr>
<tr>
<td>4 AWG</td>
<td>3</td>
</tr>
<tr>
<td>2 AWG</td>
<td>3</td>
</tr>
<tr>
<td>1/0 AWG</td>
<td>4</td>
</tr>
<tr>
<td>4/0 AWG</td>
<td>4</td>
</tr>
<tr>
<td>750 kcmil</td>
<td>7</td>
</tr>
</tbody>
</table>
FIGURE J-1 - USE OF CABLE TIES TO SECURE GROUNDING CONDUCTORS

Grounding Conductor

Cable Tie

Framing Channel

Approximately 12"

Cable Rack Stringer

Cable Bracket

Grounding Conductor

NOTE: Grounding conductors larger than #1/0 AWG must be secured with sewing twine.
Figure J-2 Bonding of Battery Return Conductors of Shared Power Plant to the MGB

- A - From Power Plant
- B - To CBN BDFB
- C - Battery Return Conductors
- D - Battery Conductors
- E - MGB
Figure J-3 Kansas City Stitch

1. Double a length of twine, even up ends and pass loop under the strap.
2. Double loop end back on itself.
3. Place free ends through loop.
4. Hold in position; pull out slack.
5. Completed stitch.

Starting Stitch:

1. Place free ends under strap.
2. Place free ends over and under these strands.
3. Pull out slack and hold with finger.
4. Try to avoid crossed stitches under strap.
5. Pull out slack and hold with thumb.
6. Remove slack by pulling up and to the right; keep loop back of cable.
7. Tighten stitch by pulling to right to drawing loop to top front edge of cable; remove slack & tighten stitch with a steady even pull.
Figure J-4 Ending Stitches

1. KEEP STITCHES STRAIGHT ON CENTERLINE OF STRAP

2. MAKE LOOP NEAR END WHEN PULLING TWINE UNDER STITCHES THAT ARE ALREADY MADE.

3. TWINE LOOPED BACK WITH KNOT READY TO BE PULLED TIGHT.

4. TWINE LOOPED BACK AND KNOT PULLED TIGHT READY FOR NEXT LAYER OF CABLE.

SECOND LAYER

TIGHTEN STITCH NEAR TOP AS SHOWN.

LOCK OR "KANSAS" CITY STITCH

SQUARE KNOT FOR ENDING STITCHES PULL TIGHT AND CUT OFF ENDS.

METHOD OF ENDING STITCHES
Figure J-5 Sewing Cable to Supports at Turns (Chicago Stitch)
Figure J-6 Cables From Miscellaneous Run Secured Together Between Rack and First Support with a Modified Chicago Stitch
Figure J-7 Cable Routing Restrictions for Racks Installed At Different Levels

CABLE SHALL EXIT/WATERFALL OFF THE SIDES OF CABLE RACK AT POINTS OF TERMINATION ONLY.

EXCEPT FOR ATT-TP-76409 FIG. 6(F) ARRANGEMENT, CABLE SHALL NOT BE ROUTED BETWEEN VERTICALLY OFFSET RACKS AT CABLE RACK INTERSECTIONS OR ALONG THE LENGTHS OF PARALLEL CABLE RACKS THAT ARE AT DIFFERENT LEVELS.
Figure J-8 Method of Placing Transition Devices
[END OF SECTION]