

- (e) Core to Cladding Offset: Less than 1.5 μm .
 - (f) Core-to-Cladding Concentricity: Less than or equal to 3.0 μm
 - (g) Coating Diameter:..... 245 +/-5 μm
 - (h) Refractive Index Profile: Graded index
 - (i) Numerical Aperture:..... 0.275 +/-0.015
 - (j) All optical fibers proof tested at minimum of 100kpsi and stress of 0.70 GN/m² by manufacturer.
 - (k) Fiber Coating: Layer of acrylate protective coating in physical contact with cladding surface and removable with commercially available stripping tool in single pass and cleaned with 98 percent isopropyl alcohol.
- (3) Typical Attenuation For Optical Fibers: 2.9 dB/Km 850 nm wavelength. (3.5 dB/Km max)
- (a) Maximum Attenuation: 3.5 dB/km at 850 nm 1.0 dB/km at 1300 nm. For tight-buffered cables, maximum 1.5 dB/km at 1300 nm.
 - (b) Attenuation Uniformity: No point discontinuities greater than 0.2 dB at either 850 nm or 1300 nm.
 - (c) Attenuation at Water Peak: Attenuation coefficient at 1380 nm not exceeding attenuation coefficient at 1300 nm by more than 1.0 dB/km.
 - (d) Macrobend Attenuation: Attenuation due to 100 turns of fiber around 75 +/-2 mm diameter mandrel not exceeding 0.5 dB at 850 nm or 1300 nm.
- (4) Minimum LED Transceiver Bandwidth Requirements: 200 MHZ at 1 Km at 850 nm wavelength and 500 MHZ at 1 Km at 1300 nm wavelength.
- (a) IEEE 802.3z Performance: Supports laser-based Gigabit Ethernet (GbE) operation in 1000BASE-SX operating window (850 nm) at 400 meters, and in 1000BASE-LX operating window (1300 nm) at 1000 meters, without using mode conditioning (offset) patchcords.
 - (b) Minimum Restricted Mode Launch (RML) Bandwidth: Greater than or equal to 385 MHz km at 850 nm
- (5) Cable Operating Temperature Range:
- (a) Inside Cables: -20 degree Celsius to +70 degree Celsius.
 - (b) Outside Cables: -40 degree Celsius to +70 degree Celsius.
- (6) Cable Storage Temperature Range: -40 degree C Celsius to + 70 degree Celsius.
- (7) Maximum Tensile Load: 270 lbs. short term.
- (8) All terminations on multimode fibers made with connectors approved for purpose and type of cable being terminated.
- (a) For convenience, details and specifications based on "UniCam 95-000-XX" by Corning/Siecor with ceramic ferrule.
 - (b) Provide SC type connectors to match patch panels or as specified on Drawings.
 - (c) Provide additional components such as fan-out kits, buffer tubes, and similar components where required for proper termination of cable.

b. 50 Micron Multimode Fiber Optic Strands: Rated to 10Gbps, plenum rated fiber optic cable with 50/125um core/cladding diameters 900mm buffer.

(1) Standards:

- (a) UL listed for plenum use; meeting NEC, Article 770 - Optical Fiber Cables and Raceways and passed UL 910 flame test.
- (b) Tight buffered fibers color coded in accordance with EIA/TIA-598 "Color Coding of Fiber Optic Cables".
- (c) Differential Mode Delay per TIA-492.

(2) Fibers: Meet EIA/TIA 455-45A, Microscopic Method for Measuring Fiber Geometry of Optical Waveguides.

- (a) Core Diameter: 50.05 +/-2.5 μm .
- (b) Core Non-Circularity: Less than or equal to 6 percent
- (c) Cladding Diameter: 125 +/-2.0 μm .
- (d) Cladding Non-Circularity: Less than 2.0 percent
- (e) Core to Cladding Offset: Less than 1.5 μm .
- (f) Core-to-Cladding Concentricity: Less than or equal to 3.0 μm
- (g) Coating Diameter: 245 +/-5 μm
- (h) Refractive Index Profile: Graded index
- (i) Numerical Aperture: 0.200 +/- 0.015
- (j) All optical fibers proof tested at minimum of 100kpsi and stress of 0.70 GN/m² by manufacturer.
- (k) Fiber Coating: Layer of acrylate protective coating in physical contact with cladding surface and removable with commercially available stripping tool in single pass and cleaned with 98 percent isopropyl alcohol.
- (l) Specifications based on "InfiniCor SX+" by Corning; "GIGAlite10" by Berktek; and "LaserCore 300 5L" by Commscope.

(3) Typical Attenuation For Optical Fibers: 2.9 dB/Km 850 nm wavelength. (3.5 dB/Km max)

- (a) Maximum Attenuation: 3.5 dB/km at 850 nm 1.0 dB/km at 1300 nm. For tight-buffered cables, 1.5 dB/km at 1300 nm.
- (b) Attenuation Uniformity: No point discontinuities greater than 0.2 dB at either 850 nm or 1300 nm.
- (c) Attenuation at Water Peak: Attenuation coefficient at 1380 nm not exceeding attenuation coefficient at 1300 nm by more than 1.0 dB/km.
- (d) Macrobend Attenuation: Attenuation due to 100 turns of fiber around 75 +/-2 mm diameter mandrel not exceeding 0.5 dB at 850 nm or 1300 nm.
- (e) Differential Mode Delay: 0.88 ps/m

- (4) Minimum LED Transceiver Bandwidth Requirements: 2000 MHZ at 1 Km at 850 nm wavelength and 500 MHZ at 1 Km at 1300 nm wavelength.
 - (a) IEEE 802.3z Performance: Supports vertical cavity surface emitting (VCSEL) laser-based 10 Gigabit Ethernet (10GbE) operation in 1000BASE-SX operating window (850 nm) at 300 meters.
- (5) Cable Operating Temperature Range:
 - (a) Inside Cables: -20 degree Celsius to +70 degree Celsius.
 - (b) Outside Cables: -40 degree Celsius to +70 degree Celsius.
- (6) Cable Storage Temperature Range: -40 degree Celsius to + 70 degree Celsius.
- (7) Maximum Tensile Load: 270 lbs. short term.
- c. All terminations on multimode fibers made with connectors approved for purpose and type of cable being terminated.
 - (1) For convenience, details and specifications based on "UniCam 95-000-XX" by Corning/Siecor with ceramic ferrule.
 - (2) Provide SC type connectors to match patch panels or as specified on Drawings.
 - (3) Provide additional components such as fan-out kits, buffer tubes, and similar components where required for proper termination of cable.
- d. Single-Mode Fiber Optic Strands: H rated, plenum rated fiber optic cable with 8.3/125um core/cladding diameters, 900mm buffer.
 - (1) Standards
 - (a) UL listed for plenum use; meeting NEC, Article 770 - Optical Fiber Cables and Raceways and passed UL 910 flame test.
 - (b) Tight buffered fibers color coded in accordance with EIA/TIA-598 "Color Coding of Fiber Optic Cables".
 - (c) Single-mode fiber utilized in optical fiber cable meeting EIA/TIA-492CAAA, "Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers," and ITU recommendation G.652, "Characteristics of Single-Mode Optical Fiber Cable"
 - (2) Fibers: Meet EIA/TIA 455-45A, Microscopic Method for Measuring Fiber Geometry of Optical Waveguides.
 - (a) Core Diameter: 8.3 nominal
 - (b) Cladding Diameter: 125 +/- 2.0 μ m
 - (c) Core to Cladding Offset: Less than or equal to 1.5 μ m
 - (d) Core-to-Cladding Concentricity: Less than or equal to 0.8 μ m
 - (e) Cladding Non-Circularity: Less than or equal to 1.0 percent
 - (f) Coating Diameter: 245 +/-10 μ m
 - (g) Colored Fiber Nominal Diameter: 256 μ m

- (h) All optical fibers proof tested at minimum of 100kpsi and stress of 0.70 GN/m² by manufacturer.
- (i) Fiber Coating: Layer of acrylate protective coating in physical contact with cladding surface and removable with commercially available stripping tool in single pass and cleaned with 98 percent isopropyl alcohol.
- (3) Maximum Attenuation: 0.4 dB/km at 1310 nm and 0.3 dB/km at 1550 nm. For tight-buffered cables, 0.7 dB/km at 1310 nm and 0.7 dB/km at 1550 nm.
- (4) Attenuation Uniformity: No point discontinuity greater than 0.10 dB at either 1310 nm or 1550 nm.
- (5) Attenuation at Water Peak: Attenuation at 1383 ± 3 nm not exceeding 2.1 dB/km.
- (6) Cutoff Wavelength: Cabled fiber cutoff wavelength (λ_{cutoff}) less than or equal to 1260 nm.
- (7) IEEE 802.3z Performance: Supports laser-based Gigabit Ethernet (GbE) operation in 1000BASE-LX (1300 nm) operating window at 5000 m.
- (8) Macrobend Attenuation: Attenuation due to 100 turns of fiber around 75 +/-2 mm diameter mandrel not exceeding 0.05 dB at 1310 nm and 0.10 dB at 1550 nm
- (9) Zero Dispersion Wavelength (λ_0): 1302 nm less than or equal to λ_0 less than or equal to 1322 nm.
- (10) Zero Dispersion Slope (S_0): Less than or equal to 0.092 ps/(nm²·km)
- (11) Maximum Dispersion: Less than or equal to 3.55 ps/(nm·km) from 1285 nm through 1330 nm and greater than 18 ps/(nm·km) at 1550 nm.
- (12) Fiber Curl: Greater than or equal to 2.0 m radius of curvature.
- (13) Individual Fiber Polarization Mode Dispersion (PMD): Less than or equal to 0.5
- (14) Cable Operating Temperature Range:
 - (a) Inside Cables: -20 degree Celsius to +70 degree Celsius.
 - (b) Outside Cables: -40 degree Celsius to +70 degree Celsius.
- (15) Cable Storage Temperature Range: -40 degree Celsius to +70 degree Celsius
- (16) Maximum Tensile Load: 270 lbs. short term
- (17) All terminations on single-mode optical fibers factory-made using machine-polished process and exhibiting minus 45 db or better back-reflection after being fusion-spliced to cable strands in field; similar to factory-manufactured pre-terminated single-mode pigtail assemblies by Corning/Siecor. Provide additional components such as fan-out kits, buffer tubes, and similar components where required for proper termination of cable. Connectors shall be SC type.

2. **Backbone Cabling:** Consists of tight buffered or loose tube cable with equal parts of multimode and single-mode fibers to provide for future bandwidth needs. (For example, 24-fiber cable contains 12 fibers multimode and 12 fibers single-mode.) Install only in interior spaces where not subject to physical damage.
 - a. **Backbone Cables Not Installed In Conduit:** Plenum rated and TYPE OFNP listed in accordance with National Electrical Code (NEC) and installed in minimum 1-inch plenum rated inner duct.
 - b. **Complete Hybrid Backbone Plenum Rated Distribution Style Cable:** 12 single-mode matched-clad optical fibers and 12 multimode U (ultra) rated optical fibers enclosed in plenum rated orange jacket; similar to "(xxxx88-331xx-29) OFNP MIC 88 series Gigabit Plus CL" by Corning Cable Systems; "P-024-DS-CM-FSDOR8A012/6U012" by Commscope, or "PDP6B024 GigaLite" by Berk-Tek.
 - c. **Plenum Rated Hybrid Backbone Cable with Metal Armor Sheath:** Intra-building backbone cable, TYPE OFCP listed for plenum applications, with optional interlocking steel or aluminum armor with PVC jacket in color matching jacket color of optical fiber cable located inside of armor. Armor comparable to liquid tight flexible metal conduit if jacketed or flexible metal conduit if not jacketed.
 - (1) Twelve single-mode matched-clad optical fibers and twelve multimode U (ultra/gigabit-CL) rated optical fibers enclosed in plenum rated jacket; similar to "OFCP listed, 2-24 fibers xxxK88-33150-A3, 62.5 μ m aluminum armored with plenum jacket, xxxR88-33131-A3, single-mode aluminum armored with plenum jacket" by Corning Cable Systems. Other manufacturers offering products complying with specified requirements includes Berk-Tek and Commscope and Sumitomo Electric Lightwave.
 - (a) **Cable Armor:** Steel or aluminum armor with positive interlock in accordance with UL 444, Section 4.10 and Table 4 applied directly over cable jacket.
 - (b) **Use Locations:** Interior spaces where physical protection desired or required without inner duct requiring "fishing" of cable or placed in tightly spaced locations or substitute for non-armored cable in inner duct in interior locations where not subject to environmental conditions unsuitable for metal armor.
 - d. **Fiber Optic Patch/Jumper Cables:** Factory assembled optical fiber assemblies with multimode fiber and SC connectors at each end. Exact lengths determined in field and based on actual rack layouts. Provide 2 cables per switch. Provide ceramic connector sleeves.
 - (1) **Cable Length:** 3 meter long, unless otherwise specified. Verify quantity and length at time of installation.
 - (2) Provide all jumpers conforming to TIA 568-B Standard.
3. **Manufacturer:** Similar to "Corning Cable Systems, (xxxx01R3131003M, single-mode single fiber jumper, 3 meters in length. xxx01K3141003, multimode 62.5 μ m single fiber jumper, 3 meters in length, OR-611-50D-[XX]-[YYYY]-[ZZ]-C" by Ortronics or equal by Hubbell, Siemon or Nordx.

2.03 EQUIPMENT RACKS AND CABINETS

A. Distribution Rack

1. Floor mounted open equipment rack: **black extra heavy gauge aluminum and steel rack, 7 ft. High x 19 inches wide** with EIA spacing suitable for 19-inch wide equipment, 3 inch wide rails, mounting holes on both sides, minimum 0.25-inch flange thickness and minimum 0.17-inch web thickness.
 - a. For convenience, details and specifications based on "Universal Rack - Part # 46353-703" by Chatsworth. Other manufacturers offering acceptable products include Great Lakes Case & Cabinet Co. Inc. and Hoffman.
 - b. Universal design based on 5/8 - 5/8 - 2 inch alternating hole pattern with rolled threaded holes for industry standard 12-24 mounting screws.
 - c. All mounting and assembly hardware and 50 minimum rack mounting screws included.
 - d. Minimum channel width of 3 inches. Racks include both bottom and top angle brackets.
 - e. Ground: #6 ground wire from data racks to approved electrical building ground per EIA/TIA 607 with "Part # 10610-019 Rack Mount Ground Bar Kit" by Chatsworth, "Part #ERGB1" by Bailiwick, or "Part #GGB-72" by Lowell Manufacturing for each rack.
 - f. Horizontal Wire Management Panels: Provided above and below each rack mounted equipment unit and patch panel. Provide 1 full height (7 foot) vertical wire management unit on each side of each rack.
 - g. Power Strip: 8-position power strip with 20 Amp circuit breaker and 12 ft. cord, similar to "Part # 7218" by Great Lakes, Part #CMRPSH20" by Panduit, or "Part #PR206" by Hubbell.
2. Wall Mounted Equipment Rack: Black anodized aluminum suitable for 19-inch wide equipment, 38.5 inches high x 10.25 inches wide x 18 inches deep, with 8-position power strip with 20 amp circuit breaker and 12 ft. cord. For convenience, details and specifications base on "Catalog # 11632-718" by Chatsworth. Other manufacturers offering acceptable products include Hoffman, Great Lakes Case & Cabinet Co., Inc and X-Mark CDT.

B. Distribution Cabinet

1. Floor Mounted Equipment Cabinet:
 - a. Manufacturers: For convenience, details and specifications base on "Catalog # P-DCP2288B" by Hoffman. Other manufacturers offering acceptable products include Chatsworth, Great Lakes Case & Cabinet Co., Inc and X-Mark CDT.
 - b. Cabinet: 87 inches high x 32 inches wide x 32 inches deep, suitable for 19-inch wide equipment with "black textured" finish and quick release side panels.
 - c. Front Door: Window door with locking handle; provide 5 keys for each lock.
 - d. Rear Door: Louvered with locking handle; provide 5 keys for each lock.
 - e. Power Strip: 8-position power strip with 20 amp circuit breaker and 12 foot cord.
 - f. Top: Vented top with integral fan tray; similar to "Cat. No. P-VT3F881".

- g. Wire Management: Cable eye 8 each 4 inch size; similar to Catalog # P-CE86.
 - h. Cable Support: Provide sweep structure to support cables from overhead cable tray to data cabinet.
2. Wall Mounted Equipment Cabinet:
- a. Manufacturers:
 - (1) For convenience, details and specifications based on following products by Great Lakes Case & Cabinet Co., Inc.
 - (a) 24 inch high cabinet....."Part # GL24WM"
 - (b) 36 inch high cabinet....."Part # GL36WM"
 - (c) 48 inch high cabinet....."Part # GL48WM"
 - (2) Other manufacturers offering acceptable products include Chatsworth, X-Mark/CDT, Hoffman and Hubbell.
 - b. Cabinet: 22 inches wide x 25 inches deep x height required for equipment, suitable for 19-inch wide equipment, with Black color, black trim, and vented side panels.
 - c. Door: Plexiglas with lock; provide 5 keys for each lock.
 - d. Power Strip: 8-position power strip with circuit breaker and 12 foot cord.
 - e. Fan Assembly: Fan assembly with fan guards (2 fans).
 - f. Wire Management Rings: 4 inch size "Part # CM-44" by Great Lakes Case & Cabinet Co., Inc.
 - (1) 24 inch cabinet: 2 each
 - (2) 36 inch cabinet: 4 each
 - (3) 48 inch cabinet: 6 each
- C. Ladder-Type Cable Tray: Chatsworth "TELCO-Style Cable Runway," or equal by Square D, Newton or Wiremold; 12 inch wide to racks/cabinets from corridor or other wire routing space where indicated on Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine conditions under which telecommunications cabling and equipment and related components are to be installed in coordination with Installer of materials and components specified in this Section and notify affected Prime Contractors and Architect in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
 - 1. When Installer confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Architect written confirmation from applicable Installer. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to Installer.
 - 2. Visit Site to identify and become familiar with existing field conditions and specific requirements of each Site.

3. Verify all dimensions in field and confirm condition of existing hardware to be re-used.
4. Confirm space requirements and physical confines of all work areas to ensure all materials can be installed in spaces indicated.
5. Confirm all outlet locations and cable pathways and advise Architect in writing of any discrepancies or issues in design described in Contract Documents.

3.02 PREPARATION

- A. Protection: Provide adequate protection of equipment before and after installation.
- B. Existing Communications Services: Ensure all telecommunications systems (voice, data, video) remain operational throughout the project.
 1. Identify any additional telecommunications outlets, circuits, and wiring at the site not shown on demolition Drawings and interfering with installation of equipment specified in this Section.
 2. Contact local telephone company to identify all circuits providing existing services.
 3. Confirm removal of existing communications devices with Owner and that removal of devices will not cause disruption of communications services.
 - a. Obtain instructions from Architect regarding conflicts that cannot be resolved by Contractor.
 - b. Remove all devices not required to ensure continuity of communications service and acceptable to Owner.
 4. Coordinate all required shutdowns of existing communication services with Owner and local telephone company not less than 14 days prior to shutdown.
 - a. Perform shutdowns after normal working hours defined by Owner and include cost of overtime and other related expenses in Contract. Claims for additional costs resulting from shutdowns not acceptable.
 5. Remove all accessible portions of abandoned communications cabling per NEC 800.52 Tag all communications cabling not terminated at both ends but retained for future use.

3.03 INSTALLATION

- A. Provide and install all components necessary to install complete telecommunications cabling and equipment system, including (but is not limited to) connectors, patch cables, terminators, etc.
- B. Secure all horizontal cables within ceiling cavities to building structure.
 1. Loosely bundle all cables and support from structure at intervals that vary from 5 feet to 6 feet with spring steel fasteners and cable clip rated for use with high performance cables (similar to Caddy Series "CableCat", Cooper "B-Line Spring Steel Fasteners", Thomas & Betts "Steel City SSF-CCXX" or approved alternate mounting methods) including placement in cable tray as indicated on Drawings.
 2. Include maximum of 50 cables in cable bundles.
 3. Properly install all cables in cable tray in locations indicated on Drawings.
 4. Verify all horizontal run lengths prior to installation. Re-distribute horizontal cabling to maintain distance requirements and maintain pathway route accessibility.

5. Provide each cable as continuous section from point of origin to point of destination. Field splices or mechanical coupling used for installation not acceptable.
 6. Do not support cables from ceiling grid T-bars, grid support wires or bridle rings.
 7. Do not allow cables to rest on ceiling grid.
 8. Install cables in conduit in all unfinished, exposed areas, including, but not limited to, storage rooms, mechanical areas, crawlspaces and pipe tunnels.
 9. Do not secure cables with tightened cable-ties or any other device that deforms cable jacket.
 10. Provide 6 inches slack at station termination and 24 inches slack at patch panels.
 11. Provide 10-foot service loop in all fiber optical cables to permit future cable splice and repair at all building entrance points and termination points.
 12. Place wire in conformance with EIA/TIA Standard 568-B and BICSI recommended practices.
 13. Re-terminate and re-test any cables or pairs of cables failing end-to-end testing. Replace any faulty cables/pairs. Remove all defective cables from pathways.
 14. Anchor all floor mounted equipment cabinets and racks to the floor structure using fasteners and hardware approved by the manufacturer for the purpose. Such attachment shall be constructed to meet Bellcore GR-63-CORE network equipment building system compliance standards for strength and rigidity in seismic zone 2. Provide hardware kit for each cabinet and rack to match the floor type and structure it is to be installed on.
- C. Determine allowable cable placement proximity to other electrical power sources of 480 volts or less using EIA-569 Cabling Pathways Standard for UTP cable separation guidelines from EMI sources as follows:

1. Minimum Separation Distance from Power Source at 480v or less

<u>CONDITION</u>	<u>Less than 2kVA</u>	<u>2-5KVA</u>	<u>Greater than 5KVA</u>
a. Unshielded power lines or electrical equipment in proximity to open or non-metal pathways	6 in.	12 in.	24 in.
b. Unshielded power lines or electrical equipment in proximity to grounded metal conduit pathway.....	3 in.	6 in.	12 in.
c. Power lines enclosed in a grounded metal conduit (or equiv. shielding) in proximity to grounded metal conduit pathway	3 in.	6 in.	12 in.
d. Transformers & electric motors	40 in.	40 in.	40 in.
e. Fluorescent lighting	12 in.	12 in.	12 in.

- D. Interior Fiber Optical Cable Installation Requirements
1. Install all interior fiber optic backbone cables in 1-inch plenum-rated inner duct similar to Pyramid Industries "#PLM100(T)", "PVDF (PC-100-PL)" by Petroflex, or "PEC-100T-XXXX" by Premier Conduit where fiber optical cable placed in cable tray or otherwise fully supported in accordance with manufacturer's requirements.
 2. In lieu of inner duct or where specified Fiber optical cables may be installed in either steel or aluminum armor with positive interlock in accordance with UL 444, Section 4.10 and Table 4, or provided as pre-manufactured armored cable assembly.
- E. Install all cables in raceway as detailed on Drawings. Install cables in raceways in accordance with all manufacturers' requirements concerning cable slack and bending radius.
- F. Install all cable in accordance with all National, State and Local Codes and both TIA/EIA 568-B standards and BICSI recommended practices.
1. Follow manufacturer's guidelines and requirements for all cable termination.
 2. Unless otherwise noted on Drawings, locate all floor mounted equipment racks and cabinets to allow minimum of 30 inches aisle clearance both in front and rear of equipment rack or cabinet for access to equipment.
 3. Ladder-Type Cable Tray: To racks/cabinets from corridor or other wire routing space where indicated on Drawings.
 - a. Mount cable tray at 6 inches above all data equipment cabinets to support cables and neatly route them to cabinet entry or vertical wire management point(s) at cabinet location.
 - b. Include in cable tray transition to proper height for wall penetration into corridor or other wire routing space as indicated on Drawings.
 - c. Make required wall penetrations by transition to minimum of two 4 inch conduit sleeves with protective insulating bushings, cable spillway or by specifically-designed cable tray sections provided with appropriate fire stop barriers.
 - d. Anchor each run of telecommunications cable runway (cable tray) to every wall it intersects and to each equipment cabinet and rack it serves. Support each run of telecommunications cable runway (cable tray) to every wall it runs along. Provide fasteners and hardware approved by the manufacturer for these purposes.
- G. Properly terminate all cables at each outlet location and at each Distribution cabinet/. Permanently identify all cables in all pull boxes, in wiring gutters and at each termination point with pre-marked self-adhesive wrap around markers.
- H. Permanently identify all system components following TIA/EIA 606 standard and following identification format:
1. Identification: Provide permanent Identification labels for outlets, faceplates, patch panels, and other locations where specified. For convenience, details and specifications based on "TLS2200 PC Link Labels" by Brady for voice/data identification.

2. Cable Labels: Permanently mark all cables in accordance with following labeling scheme.
 - a. Example: Outlet end of cable labeled "02-01A35" indicates:
 - (1) Data Room # 02
 - (2) Distribution Rack # 01
 - (3) Patch Panel # A
 - (4) Patch Panel Port # 35
 - b. Example: Data room end of cable labeled "1125 – 02" indicates:
 - (1) Outlet Room # 1125
 - (2) Outlet Port # 02
3. Faceplate Labels: Match cable label and permanently affix to faceplate; handwritten or "Dymo" type labels not acceptable.
4. Coordinates all labeling work with Owner and obtain Owner and Architect's approval of any deviation from proposed identification scheme prior to installation. Refer to "Cable Identification Nomenclature Legend" on Drawings. Confirm and submit complete cabling schedules to Owner for final approval prior to installation.
5. Provide typed or printed Cable ID-to-Room reference chart mounted in clear plastic pouch on each data cabinet with additional copy provided to Architect.

3.04 FIELD QUALITY CONTROL

A. Computer Network Infrastructure Testing: Provided by Contractor

1. Perform all testing under direct supervision of manufacturer's representative or accredited agencies for all specified equipment and services. Notify Architect and Owner in writing at least 3 working days prior to time testing is to begin. Architect and Owner reserves right to have representatives present and participating in testing. Provide re-testing at Contractor's expense if proper written notification required above is not given.
2. Test entire computer network cabling system in presence of Owner's representative and issue report to Architect stating that cabling system is in proper operating condition and meets all manufacturer's minimum listed specifications for signal levels and data speeds.
3. Twisted-Pair Cable Testing:
 - a. Perform with cable testing system similar to Microtest "OMNI scanner" using factory-prescribed test procedure for certification of Category 6 cable systems.
 - b. Report test results in format provided as standard for OMNI scanner with additional formatting provided by Architect that can be directly loaded into OMNI scanner per directions provided by Microtest. Software provided in this manner to ensure reporting in uniform and easily read format for convenience of Contractor responsible for testing. Obtain Architect's approval of any proposed deviation from specified testing process as part of Submittals described in Part 1 above.
4. Fiber Optic Testing Procedures: Based on EIA/TIA Standards. Include (but not limited to) the following testing:

- a. Testing each fiber optic strand on reel with OTDR (Optical Time Domain Reflectometer) at 850nm (multimode) and 1310nm (single-mode). Document point discontinuities greater than 0.20 dB and identify to Owner's representative prior to installation.
 - b. **Measuring attenuation** (insertion loss) values for each link and determining acceptance by attenuation coefficient values specified below. Provide final power loss (attenuation) report for each channel using measurements by optical power meter, associate insertion loss with OTDR test results to provide a comparison of test results for all channels.
 - (1) 50/125 and 62.5/125 multimode fiber tested at 850 Nm 3.5 db/km max
 - (2) 50/125 and 62.5/125 multimode fiber tested at 1300 Nm 1.5 db/km max
 - (3) Single-mode Inside plant tight-buffered fiber tested at 1310 Nm 0.7 db/km max.
 - (4) Single-mode Outside plant loose tube fiber tested at 1310 Nm 0.5 db/km max
 - (5) Single-mode Inside plant fiber tested at 1550 Nm 0.7db/km max.
 - (6) Single-mode Outside plant loose tube fiber tested at 1550 Nm 0.5 db/km max
5. Connector Loss: 0.75 db per connector max
- a. Checking all splices with OTDR during (or following) splicing procedure to verify attenuations within limits specified for products. Provide record of tests to Owner. Splices with losses greater than 0.3 dB are not acceptable; provide new splices as required to meet specified requirements.
 - b. Ensure all terminations on single-mode optical fibers are **factory-made using machine-polished process**; tested for and exhibiting maximum value of minus 50 db back-reflection after fusion-spliced to cables in field.
 - c. Upon completion of installation, provide complete documentation of OTDR signature traces at 800nm and 1300nm for multimode and 1310nm and 1550nm for single-mode, displaying entire length of cable runs. Provide complete insertion loss test results including record of:
 - (1) Wavelength
 - (2) Fiber type
 - (3) Fiber and cable number
 - (4) Measurement direction
 - (5) Test equipment model and serial number and calibration history
 - (6) Date and operator
 - d. Report test results in format provided as standard for OMNI scanner with additional formatting provided by Architect that can be directly loaded into OMNI scanner per directions provided by Microtest. Software provided in this manner to ensure reporting in uniform and easily read format for convenience of Contractor responsible for testing. OTDR testing and reporting to be done by and in the format specified for the NetTest model CMA4000i optical test system or the Corning Cable Systems Model 340 OTDR PLUS Multitester II. Obtain Architect's approval of any proposed deviation from specified testing process as part of Submittals described in Part 1 above.
6. Category 6, Copper UTP Testing Procedures - Includes (but not limited to):
- a. Testing each copper pair with equipment similar to Microtest Omni Scanner in accordance with EIA/TIA 568-B Transmission Performance requirements, testing each pair from both ends and not exceeding 90m in cable length.
 - (1) Only "PASS" results acceptable; "PASS" (modified standard) not acceptable.
 - (2) Property set all testing parameters for type of cable being tested and equipment used to perform tests.

- b. Verifying all terminations pass wire map, length, attenuation, NEXT loss, resistance, Impedance Capacitance, Power Sum and ACR, and meet or exceed current EIA/TIA 568-B and BICSI standards. Provide record of test results to Architect.
 - c. Test Results: Provide results on CD Rom with all software required for viewing compatible with all IBM PC compatible computers and 1 printed copy for archival purposes. Include cable ID and test results for each cable in each test result table.
7. Report: Submit written test report from authorized representative of equipment manufacturer indicating that system has been tested and is in working order prior to final inspection.

3.05 ADJUSTING / CLEANING

- A. Clean up debris from installation on daily basis.

PART 4 - QUANTITIES

SCHOOL NAME	ADDRESS	SCHOOL TYPE	CONSTRUCTION TYPE	SQUARE FEET	CLASSROOM S	DATA / PHONE PORTS	DATA / PHONE PORTS DEMOLITION	CATEGORY 8 STATION CABLING (FEET)	MDF / IDF (QUANTITY)	CABLING ALLOWANCE
Mildred B. Garvin Micro Society Elementary School	1 Grove Pl. East Orange, NJ 07017	ES	New	61,250	18	180	N/A	45,000	4	\$12,800

END OF SECTION

SECTION 18753 – TELEPHONE BACKBONE WIRING SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. Telecommunications equipment and systems wiring, providing structured cabling infrastructure for telephone system.

1.02 SYSTEM DESCRIPTION

A. Design Requirements

1. Provide labor, materials, equipment, and services and perform all operations required for complete installation of telecommunications equipment and systems and related components shown on Drawings and specified in this Section.
 - a. Associated wiring system to each telephone as indicated on riser diagrams and on floor plans is specified elsewhere.
 - b. Include all wiring between building sound system and PBX.
 - c. Refer to specification section 18751 for requirements for all Category 6 telephone station wiring, installation, and testing.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's product brochures and other data for each specified telecommunications item demonstrating compliance with specified requirements and provide list of locations where each item is installed.
- B. Shop Drawings: Submit complete drawings showing entire system, components, point-to-point wiring, and field connections.
- C. Samples: Submit samples of all copper cables, terminal blocks, protector blocks, terminations, jacks, cover plates and cable hangers, unless manufacture and part number are same as specified in Part 2 - Products below.
- D. Quality Control Submittals
 1. Certificates
 2. Submit certification from telephone network cabling system manufacturer indicating that Installer is a "Certified Installer" for product line proposed for use in this Project.

1.04 QUALITY ASSURANCE

A. Installer Qualifications:

1. Qualified to cable, terminate and test telephone network cabling system described in this Section. Provide listing of at 5 telephone network cabling system projects of similar size with complete client references.
2. "Certified Installer" in product line submitted for use in this Project.

1.05 PROJECT/SITE CONDITIONS

A. Information and Services Provided by Owner

1. *Access for Contractor personnel to premises and facilities. Contractor remains responsible for coordinating access requirements with Owner prior to requirement for access.*
2. Additional detail drawings of existing conditions required for installation.
3. Required inspections. Contractor remains responsible for coordinating with Owner, sufficiently prior to requirement for inspection, to allow scheduling of inspection.

1.06 SEQUENCING AND SCHEDULING

- ### A. Provide installation schedule demonstrating that existing equipment will be maintained in operation until new equipment is programmed and ready for use.

1.07 WARRANTY

- ### A. Special Warranty: Provide manufacturer's system warranty against electrical or mechanical defects for 1 year from date of final acceptance.

PART 2 - PRODUCTS

2.01 COMPONENTS

- #### A. Trunk Cables: Category 3 grade plenum premises cable; 24AWG solid bare copper conductors, multi-pair telephone cable bundled in 25 pair groups. Similar to "CMP-10024SPP-1 (100 pair) General Cable 2131377", Nordx/CDT 24571250, or Superior Essex 18-799-86.
- #### B. Grounding Cable: Minimum 1 dedicated copper ground conductor, #6 AWG or larger, directly connected to main building ground system and routed with all backbone riser cables. Ground cable bonded to all protector blocks and provides ground connection to special ground terminals provided on telephone equipment.
- #### C. T-1 Extension Cable: If Telephone Company demarcation needs to be extended to PBX location, provide multi-pair voice grade cable of 25 or more pairs, similar to Lucent "CMP-002524SAS-3", Berk-Tek 10032052, or Belden 1590A and dual screened 4-pair T-1 circuit rated cable, similar to Lucent "CMP-00822-T1-3", Krone DSP-25225SDWT02, or Berk-Tek 10032052.
1. Place cable from point of demarcation to cross connect terminal blocks serving CO connections to PBX.
 2. Refer to Drawings for specific requirements.
 3. Inter-building Outside Plant Cables in Underground Duct: Exchange cable code PE-39 or PC-89, 24AWG copper conductors, polyethylene sheath, filled core, coated aluminum shield, specified pair count; similar to Anixter "E-020024AFC" or "E-020024AFO", Superior Essex 85-108-AR, or Berk-Tek "E-020024AFO" for 200 pair size.
- #### D. Termination Blocks
1. Station Cables: Terminate on pair block assembly similar to Siemon "S110AB2-300FT 300 Pair Block Assembly" or Siemon "S110AB2-100FT 100 Pair Block Assembly with S110C-4 4-Pair Connecting Blocks for 4-pair Station Cables", Avaya "107058919 100 Pair Block 110 Kit with Legs Cat5e XP6 Field Term 4 Pair Clips", or Leviton "41AB2-1FT 100 Pair Block 110 Kit with Legs Cat5e 4 Pair Clips, Labels & Holders"

2. Riser Cables: Terminate on pair block assembly similar to Siemon "S110AA2-300FT 300-Pair Block Assembly" or Siemon "S110AA2-100FT 100-Pair Block Assembly with S110C-5 5-Pair Connecting Blocks for 25-Pair (or multiples of 25-pair) Riser Cable Termination", Panduit "P110KB1004 100 Pair Block 110 Kit with Legs Cat5e XP6 Field Term 5 Pair Clips", or Ortronics "30200116 100 Pair Block 110 with Legs Cat5e XP6 Field Term 5 Pair Clips"
- E. Consolidation Point Enclosure (CPE): Similar to Siemon "CPEV", Hubbell "CPEI", or Holocom "PGW-CM-CP1" designed to house telecommunication hardware being utilized as a Consolidation Point (IDF) and including following features:
1. Accepts up to six 100-pair S110 blocks.
 2. Smoked plexiglass viewing window.
 3. Hinges on left or right side.
- F. Termination Boards: 3/4-inch thick fire-retardant treated plywood painted with 2 coats of grey paint on both sides including edges of plywood panel.
1. At Contractor's option, provide non-fire-retardant treated plywood with 2 coats of gray fire-retardant paint on all sides including edges of plywood panel.
- G. Lightning Protection: Provide UL listed and approved gas tube and solid state lightning protection with Sneak Current Protection on both ends of all aerial cables and both ends of all underground cables where cable length exceeds 42 meters (140 feet).
1. Protection devices not required on underground cables connecting buildings that are inside properly grounded metallic conduit or have properly grounded integral metallic shielding AND are less than 42 meters (140 feet) in length.
 2. Comply with Article 800-30 of National Electric Code governing specific requirements of protective devices and their installation.
 3. Provide devices similar to products by Porta Systems Corp., ITW Linx, or Midsouth.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine conditions under which telecommunications wiring systems are to be installed in coordination with Installer of materials and components specified in this Section and notify affected Prime Contractors and Architect in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
1. When Installer confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Architect written confirmation from applicable Installer. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to Installer.
 2. Survey buildings and issue report to Architect prior to starting installation that indicates any circumstance that may hinder system installation.

3.02 INSTALLATION

- A. Install telecommunications systems and equipment specified in this Section in strict accordance with requirements of local law and ordinances, rules of State of New Jersey, National Board of Fire Underwriters and National Electrical Code and that systems and power supplies are Underwriter Laboratory (UL.) approved.
1. Do not change or deviate from Contract Documents without obtaining prior written approval from Architect and Owner.
 2. Obtain approval of Architect before proceeding with any installation requiring cutting into, or through, any part of building structure such as girders, beams, concrete or tile floors, or partition ceilings. Refer to DIVISION 1 for additional requirements
- B. Install equipment in accordance with manufacturer's specifications for system.
1. Conduct tests and inspections after installation has been completed to assure Owner that installation requirements have been met.
 2. At least 1 week prior to completion of equipment installation, notify Architect of date equipment will be ready for inspection.
 3. Promptly correct all defects.
- C. Wiring, Raceway and Distribution Frames
1. Telephone Cable Termination: Terminate all cables on 110 style termination blocks at MDF and IDF's in each building. Label with riser pair numbers and location numbers.
 2. Secure all horizontal cables within ceiling cavities to building structure.
 - a. Loosely bundle all cables and support from structure at 5 ft. intervals with spring steel fasteners and cable clip rated for use with high performance cables (similar to Caddy Series 'CableCat') or approved alternate mounting methods (including placement in cable tray) as indicated on Drawings.
 - b. Properly install all cables in cable tray in locations indicated on Drawings.
 - c. Do not support cables from ceiling grid T-bars or grid support wires or bridle rings.
 - d. Do not allow cables to rest on ceiling grid.
 - e. Install cables in conduit in all unfinished, exposed areas, including, but not limited to, storage rooms, mechanical areas, crawlspace and pipe tunnels.
 - f. Do not secure cables with tightened cable-ties or any other device that deforms cable jacket.
 - g. Provide 6 inches slack at station termination and 24 inches slack at patch panels or terminal blocks.
 - h. Place wire in conformance with EIA/TIA Standard 568A and BICSI standards.
 - i. Re-terminate and re-test any cables or pairs of cables failing end-to-end testing. Replace any faulty cables/pairs. Remove all defective cables from pathways.

3. Determine allowable cable placement proximity to other electrical power sources of 480 volts or less using EIA-569 Cabling Pathways Standard for UTP cable separation guidelines from EMI sources as follows:

a. Minimum Separation Distance from Power Source at 480v or less

<u>CONDITION</u>	<u><2kVA</u>	<u>2-5KVA</u>	<u>>5KVA</u>
(1) Unshielded power lines or electrical equipment in proximity to open or non-metal pathways	6 in.	12 in.	24 in.
(2) Unshielded power lines or electrical equipment in proximity to grounded metal conduit pathway	3 in.	6 in.	12 in.
(3) Power lines enclosed in a grounded metal conduit (or equiv.shielding) in proximity to grounded metal conduit pathway	3 in.	6 in.	12 in.
(4) Transformers & electric motors	40 in.	40 in.	40 in.
(5) Fluorescent lighting	12 in.	12 in.	12 in.

4. Install all exposed cables in surface raceway manufactured by Wiremold, Hubbell, Panduit, or Ortronics and as detailed on Drawings. Install cables in surface raceway in accordance with all manufacturers' requirements concerning cable slack and bending radius.

5. Install all cable in accordance with all National, State and Local Codes and both TIA/EIA and BICSI standards and practices.

- a. Follow manufacturer's guidelines and requirements for all cable termination.
- b. Install and connect #6AWG or larger ground wires to bond all equipment racks and cabinets to building ground per EIA/TIA 607.
- c. Unless otherwise noted on Drawings, locate all equipment racks to allow minimum of 30 inches aisle clearance both in front and rear of equipment rack for access to equipment.

6. Properly terminate all cables at each outlet location and at each Distribution Rack or terminal. Permanently identify all cables in all pull boxes, in wiring gutters and at each termination point with pre-marked self-adhesive wrap around markers similar to Brady "B-500+ Plastic Cloth Markers", GVSI "TC-WM-X", or Electromark "C113-A1".

7. Permanently identify all system components using following identification format:

- a. Cable Labels: Refer to specification section 18751 for requirements for all labels, installation, and associated work
- b. Faceplate Labels: Match cable label and permanently affix to faceplate; handwritten or "Dymo" type labels not acceptable.
- c. Obtain Owner's and Architect's approval of any deviation from proposed identification scheme prior to installation. Refer to "Cable Identification Nomenclature Legend" on Drawings. Confirm and submit complete cabling schedules to Owner for final approval prior to installation.
- d. Provide typed or printed Cable ID-to-Room reference chart mounted in clear plastic pouch on each data cabinet with additional copy provided to Architect.

3.03 **FIELD QUALITY CONTROL**

A. Telecommunications Wiring System Testing: Provided by Contractor.

1. Perform all testing under direct supervision of manufacturer's representative or accredited agencies for all specified equipment and services. Notify Architect and Owner in writing at least 3 working days prior to time testing is to begin. Architect and/or Owner reserves right to have representatives present and participating in testing. Provide re-testing at Contractor's expense if proper written notification required above is not given.
2. Test entire telecommunications wiring system in presence of Owner's representative and issue report to Architect stating that cabling system is in proper operating condition and meets all manufacturer's minimum listed specifications for signal levels and data speeds.
3. Twisted-Pair Cable Testing:
 - a. Perform with cable testing system similar to Microtest/Fluke "OMNI scanner" using factory-prescribed test procedure for certification of Category 6 (CAT 6) cable systems.
 - b. Report test results in format provided as standard for OMNI scanner with additional formatting provided by Architect that can be directly loaded into OMNI scanner per directions provided by Microtest. Software provided in this manner to ensure reporting in uniform and easily read format for convenience of Contractor responsible for testing. Obtain Architect's approval of any proposed deviation from specified testing process as part of Submittals described in Part 1 above.
4. Report: Submit written test report from authorized representative of equipment manufacturer indicating that system has been tested and is in working order prior to final inspection.

3.04 **ADJUSTING / CLEANING**

- A. Clean up debris from installation on daily basis.**

PART 4 - QUANTITIES

SCHOOL NAME	ADDRESS	SCHOOL TYPE	CONSTRUCTION TYPE	100 PAIR TRUNK CABLE (FEET)	MDF / IDF QUANTITY
Midred B. Garvin Micro Society Elementary School	1 Grove Pl. East Orange, NJ 07010	ES	New	2800	4

END OF SECTION

SECTION 18759 – TELECOMMUNICATIONS GROUNDING

18759

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes grounding and bonding requirements for the telecommunications infrastructure.
- B. Telecommunications bonding and grounding is additional bonding and grounding installed specifically for telecommunications systems.

1.02 SUBMITTALS

- A. Submit product data for the following:
 - 1. TMGB and TGB grounding busbars.
 - 2. Equipment rack and cabinet busbars.
 - 3. Wire conductors.

1.03 REFERENCES

- A. ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications Systems.
- B. All work and materials shall comply with the latest rules, codes and regulations, including but not limited to the following:
 - 1. NFPA 70 – National Electrical Code (NEC)
 - 2. BICSI Telecommunications Distribution Methods
 - 3. Occupational Safety and Health Act Standards (OSHA)
 - 4. ANSI/IEEE C-2 National Electrical Safety Code
 - 5. All other applicable Federal, State, and local codes and regulations.

1.04 BONDING & GROUNDING INFRASTRUCTURE

- A. Bonding Conductor for Telecommunications per TIA/EIA-607: The copper conductor that bonds the Telecommunications Main Grounding Busbar (TMGB) to the service equipment (electric power) ground.
- B. TMGB (Telecommunications Main Grounding Busbar): A copper ground reference busbar, typically installed in the entrance facility or entrance room, and is bonded to the service equipment (power) ground by the Interconnecting Bonding Conductor.
- C. TGB (Telecommunications Grounding Busbar): A copper ground reference busbar typically installed in telecommunication rooms (TR) and is bonded to the TMGB by the Telecommunications Bonding Backbone. The TGB references metallic entities in the TR space to ground.
- D. Telecommunications Bonding Backbone: A network of insulated copper conductors extending from the TMGB to each TGB.
- E. Equipment Bonding Conductor: An insulated copper conductor that bonds metallic items and equipment to the TMGB and TGB.

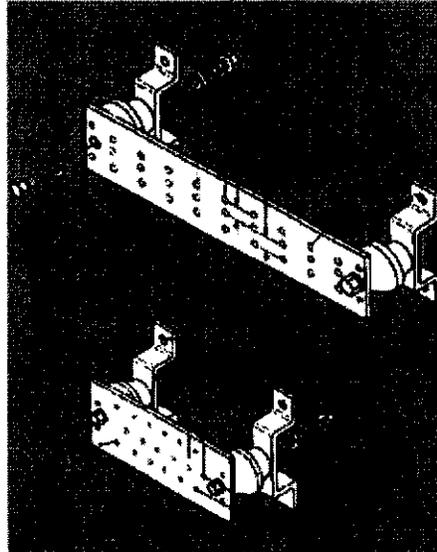
PART 2 - PRODUCTS

2.01 TELECOMMUNICATION MAIN GROUNDING BUSBAR (TMGB)

- A. Acceptable Manufactures: Newton Instrument Company type 3056, Eritech TMGB - A20L27PT, or Chatsworth 10622-020 1/4" x 4" x 20" insulated copper ground bar or approved equal.

Typical Telecommunications Main Grounding Busbar (TMGB)

Newton Type 3056



Newton Type 3058

Typical Telecommunications Grounding Busbar (TGB)

2.02 TELECOMMUNICATION GROUNDING BUSBAR (TGB)

- A. Acceptable Manufactures: Newton Instrument Company 3058, Alltec Corp. TB-7408-12 or Chatsworth 10622-010 1/4" x 4" x 10" insulated copper ground bar or approved equal.

2.03 EQUIPMENT RACK BUSBARS

- A. Acceptable Manufactures: Newton Instrument Company, Panduit TRGB191 or Chatsworth 10610 1/4" x 1" x 19" rack ground bar detail, for equipment rack and cabinet applications or approved equal.

2.04 OTHER GROUND REFERENCE BUSBARS

- A. Acceptable manufactures: Newton Instrument Company 1/4" x 1" x 12" insulated copper bar, Eritech EGBA14112EE, Thompson Lightning Protection 37208 or approved equal for miscellaneous applications.

2.05 BONDING CONDUCTORS

- A. Single Conductors: 600 volts rated, 98 percent conductivity, stranded, annealed copper, THWN or THHN green colored insulation, sizes as indicated. If due to wire size, green insulation color is not available, identify each conductor every 20 feet when exposed with a green band and identify each end with a green band and a label.
- B. All bonding conductors shall be insulated copper. Exception is use of flat, braided, aluminum ground straps utilized for bonding sections of aluminum cable tray.
- C. Unless otherwise specified, size the conductors as required by NEC.
- D. Unless otherwise specified, the Bonding Conductor for Telecommunications per TIA/EIA-607 shall be No. 3/0 AWG.
- E. Unless otherwise specified, the Telecommunications Bonding Backbone shall be No. 3/0 AWG.
- F. Unless otherwise specified, the Equipment Bonding Conductor shall be No. 6 AWG.

2.06 BONDING CONDUCTOR TERMINATIONS

- A. Acceptable Manufacturers: Thomas and Betts, ILSCO, Alltec or approved equal.
- B. Acceptable materials:
 - 1. Two hole compression lugs: Thomas and Betts, "Two Hole Lugs Long Barrel Type" color code blue (example catalogue No. 54816BE), ADC "PowerWorx CL-02M", or Burndy YA8C-L high conductivity wrought copper, electro tin plated, or approved equal.
 - 2. One hole compression lugs: Thomas and Betts, "Long Barrel One Hole Lugs" color code blue (example catalogue No. 54905BE), Burndy YA4C-L, or ADC PowerWorx CL-01M high conductivity wrought copper, electro tin plated, or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Site and materials preparation for testing is the responsibility of Contractor.

3.02 INSTALLATION

- A. In the Telecommunications Rooms, Equipment Rooms, and Entrance Facilities provide all local bonding as indicated on the drawings and in the specifications.
- B. Provide electrical systems and equipment grounding as required by code, utility, local ordinances, and requirements herein.
- C. Provide cable connections and joints per ANSI/TIA/EIA-607.
- D. Bonding conductors shall be continuous and routed in a direct route to point of termination.
- E. All insulated ground bars shall be isolated from the structural support by a 2" minimum separation, using manufacturer's recommended insulating stand-offs and hardware.
- F. Clean ground bars, terminals, and lug prior to terminating conductors.

- G. Label all telecommunications bonding conductors within 6 inches of their termination point.
- H. Bond the TMGB to the service equipment (power) ground, typically located in the main electrical MDP facility, utilizing the most direct route possible to minimize conductor length.
- I. Bond all TGB's to the TMGB using conductor size specified.
- J. Whenever two or more Telecommunications Bonding Backbones are used in a multi-story building, they shall be bonded together on the top floor, and at every third floor, at a minimum, using the bonding conductor size specified.
- K. Bond the following to the TMGB when present:
 - 1. Telecommunication panelboards: Alternating Current Equipment Ground Bus (ACEG), if equipped, or its enclosure.
 - 2. Building structural steel, if exposed.
 - 3. Metallic equipment racks.
 - 4. Telecommunications riser and utility cable shields.
 - 5. All metal raceways and cable trays for telecommunications cabling extending from the same room or space where the TMGB is located.
 - 6. Others as identified on the Plans.
- L. Bond the following to the TGB when present:
 - 1. Telecommunication panelboards: ACEG, if equipped, or it's enclosure.
 - 2. TGBs within the same space.
 - 3. Telecommunications Bonding Backbones terminated on the same floor to other TGBs.
 - 4. Metallic equipment racks.
 - 5. Telecommunications riser and utility cable shields.
 - 6. All metal raceways and cable trays for telecommunications cabling extending from the same room or space where the TGB is located.
 - 7. Others as identified on the Plans.
- M. Bonding Conductor for Telecommunications and Telecommunications Bonding Backbone Conductors shall be terminated with at the TMGB with TWO-HOLE, COMPRESSION LUGS.
- N. Equipment Bonding Conductors shall be terminated with ONE-HOLE COMPRESSION LUGS.
- O. Any conduit and sleeves for Bonding Conductors for Telecommunications and Telecommunications Bonding Backbone Conductors shall be of non-metallic construction. It shall be permissible to route the conductors in a metallic telecommunications cable tray where designated for the purpose.

3.03 TESTING PROCEDURES AND GUIDELINES

- A. Tests To Be Performed – The following tests shall be performed. Multiple steps are necessary for each test.
 - 1. Grounding Reference System Continuity Test.

NOTE: The continuity of each equipment bonding conductor is NOT part of this procedure.
- B. Test Equipment – Biddle Instruments, megger DET2/2 Ground Tester or later approved model. The testing procedure that follows refers to the DET2/2 Tester.

C. Testing Process – The following testing guidelines apply to all test procedures and shall be followed to promote efficient and accurate testing.

1. Be sure all connections are tight. Loose connections will have a major effect on the test results.
2. The test lead shall be No. 14 AWG, stranded, insulated, copper conductor. The test lead shall be long enough to reach all TGBs from the TMGB. One test lead shall be used for all tests.

NOTE: The test lead may be spooled however, the Biddle test meter may produce inaccurate or erratic resistance measurements if the quantity of cable on the spool is too great. If the meter behaves erratically first try performing the test in the "low current" setting. If the behavior persists, the test lead should be unspooled.

3. The Current shall be set to "HIGH".
4. The Filter shall be set to "ON".
5. The Frequency shall be set to "150Hz".
6. Connect Terminals C2 and P2 by a jumper wire (if not connected by the manufacturer).
7. Connect Terminals P1 and C1 by a jumper wire (if not connected by the manufacturer).
8. Once the test lead is attached to the meter it should not be removed as identified in the specific test procedure.

3.04 TESTING

A. Reference Test – The reference test procedure is necessary to calibrate the test setup. The reference test procedure shall be performed prior to performing any test. The reference value shall be recorded and subtracted from all other measurements. If the length of the test lead is changed, new reference data must be taken and recorded. Refer to the test documentation.

The test procedure is as follows:

1. Connect one end of the test lead to Terminal C1 and the other end to Terminal C2.
2. Perform the Biddle Meter Resistance Test.
3. Record test lead resistance on the data sheet.
4. Disconnect the test lead from Terminal C1 ONLY. The test lead should remain connected to Terminal C2 if possible throughout the tests.

B. GROUND REFERENCE SYSTEM CONTINUITY TEST – The ground reference system shall be tested to validate the continuity and integrity of the interconnection of the TMGB, TGB, Telecommunications Bonding Backbone, Bonding Conductor for Telecommunications, and building's grounding electrode.

The test procedure is as follows:

1. Remove all equipment bonding conductors from the TMGB and the TGBs. The Bonding Conductor for Telecommunications SHALL REMAIN ATTACHED TO THE TMGB. Panelboard and building steel bonds shall be removed. The Telecommunications Bonding Backbone conductor (interconnecting the TMGB and TGBs) shall remain attached at all busbars.