SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Horizontal (distribution) communications wiring and connecting hardware from Telecommunications Room (TR) to Telecommunication Outlets (TO).

1.2 RELATED REQUIREMENTS

A. Section 27 05 26 – Grounding and Bonding for Communications Systems.

B. Section 27 05 28 – Pathways for Communications Systems.

C. Section 27 10 00 – Structured Cabling.

D. Section 27 11 00 – Communications Equipment Room Fittings.

E. Section 27 13 00 – Communications Backbone Cabling.

F. Section 27 16 00 – Communications Connecting Cords, Devices, and Adapters.

1.3 REFERENCE STANDARDS

A. ANSI/TIA-492.AAAC-B – Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class 1a Graded-index Multimode Optical Fibers (OM3/OM4). Current Edition

B. ANSI TIA-492.CAAB – Detail Specification for Class Iva Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak. Current Edition

C. ANSI/TIA 526 – OFSTP-19 Optical Signal-to-Noise Ratio Measurement Procedures for Dense Wavelength-Division Multiplexed Systems.

D. ANSI/TIA-568-C.0 – Generic Communications Cabling for Customer Premises..

E. ANSI/TIA-568-C.1 – Commercial Building Communications Cabling Standard Part 1: General Requirements.

F. ANSI/TIA 568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards

G. ANSI/TIA 568-C.3 – Optical Fiber Cabling Components Standard

H. ANSI/TIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces.

I. ANSI/TIA-606-A – Administration Standard for the Commercial Telecommunications Infrastructure.

J. ANSI/TIA-607-B – Commercial Building Bonding and Grounding (Earthing) Requirements for Telecommunications.

K. NFPA 70 – National Electrical Code (NEC).

L. BICSI – TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM)

1.4 PRE-INSTALLATION MEETINGS

A. Convene pre-installation meeting 2 weeks before start of installation of communications horizontal cabling.

B. Require attendance of parties directly affecting work of this section, including Contractor, Architect, installer, and manufacturer's representative.

C. Review materials, installation, field quality control, labeling, protection, and coordination with other work.

1.5 SUBMITTALS

A. Comply with Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's product data sheets, including installation instructions verifying that materials comply with specified requirements and are suitable for intended application.

C. Installer's Project References: Submit installer's list of successfully completed communications horizontal cabling projects, including project name and location, name of architect, and type and quantity of communications horizontal cabling installed.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer regularly engaged, for past 10 years, in manufacture of communications horizontal cabling of similar type to that specified.

B. Installer's Qualifications:
1. Approved Leviton Certified Installer or Berk-Tek Oasis Certified Integrator certified before, during, and through completion of the system installation. Supporting documentation will be required as part of the submittal.
2. Responsible for workmanship and installation practices in accordance with Leviton Certified Installer Program and Berk-Tek Oasis Program.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling Requirements:

1. Store and handle materials in accordance with manufacturer's instructions.
2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
3. Store materials in clean, dry area indoors.
4. Protect materials during storage, handling, and installation to prevent damage.

1.8 WARRANTY

A. The horizontal communications cabling system installed shall be eligible for coverage by a Limited Lifetime Warranty to the end user.
   1. Horizontal channels shall be completed with Leviton Network Solutions factory-terminated copper and/or fiber optic patch cords in order to be eligible for the applicable Berk-Tek or Leviton Warranty with channel performance guarantees.
   2. Approved product shall be listed on the most recent version of the applicable Berk-Tek Leviton Technologies data sheets for each Berk-Tek Leviton Technologies solution.

B. Certified Installer/Certified Integrator shall provide labor, materials, and documentation in accordance with Berk-Tek and Leviton Network Solutions requirements necessary to ensure that the Owner will be furnished with a Limited Lifetime Warranty.

C. The installed structured cabling system shall provide a warranty guaranteeing installed channel performance above the ANSI/TIA 568-C requirements for Cat 5e, Cat 6, and/or Cat 6A cabling systems or ISO 11801 requirements for Cass D, Class E, and/or Class E_a.
   1. Standards-compliant channel or permanent link performance tests shall be performed in the field with a Berk-Tek Leviton Technologies approved certification tester in the appropriate channel or permanent link test configuration. See 1.8 A.1 above for channel requirements.

D. Necessary documentation for warranty registration shall be provided to the manufacturer by the installer (within 10 days) following 100 percent testing of cables.
   1. Submit test results to Leviton Network Solutions or to Berk-Tek, in the certification tester's original software files.
   2. Installer shall ensure that the warranty registration is properly submitted, with all required documentation within 10 days of project completion.
   3. Certified Contractor/Certified Integrator must adhere to the terms and conditions of the respective manufacturer's warranty programs.

E. Installer shall ensure that the Owner receives the manufacturer issued project warranty certificate within 60 calendar days of warranty registration.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Leviton Network Solutions, 2222 222nd Street SE, Bothell, Washington 98021. Phone 425-486-2222. Fax 425-485-3373. Website www.leviton.com.
Berk-Tek, A Nexans Company, 132 White Oak Road, New Holland, PA 17557 Phone: 717-354-6200. Fax 717-354-7944. Website www.berktek.com.

2.2 SYSTEM DESCRIPTION

Specifier Notes: Edit the system description for the specific application.

A. Horizontal Distribution Subsystem: Intra-building twisted-pair and fiber optic communications cabling connecting Telecommunication Rooms (TRs) to Telecommunication Outlets (TOs) located at individual work areas.

B. Horizontal Cabling: Combination of the following types of cables from TR to TO:
1. Enhanced Category 6, (100-Ohm, 4-pair, unshielded twisted pair) cables from TRs to TOs, or Category 6A or Category 6 shielded (100-Ohm, 4-pair, shielded twisted pair) cables from TRs to TOs. Port 1 or Port 2.
2. 75 Ohm Dual Shield Coax.

C. Communications Horizontal Cabling System: Includes cables, jacks, patch panels, connecting blocks, patch cords, fiber connectors, fiber adapter plates, fiber enclosures, jumpers, and necessary support systems, such as cable managers and faceplates.

D. Cables: Rout through conduit, cable trays, spaces below raised floors, open ceiling areas, non-ventilated spaces above ceiling tile, and through plenum air-handling spaces above ceiling tile.

E. Furnish and install all materials necessary for a complete and working communications horizontal cabling system.

2.3 STATION CABLING

A. Enhanced Category 6 Unshielded Twisted Pair: **CX6200 Cat 6 Premium UTP System**.

1. A Minimum of (2) 100 ohm, Category 6, 23 AWG, 4-pair unshielded twisted pair, LANmark 2000, CMP rated per workstation faceplate.
   a. Color: Blue.
   b. Part Number: 10064547.
   c. Maximum Insertion Loss:
      1) 1.7 dB/100 m at 1 MHz.
      2) 18.0 dB/100 m at 100 MHz.
      3) 30.9 dB/100 m at 250 MHz.
      4) 47.7 dB/100 m at 500 MHz.
   d. NEXT, PSNEXT, ELFEXT, PSELFEXT margin greater than 8 dB better than ANSI/TIA category 6 standards requirement.
   e. Cable Balance: LCL/TCL greater than:
      1) 50 dB @ 100 m at 1 MHz.

2) 30.0 dB @ 100 m at 100 MHz.
3) 26.0 dB @ 250 MHz.
4) EL TCTL greater than:
   a) 30 dB @ 100 m at 1 MHz.
   b) 5.5 dB @ 100 m at 31.25 MHz.

f. Electrical Characteristics: Characterized to 600 MHz.
g. Each Pair in Cable: Insulated with FEP.
h. Cable: Third-party verified by ETL.
i. Berk-Tek LANmark-2000.
j. All category cabling manufacturers must be able to provide documentation from an independent third-party testing agency that verifies through random sampling that cable components perform at or above the levels contained on their product specifications, not simply at or above the standard

2. In Residential Installations, a Minimum of (1) 75 Ohm RG6 Quad Shield Coax CMP rated per workstation faceplate.

Braid %:	40% AND 60% BRAID AS QUAD SHIELD
Braid Material:	ALUMINUM
Coax Construction:	COAXIAL
Coax Type:	RG 6
Conductor Material:	COPPER CLAD STEEL
Conductor Size:	18 GAUGE AWG
Conductor Stranding/Dia. AWG & Type:	1/0.040/18/CCS
Conductor Type:	18 AWG SOLID CCS
Conductor Type:	18 AWG Solid CCS
Conductor Type:	SOLID CONDUCTOR
Dielectric Material:	FPE-FOAMED (CELLULAR) POLYETHYLENE
Dielectric Type/Jkt.:	FPE/FRPVC-BLACK
Dielectric Type/Jkt.:	FPE/FRPVC-black
Fire Rating:	GENERAL PURPOSE (CM, CMG, CMX)
Flooded:	NO NOT FLOODED OVER BRAID
Imped. Ohms:	75
Impedance:	75 OHM NOMINAL IMPEDANCE
Insulation Material (O.D. in.):	FPE/0.180
Jacket Material Color (O.D. in.):	PVC/BLK/0.297
Jacket Material:	FRPVC-SMOKE-GUARD OR FLAME RETARDANT PVC
NEC Rating:	UL LISTED ART 820 CABLE TV
Nom. O.D. (in.):	0.297
Outdoor:	NO NOT OUTDOOR GRADE MATERIAL
RG Type:	RG6
Rating:	CM
Screen/Shield Type:	QUAD SHIELD (F/B+F/B)
Shield Coverage:	2 Foil + 60% + 40% AL Braids
Shield:	Quad
Vendor:	Berk-Tek

2.4 MODULAR JACKS FOR WORKSTATION OUTLETS

A. Category 6 Modular Jacks: **CX6200 Cat 6 Premium UTP System**.
   1. 8-position QuickPort modular jack, Category 6, IDC terminals, T568A/B wiring scheme.
   2. Component-rated jack.
   3. Each Jack: Identified on its face as CAT 6.
   4. Color: 13 colors available.
      a. Part Number: Leviton 61110-RW6 (white).

2.5 WORK AREA OUTLETS

A. Flush-Mounted Plastic Faceplates:
   1. 1-port single-gang plastic wallplate with ID windows.
      a. Colors: 5 colors available
      b. Part Number: Leviton 42080-1WS (white).
   2. 2-port single-gang plastic wallplate with ID windows.
      a. Colors: 5 colors available
      b. Part Number: Leviton 42080-2WS (white).
   3. 3-port single-gang plastic wallplate with ID windows.
      a. Colors: 5 colors available
      b. Part Number: Leviton 42080-3WS (white).
   4. 4-port single-gang plastic wallplate with ID windows.
      a. Colors: 5 colors available
      b. Part Number: Leviton 42080-4WS (white).
   5. 6-port single-gang plastic wallplate with ID windows.
      a. Colors: 5 colors available
      b. Part Number: Leviton 42080-6WS (white).
   6. 1-port dual-gang plastic wallplate with ID windows.
      a. Colors: 5 colors available
      b. Part Number: Leviton 42080-1WP (white).
   7. 2-port dual-gang plastic wallplate with ID windows.
      a. Colors: 5 colors available
      b. Part Number: Leviton 42080-2WP (white).
   8. 3-port dual-gang plastic wallplate with ID windows.
      a. Colors: 5 colors available
      b. Part Number: Leviton 42080-3WP (white).
   9. 4-port dual-gang plastic wallplate with ID windows.
      a. Colors: 5 colors available
      b. Part Number: Leviton 42080-4WP (white).
   10. 6-port dual-gang plastic wallplate with ID windows.
      a. Colors: 5 colors available
      b. Part Number: Leviton 42080-6WP (white).
   11. 8-port dual-gang plastic wallplate with ID windows.
      a. Colors: 5 colors available
      b. Part Number: Leviton 42080-8WP (white).
   12. 12-port dual-gang plastic wallplate with ID windows.
      a. Colors: 5 colors available
      b. Part Number: Leviton 42080-12W (white).
   13. Faceplate Colors: Coordinate with Architect to match finish. Part numbers shown are for standard color of white. Also available in Light Almond, Ivory, Grey, and Black.

B. Flush-Mounted Stainless Steel Faceplates:
   1. 1-port QuickPort faceplate with mounting lugs for wall phone, stainless steel, mounts onto single-gang wall box.

a. Part Number: Leviton 4108W-0SP (flush plate) or 4108W-1SP(jack area recessed).

2. 1-port QuickPort single-gang stainless steel wallplate, with ID windows
   a. Part Number: Leviton 43080-1L1.
3. 2-port QuickPort single-gang stainless steel wallplate, with ID windows
   a. Part Number: Leviton 43080-1L2.
4. 3-port QuickPort single-gang stainless steel wallplate, with ID windows
   a. Part Number: Leviton 43080-1L3.
5. 4-port QuickPort single-gang stainless steel wallplate, with ID windows
   a. Part Number: Leviton 43080-1L4.
6. 6-port QuickPort single-gang stainless steel wallplate, with ID windows
   a. Part Number: Leviton 43080-1L6.
7. 2-port QuickPort dual-gang stainless steel wallplate, with ID windows
   a. Part Number: Leviton 43080-2L2.
8. 4-port QuickPort dual-gang stainless steel wallplate, with ID windows
   a. Part Number: Leviton 43080-2L4.
9. 6-port QuickPort dual-gang stainless steel wallplate, with ID windows
   a. Part Number: Leviton 43080-2L6.
10. 8-port QuickPort dual-gang stainless steel wallplate, with ID windows
    a. Part Number: Leviton 43080-2L8.
11. 12-port QuickPort dual-gang stainless steel wallplate, with ID windows
    a. Part Number: Leviton 43080-L12.

C. Surface-Mounted Outlet Boxes:
1. 1-port QuickPort surface-mount box, plastic, with ID window.
   a. Color: 4 colors available
   b. Part Number: Leviton 41089-1WP (white).
2. 2-port QuickPort surface-mount box, plastic, with ID window.
   a. Color: 4 colors available
   b. Part Number: Leviton 41089-2WP (white).
3. 4-port QuickPort surface-mount box, plastic, with ID window.
   a. Color: 4 colors available
   b. Part Number: Leviton 41089-4WP (white).
4. 6-port QuickPort surface-mount box, plastic, with ID window.
   a. Color: 4 colors available
   b. Part Number: Leviton 41089-6WP (white).
5. 12-port QuickPort surface-mount box, plastic, with ID window.
   a. Color: 4 colors available
   b. Part Number: Leviton 41089-12W (white)
6. 2-port QuickPort surface-mount box, plastic, with ID window, extra-deep for shielded connectors, Cat 6A, other larger bend-radius cable applications.
   a. Color: 4 colors available
   b. Part Number: Leviton 4S089-2WP (white)
7. 4-port QuickPort surface-mount box, plastic, with ID window, extra-deep for shielded connectors, Cat 6A, other larger bend-radius cable applications.
   a. Color: 4 colors available
   b. Part Number: Leviton 4S089-4WP (white)
8. Surface Box Colors: part numbers shown are for white. Also available: Ivory, Grey, and Black. Coordinate with Architect to match finish.

D. Modular Furniture Faceplates:
1. 2-port furniture wallplate fits 1.38-inch by 2.63-inch furniture knockout, with ID window.
   a. Colors: 4 available
   b. Part Number: Leviton 49910-SW2 (white).

2. 4-port furniture wallplate fits 1.38-inch by 2.63-inch furniture knockout, with ID window.
   a. Colors: 4 available
   b. Part Number: Leviton 49910-SW4 (white).
3. 4-port furniture wallplate fits 1.38-inch by 2.63-inch furniture knockout, with ID window. Extra-deep version with additional room for cable bend radius.
   a. Colors: 4 available
   b. Part Number: Leviton 49910-EW4 (white).
4. 2-port furniture wallplate fits 1.88-inch by 2.98-inch Hermann-Miller furniture knockout, with ID window.
   a. Colors: 4 available
   b. Part Number: Leviton 49910-HW2 (white).
5. 4-port furniture wallplate fits 1.88-inch by 2.98-inch Hermann-Miller furniture knockout, with ID window.
   a. Colors: 4 available
   b. Part Number: Leviton 49910-HW4 (white).
6. Furniture Faceplate Colors: Part numbers shown are for white. Also available: Ivory, grey, and black. Coordinate with Architect to match finish.

E. Mounting Frames for QuickPort Jacks and Connectors
1. 1-port QuickPort Decora-style frame. Fits in Decora-style wallplate
   a. Colors: 6 available
   b. Part Number: Leviton 41641-00W (white).
2. 2-port QuickPort Decora-style frame. Fits in Decora-style wallplate
   a. Colors: 6 available
   b. Part Number: Leviton 41642-00W (white).
3. 3-port QuickPort Decora-style frame. Fits in Decora-style wallplate
   a. Colors: 6 available
   b. Part Number: Leviton 41643-00W (white).
4. 4-port QuickPort Decora-style frame. Fits in Decora-style wallplate
   a. Colors: 6 available
   b. Part Number: Leviton 41644-00W (white).
5. 6-port QuickPort Decora-style frame. Fits in Decora-style wallplate
   a. Colors: 6 available
   b. Part Number: Leviton 41646-00W (white)
6. 2-port QuickPort Duplex 106-style frame. Fits in Duplex electrical-style wallplate
   a. Colors: 5 available
   b. Part Number: Leviton 41087-2WP (white).
7. Decora-style wallplates for above mounting frames
   a. Single-gang, nylon: Leviton part number 80401-0NW (white)
   b. Dual-gang, nylon: Leviton part number 80409-0NW (white)
8. 4-port QuickPort Duplex 106-style frame. Fits in Duplex electrical-style wallplate
   a. Colors: 5 available
   b. Part Number: Leviton 41087-QWP (white).
9. Duplex electrical-style wallplates for above mounting frames
   a. Single-gang, nylon: Leviton part number 80703-00W (white)
   b. Dual-gang, nylon: Leviton part number 80716-00W (white)
10. Mounting Frame colors: Part numbers shown are for white. Also available: Light almond, ivory, grey, black (and brown for the Decora-style frames). Coordinate with Architect to match finish.

F. Multimedia Outlet System (MOS):
1. Single-gang Multimedia Outlet System wallplate, plastic, with ID windows. Holds a wide variety of copper, fiber, and/or audio-video inserts.
   a. Color: 5 colors available
   b. Part Number: Leviton 41290-SMW (white).

2. Dual-gang Multimedia Outlet System wallplate, plastic, with ID windows. Holds a wide variety of copper, fiber, and/or audio-video inserts.
   a. Color: 5 colors available
   b. Part Number: Leviton 41290-DMW (white).
3. Fiber storage/spacer ring, plastic. Fits Dual-gang Multimedia Outlet System wallplate.
   a. Color: 4 colors available
   b. Part Number: Leviton 41290-DRW (white).
4. 6-port Multimedia Outlet System surface-mount box, plastic, with ID window. Holds a wide variety of copper, fiber, and/or audio-video inserts.
   a. Color: 5 colors available
   b. Part Number: Leviton 41290-SMW (white).
5. Multimedia Outlet System (MOS) colors: Part numbers shown are for white. Also available: Light almond, ivory, grey, and black (ivory, grey, and black for the fiber storage/spacer ring). Coordinate with Architect to match finish.
6. Multimedia Outlet System (MOS) Inserts: For a complete list of MOS Inserts available please visit www.leviton.com/mos

2.6 PATCH PANELS

A. Category 6 110-style Modular Patch Panels: **CX6200 Cat 6 Premium UTP System**.
   1. 24-port, flat metal, component-rated, 8-position modular jack panel, Category 6, T568A/B universal wiring label.
      a. Part Number: Leviton 69586-U24.
   2. 48-port, flat metal, component-rated, 8-position modular jack panel, Category 6, T568A/B universal wiring label.
      a. Part Number: Leviton 69586-U48.
   3. 48-port, angled metal, component-rated, 8-position modular jack panel, Category 6, T568A/B universal wiring label.
      a. Part Number: Leviton 69587-U48.
   4. 48-port, flat, composite, component-rated, 8-position modular jack panel, Category 6, T568A/B universal wiring label.
      a. Part Number: Leviton C1686-U48.

B. QuickPort-Style Patch Panels: **CX6200 Cat 6 Premium UTP System**
   1. 24-port, 1RU, QuickPort, flat metal, patch panel, empty.
      a. Part Number: Leviton 49255-H24.
   2. 48-port, 1RU, QuickPort, flat metal, patch panel, empty.
      a. Part Number: Leviton 49255-H48.
   3. 24-port, 1RU, QuickPort, angled metal, patch panel, empty.
      a. Part Number: Leviton 49256-H24.
   4. 48-port, 2RU, QuickPort, angled metal, patch panel, empty.
      a. Part Number: Leviton 49256-H48.
   5. 48-port, 1RU high-density, QuickPort, flat metal, patch panel, empty.
      a. Part Number: Leviton 49255-Q48.
   6. 48-port, 1RU high-density, QuickPort, angled metal, patch panel, empty.
      a. Part Number: Leviton 49256-D48.
   7. 72-port, 2RU high-density, QuickPort, flat metal, patch panel, empty.
      a. Part Number: Leviton 49255-D72.
   8. 72-port, 2RU high-density, QuickPort, angled metal, patch panel, empty.
      a. Part Number: Leviton 49256-D72.
   9. 48-port, 1RU high-density, QuickPort, die-cast flat metal, patch panel, empty.
      a. Part Number: Leviton 49255-D48.

2.7 PATCH CORDS/JUMPERS

Specifier Notes: Specify required patch cords/jumpers. Delete patch cords/jumpers not required.

A. Category 6 Modular Patch Cords: **CX6200 Cat 6 Premium UTP System**.
   1. Slim-Line style, Category 6 UTP patch cord, 4-pair, stranded wire construction.
      b. Color: 8 colors available.
      c. Part Numbers:
         1) Leviton 6D460-03L (3 feet, Blue).
         2) Leviton 6D460-05L (5 feet, Blue).
         3) Leviton 6D460-07L (7 feet, Blue).
         4) Leviton 6D460-10L (10 feet, Blue).
         5) Leviton 6D460-15L (15 feet, Blue).
         6) Leviton 6D460-20L (20 feet, Blue).

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas to receive communications horizontal cabling.

B. Notify Architect of conditions that would adversely affect installation or subsequent use.

C. Do not begin installation until unacceptable conditions are corrected.

3.2 INSTALLATION – GENERAL

A. Install communications horizontal cabling in accordance with manufacturer's instructions, ANSI/TIA-568-C.0, ANSI/TIA-568-C.1, ANSI/TIA-569-B, BICSI TDMM, and NFPA 70.

B. Field Terminated Copper Patch Cords and Jumpers: Not allowed.

C. Copper Patch Cords: Manufactured by Leviton Network Solutions.

D. Install cables after building interior has been physically protected from weather and mechanical work likely to damage cabling has been completed.

E. Ensure cable pathways are completely and thoroughly cleaned before installing cabling.

F. Inspect installed conduit, wireway, cable trays, and innerduct.

G. Clean additional enclosed raceway and innerduct systems furnished.

H. Provide protection for exposed cables where subject to damage.

I. Abrasion Protection:
   1. Provide abrasion protection for cable or wire bundles which pass through holes or across edges of sheet metal.
   2. Use protective bushings to protect cables.

J. Cable Ties and Other Cable Management Clamps:
   1. No more than hand tightened.
   2. Fit snugly, but not compress, crimp, or otherwise change physical characteristics of cable jacket or distort placement of twisted-pair components.
   3. Replace cables exhibiting stresses due to over tightening of cable management devices.
   4. Use plenum-rated cable ties in plenum spaces.
   5. Velcro wraps are preferred over cable ties for all cable bundles. Plenum-rated Velcro wraps are available from Leviton.

K. Where possible, route cables in overhead cable trays and inside wire management systems attached to equipment cabinets and racks.
   1. Use Velcro, plastic ties or ducts to restrain cabling installed outside of wire management systems on racks or in cabinets.
   2. Cable Trays: Do not exceed 50 percent fill.

L. Pull Cord:
   1. Nylon, 1/8-inch minimum.
   2. Co-install with cables installed in conduit.

M. Cable Raceways: Do not fill greater than ANSI/TIA-569-B maximum fill for particular raceway type.

N. Support horizontal cables at a maximum of 48-inch (1.2 to 1.5-m) irregular intervals, if J-hook or trapeze system is used to support cable bundles.

O. Do not allow cables to rest on acoustic ceiling grids, plumbing pipes, or electrical conduits.

P. Bundle horizontal distribution cables in groups of no more than amount of cables designed for by cable support manufacturer, based on cable OD and weight.

Q. Fire-Sprinkler System:
   1. Install cables above fire-sprinkler system.
   2. Do not attach cables to fire-sprinkler system or ancillary equipment or hardware.
   3. Install cable system and support hardware so that it does not obscure valves, fire alarm conduit, boxes, or other control devices.

R. Do not attach cables to ceiling grid or lighting fixture wires.

S. Install appropriate carriers to support cabling, where support for horizontal cables are required.

T. Replace before final acceptance, cables damaged or exceeding recommended installation parameters during installation.

3.3 INSTALLATION – UNSHIELDED TWISTED-PAIR CABLES

A. Install unshielded twisted-pair cables in accordance with manufacturer's instructions.

B. Install cables in continuous lengths from origin to destination, without splices, except for transition points or consolidation points.

C. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in enclosure intended and suitable for the purpose.

D. Cable Minimum Bend Radius and Maximum Pulling Tension:
   1. Do not exceed bend radius for UTP = 4 X Cable OD, FTP = 4 X Cable OD.
   2. Install unshielded twisted-pair cables so that there are no bends smaller than 4 times cable outside diameter at any point in the run and at the termination field.
   3. Pulling Tension on 4-Pair UTP Cables: Do not exceed 25 ft.lb. for 4-pair UTP cable.

E. Separation from Power Lines: Provide following minimum separation distances between pathways for copper communications cables and power wiring of 480 volts or less:
   1. Open or Nonmetal Communications Pathways:
      a. Electric motors, fluorescent light fixtures, and unshielded power lines carrying up to 3 kVA: 12 inches.
      b. Electrical equipment and unshielded power lines carrying more than 5 kVA: 36 inches.
      c. Large electrical motors or transformers: 48 inches.

   2. Grounded Metal Conduit Communications Pathways:
      a. Electrical equipment and unshielded power lines carrying up to 2 kVA: 2-1/2 inches.
      b. Electrical equipment and unshielded power lines carrying from 2 kVA to 5 kVA: 6 inches.
      c. Electrical equipment and unshielded power lines carrying more than 5 kVA: 12 inches.
      d. Power lines enclosed in grounded metal conduit (or equivalent shielding) carrying from 2 kVA to 5 kVA: 3 inches.
      e. Power lines enclosed in grounded metal conduit (or equivalent shielding) carrying more than 5 kVA: 6 inches.

3.4 INSTALLATION – UNSHIELDED TWISTED-PAIR TERMINATION

A. Coil cables to house cable coil without exceeding manufacturer's bend radius.
   1. In hollow wall installations where box eliminators are used, store excess wire in wall.
   2. Store no more than 12 inches of UTP and 36 inches of fiber slack.
   3. Loosely coil excess slack and store in ceiling above each drop location, when there is not enough space present in outlet box to store slack cables.

B. Dress and terminate cables in accordance with ANSI/TIA-568-C.0, ANSI/TIA- C.1, BICSI TDMM, and manufacturer's instructions.

C. Terminate 4-pair cables on jack and patch panels using T568-B or T568-A wiring scheme.

D. Pair Untwist at Termination: Do not exceed 12 mm (1/2 inch).

E. Bend Radius of Horizontal Cables:
   1. Not less than 4 times OD of UTP cables.
   2. Not less than 4 times OD of FTP cables.

F. Maintain cable jacket to within 25 mm (1 inch) of termination point.

G. Neatly bundle cables and dress to their respective panels or blocks.

H. Feed each panel or block by individual bundle separated and dressed back to point of cable entrance into rack or frame.

3.5 FIELD QUALITY CONTROL

A. Cables and Termination Hardware: Test 100 percent for defects in installation and verify cabling system performance under installed conditions in accordance with ANSI/TIA-568-C.0.
   1. Verify all pairs of each installed cable before system acceptance.
   2. Defects in cabling system installation, including but not limited to cables, connectors, patch panels, and connector blocks shall be repaired or replaced to ensure 100 percent useable conductors in all cables installed.

B. Test all cables in accordance with this specification section, ANSI/TIA-568-C.0, ANSI/TIA-568-C.1, and ANSI/TIA-568-C.2 standards, and Berk-Tek and Leviton Network Solutions instructions
   1. If any of these are in conflict, bring discrepancies to the attention of the Architect for clarification and resolution.

C. Cables, Jacks, Connecting Blocks, and Patch Panels:

D. Testing Unshielded Twisted-Pair Cables:
   1. Test twisted-pair copper cable links for continuity, pair reversals, shorts, opens, and performance as specified.
      a. Additional testing is required to verify Category performance.
      b. Test horizontal cabling using approved certification tester for Category 6 performance compliance in accordance with ANSI/TIA-568-C.2.

   2. Follow ANSI/TIA-568-C.2.
   3. Basic Tests Required:
      a. Wire map.
      b. Length (feet).
      c. Insertion loss (dB), formerly attenuation.
      d. NEXT (Near end crosstalk) (dB).
      e. Return loss (dB).
      f. ELFEXT (dB).
      g. Propagation delay (ns).
      h. Delay skew (ns).
      i. PSNEXT (Power sum near-end crosstalk loss) (dB).
      j. PSELFEXT (Power sum equal level far-end crosstalk loss) (dB).
   4. Test Category 6A by auto test to 500 MHz.
   5. Test Category 6 by auto test to 250 MHz.
   6. Test Category 5e by auto test to 100 MHz.
   7. Provide test results in approved certification testers original software format on CD, with the following minimum information per cable:
      a. Circuit ID.
      b. Information from specified basic tests required.
      c. Test Result: “Pass” or “Fail”.
      d. Date and time of test.
      e. Project name.
      f. NVP.
      g. Software version.
   8. No asterisk will be accepted by Leviton or Berk-Tek. Rework these links, retest these results, and submit after a “Pass” is received.
   9. Submit software copy of test results, in original tester software format, to the Owner and to the Manufacturer.
   10. Submit fully functional version of tester software for use by the Owner in reviewing test results.

a. Report in writing to the Owner immediately, along with copy of test results, failed test results that cannot be remedied through re-termination (as in the case of reversed or split pairs).

3.6 LABELING

A. All labeling is to be in accordance with ANSI/TIA-606-A and manufacturer's instructions.

B. Label horizontal cables using machine-printed label at each end of cable at approximately 12 inches from termination point and again at approximately 48 inches from termination point.
   1. Handwritten Labels: Not acceptable.

C. Label patch panel ports and TO ports with cable identifier.

D. Labels: Denote TO ID and unique cable number for that TO, i.e. A-001-A for cable number 1, A-001-B for cable number 2, and so forth.
   1. Owner may provide specific labeling requirements. Coordinate with the Owner.

E. Note labeling information on as-built drawings.

3.7 PROTECTION

A. Protect installed communications horizontal cabling from damage during construction.

END OF SECTION