## D-3 – OUTLINE SPECIFICATION FOR TELEPHONE AND DATA SYSTEM

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**Product Guide Specification**

Specifier Notes: This product guide specification is written according to the Construction Specifications Institute (CSI), *MasterFormat™, SectionFormat,* and *PageFormat,* contained in the CSI *Manual of Practice, Proposed Draft 4 (September 2, 2003).*

The section must be carefully reviewed and edited by the Architect to meet the requirements of the project and local building code. Coordinate this section with other specification sections and the drawings.

Delete all "Specifier Notes" when editing this section.

**DIVISION 260000**

**NETWORK CABLING SYSTEM – CATEGORY 6**

Specifier Notes: This section covers the AMP NETCONNECT modular network cabling system. Consult AMP NETCONNECT for assistance in editing this section for the specific application.

### PART 1 GENERAL

(Reference Division 261000 Communications Structured Cabling and Enclosures

Specifier Notes: Edit the following list as required for the project.

### 1.1 SECTION INCLUDES

A. Backbone Cabling System
   1. Voice Backbone Cabling
   2. Data Backbone Cabling
   3. Backbone Termination Hardware
   4. Data Backbone Termination Hardware

B. Communications Equipment Room
   1. Telecommunications closet hardware.

C. Horizontal Cabling System
   1. Copper
   2. Fiber
   3. Coax
   4. Faceplates & Connectors

D. Work Area and Patch Cord Cable Assemblies
   1. Custom
   2. Media Converters
   3. Patch, Station, Cross-Connects

Specifier Notes: Edit the following list of related sections as required for the project. List other sections with work directly related to this section.

## 1.2 RELATED SECTIONS

A. Division 096900 - Access Flooring.

B. Section 127000 - Systems Furniture.

C. Section 216740 - Air Terminal Units.

D. Section 217103 - Diffusers, Registers, and Grilles.

E. Section 26500 - Common Materials and Methods for Communications.

F. Section 261000 – Cabling Enclosures.

G. Section 26113 – Cable Management and Ladder Rack.

H. Section 263000 – Voice Systems.

Specifier Notes: List standards referenced in this section, complete with designations and titles. This article does not require compliance with standards, but is merely a listing of those used.

## 1.3 REFERENCES

A. This Technical Specification and Associated Drawings

B. ANSI/TIA/EIA 568-B.2-1 Performance Specification for 4-Pair 100 Ohm Category 5e Cabling (latest revision)

C. ANSI/TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard – April, 2001

D. ANSI/TIA/EIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces - February, 1998

E. ANSI/TIA/EIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings – May, 2002

F. ANSI/J-STD--607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications - October, 2002

G. Building Industries Consulting Services, International (BICSI) Telecommunications Distribution Methods Manual (TDMM) – 10th edition, 2003

H. National Fire Protection Agency (NFPA) - 70, National Electrical Code (NEC) -2002

I. AMP NETCONNECT Design and Installation Contractor Agreement (current)

## 1.4 SYSTEM DESCRIPTION

A. Telecommunications horizontal cabling system shall ensure efficient voice and data signal transmission up to 200MHz performance in compliance to ANSI/TIA/EIA/568-B for Category 6 Systems. The system shall ensure efficient operation from patch panels in the telecommunications room to the workstation outlets. System shall be designed and approved for use below raised access floor systems and above drop ceiling spaces.

B. Cabling system is based on home run cabling requirements. Distribution is achieved above or below ceiling or access floor through use of individual 4-pair Category 6 rated cables and components. The cable will distribute telecommunication signals from patch panels located in the telecommunications room.

## 1.5 SUBMITTALS

A. Cabling System Labeling: The contractor shall develop and submit for approval a labeling system for the cable installation based on TIA/EIA-606-A standards. Customer will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cabling system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

   All label printing will be machine generated using labeling software and laser printers obtained from cabling system manufacturer. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet labels will be the manufacturer's labels made of white card stock or self-adhesive polyester where applicable.

B. As-Built Drawings: The installation contractor will be provided with 2 sets of D or E-size drawings at the start of the project. One set will be designated for as the central location to document all as-built information as it occurs throughout the project. The central set will be maintained by the Contractor's Foreman on a daily basis, and will be available to the Technical representative upon request during the course of the project. Anticipated variations from the build-to drawings may be for such things as cable routing and actual outlet placement. No variations will be allowed to the planned termination positions of horizontal and backbone cables, and grounding conductors unless approved in writing by the Owner.

   The Contractor shall provide the central drawing set to the owner at the conclusion of the project. The marked up drawing set will accurately depict the as-built status of the system including termination locations, cable routing, and all administration labeling for the cabling system. In addition, a narrative will be provided that describes any areas of difficulty encountered during the installation that could potentially cause problems to the telecommunications system.

C. Test Documentation: Test documentation shall be provided in both a three ring binder(s) and electronic format on appropriate media, within three weeks after the completion of the project. The binder(s) shall be clearly marked on the outside front cover and spine with the words "Test Results", the project name, and the date of completion (month and year). The binder shall be divided by major heading tabs, Horizontal and Backbone. Each major heading shall be further sectioned by test type. Within the horizontal and backbone sections, scanner test results (Category 3, 5E, or 6), fiber optic power meter attenuation test results, OTDR traces, and green light test results shall be segregated by tab. Test data within each section shall be presented in the sequence listed in the administration records. The test equipment by name, manufacturer, model number, serial number and last calibration date will also be provided at the end of the document. Unless a more frequent calibration cycle is specified by the manufacturer, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test.

   Scanner tests shall be printed on 8-1/2" x 11" paper, and in native format of the tester used. Hand written test results (attenuation results and green light results) shall be documented on the attached test form (Appendix C). Electronic native format test results shall include the test equipment manufactures software for reading and interpreting test results. OTDR test results shall be in electronic format as well as printed or attached and copied on 8-1/2" x 11" paper for inclusion in the test documentation binder.

   When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be collocated in the binder.

D. Warranty: The contractor shall provide a system warranty covering the installed cabling system against defects in workmanship, components, and performance, and follow-on support after project completion. Warranty submittal shall comply with manufactures requirements for warranty to eliminate possible problems and delays.

## 1.6 QUALITY ASSURANCE

A. Each cable shall be tested for continuity and wire-map on all pairs and/or conductors. Voice back-bone twisted-pair voice cables shall be tested for continuity, pair reversals, shorts, and opens using a "green light" type test set. Twisted-pair data cables shall be tested for the all of the above requirements, plus tests that indicate installed cable performance. These data cables shall be tested using a Level III cable scanner.

   a. Continuity/Wire Map

      Each pair of each installed cable shall be tested using a "green light" test set that shows opens, shorts, polarity and pair-reversals and splits. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance. As an alternate, each wire shall be tested as part of an autotest procedure to comply with ANSI/TIA/EIA?568-B standard with the Level III tester/scanner.

   b. Length

Each installed cable shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel work area outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the longest pair length shall be recorded as the length for the cable.

B. Performance Verification

1. Copper

1. Category 6 data cabling systems shall be performance verified using an automated test set. This test set shall be a Level III qualified tester approved by the cabling manufacturer. The test shall be permanent link which tests for the following performance parameters:

1. Wire Map
2. Length
3. Insertion Loss
4. Pair-to-Pair Near End Crosstalk (NEXT)
5. Power Sum Near End Crosstalk (PSNEXT
6. Equal Level Far End Crosstalk (ELFEXT)
7. Power Sum Equal Level Far End Crosstalk (PSELFEXT)
8. Return Loss (RL)
9. Propagation Delay
10. Delay Skew

2. Category 6 data cable shall be performance verified using an automated test set. Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the ANSI/TIA/EIA-568-B.2.1 Standard, and the result shown as pass/fail. Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed, the expected test result and the actual test result achieved.

2. Fiber

1. Attention:

    a. The backbone optical fiber cabling link segment shall be tested in at least one direction at both operating wavelengths to account for attenuation deltas associated with wavelength. Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper. Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper. Because backbone length and the potential number of splices vary depending upon site conditions, the link attenuation equation shall be used to determine acceptance values based upon this Standard's component requirement at each of the applicable wavelengths.

    Link attenuation is calculated as:
    Link Attenuation = Cable Attenuation + Connector Insertion loss + Splice Insertion loss where:
    Cable Attenuation (dB) = Attenuation Coefficient (dB/km) ´ Length (km)
    Attenuation Coefficients are:
    3.5 dB/km @ 850 nm for multimode
    1.5 dB/km @ 1300 nm for multimode
    0.5 dB/km @ 1310 nm for singlemode outside plant cable
    0.5 dB/km @ 1550 nm for singlemode outside plant cable
    1.0 dB/km @ 1310 nm for singlemode inside plant cable
    1.0 dB/km @ 1550 nm for singlemode inside plant cable

    Connector Insertion loss (dB) = number of connector pairs ´ connector loss (dB)
    Example: = 2 X 0.75 dB = 1.5 dB

    Splice Insertion loss (dB) = number of splices (S) ´ splice loss (dB)
    Example: = 2 X 0.3 dB = 0.6dB

2. Distance and Footprint

    a. OTDR testing will be for length verification only and be conducted in accordance with ANSI/TIA/EIA-526-7

    b. Documentation to be recorded for OTDR test results shall include:
        1) Date of the test
        2) Description of equipment used; manufacturer model number and serial number
        3) Date of latest equipment calibration
        4) Test personnel
        5) Trace of the fiber or cabling link
        6) Fiber identifier or circuit identifier with fiber length and fiber attenuation of events
        7) Test wavelength(s)

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened, protective containers

and packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store materials in secure, clean, dry area indoors in accordance with manufacturer's instructions.

C. Handling: Protect materials and finish from damage and moisture during handling and installation.

## 1.8 WARRANTY

The contractor shall provide a system warranty covering the installed cabling system against defects in workmanship, components, and performance, and follow-on support after project completion.

A. Installation Warranty

The contractor shall warrant the cabling system against defects in workmanship for a period of one year from the date of system acceptance. The warranty shall cover all labor and materials necessary to correct a failed portion of the system and to demonstrate performance within the original installation specifications after repairs are accomplished. This warranty shall be provided at no additional cost to the Owner.

B. Cabling System Warranty

The contractor shall facilitate a 25-year system performance warranty between the manufacturer and the Owner. A component warranty shall be provided which warrants functionality of all components used in the system for 25 years from the date of acceptance. The performance warranty shall warrant the installed horizontal copper, and both the horizontal and the backbone optical fiber portions of the cabling system. Copper links shall be warranted against the performance minimum expected results defined in ANSI/TIA/EIA-568-B.2-1. Fiber optic links shall be warranted against the link and segment performance minimum expected results defined in ANSI/TIA/EIA-568-B.1.

C. Post Installation Maintenance

The contractor shall furnish an hourly rate with the proposal submittal which shall be valid for a period of one year from the date of acceptance. This rate will be used when cabling support is required to affect moves, adds, and changes to the system (MACs). MACs shall not void the Contractor’s nor manufacturer’s warranty.

# PART 2 PRODUCTS

## 2.1 MANUFACTURER

A. Tyco Electronics, Inc., AMP NETCONNECT Division,
2900 Fulling Mill Road,
Middletown, Pennsylvania, 17057.
Toll Free (800) 553-0938.
Web Site: www.ampNETCONNECT.com.

## 2.2 BACKBONE CABLING SYSTEM

A. Voice Backbone Cabling

Voice backbone cabling shall be 24 AWG, 100-pair UTP, UL/NEC CMR rated, with a gray PVC jacket. Cable shall be third party verified to comply with TIA Category 3 requirements. Cable shall be supplied on 1000 ft. reels. A coupled bonding conductor will be installed within the riser bundle and bonded and grounded at each end.

Voice backbone cables shall be terminated in rack mount Category 3 patch panels. Patch panels wired per the wiring specification of the PBX system. Patch panel modular jacks shall be configured as 6-port, replaceable modules. The front of each module shall be capable of accepting 9mm to 12mm labels. Each port shall be capable of accepting an icon to indicate its function. Patch panels shall terminate the building cabling on 110-style insulation displacement connectors. Patch panels must be UL Listed under file number E81956.

AMP NETCONNECT Voice Backbone Termination Hardware:

| | |
|---|---|
| Category 3 110Connect patch panel, 24-port, RJ14C (2-pair) | Part No. 557403-1 |
| Category 3 110Connect patch panel, 48-port, RJ14C (2-pair) | Part No. 557411-1 |
| Category 3 110Connect patch panel, 96-port, RJ14C (2-pair) | Part No. 557415-1 |
| Category 3 110Connect patch panel, 24-port, RJ25C (3-pair) | Part No. 558257-1 |
| Category 3 110Connect patch panel, 48-port, RJ25C (3-pair) | Part No. 558258-1 |
| Category 3 110Connect patch panel, 96-port, RJ25C (3-pair) | Part No. 558259-1 |

B. Data Backbone Cabling

Twenty-four strand fiber optic cable shall be utilized to provide backbone connectivity between the Data MC and each TR. The optical fiber cable shall consist of two subunits bound together by a PVC outer jacket. Each subunit shall contain twelve tight-buffered 50-micron fibers surrounded by aramid strength members and a yellow PVC jacket. The cable shall have a UL rating of [OFNR (Riser) or OFNP (Plenum)]. The outside diameter of each unit shall be 6.2 mm making the overall cable dimensions 7.2 mm x 13.4 mm. The cable jacket shall be orange for multimode. The cable shall provide a maximum attenuation of 3.5 dB/km @ 850 nm and 1.5 dB/km @ 1300 nm. The bandwidth of the cable shall be 500 MHz/km @ 850 nm and 500 MHz/km @ 1300 nm. The optical fiber cable shall be AMP NETCONNECT part number:

| | OFNR | OFNP |
|---|---|---|
| 50/125 | 2-1664056-1 | 2-1664057-1 |
| 50/125 LOF | 8-1664056-1 | 8-1664057-1 |

Each fiber optic cable shall be terminated in the Data MC and TR's in 24 port rack mount enclosures providing protection to the terminated fibers. The optical fiber patch panel(s) shall each be capable of containing 24 MT-RJ connectors in a 1U enclosure. The MT-RJ jacks shall be 50/125 μm or 50/125 LOF (XG), multimode connectors, capable of terminating either 250

µm coated or 900 µm buffered fibers. The connectors shall be field-installable, requiring no epoxy, no polishing and no crimping. The connectors shall meet the intermateability requirements of TIA/EIA-604-12. Connector performance requirements are listed in Table 1:

MT-RJ Jack Typical Performance Characteristics

| Test Description | FOTP | Requirement (dB) |
|---|---|---|
| Visual and Mechanical Inspection | 13 | TIA/EIA-604-2 or -3 Intermateability |
| Attenuation | 34 | ≤ 0.75 |
| Return Loss | 107 | ≥ 20 |
| Low Temperature (0°C for 4 days) | 188 | ≤ 0.3 change |
| Temperature Life (55°C for 14 days) | 7 | ≤ 0.3 change |
| Humidity (90 to 95% @ 40°C for 4 days) | 5 | ≤ 0.3 change |
| Impact (8 drops from 1.8 meters) | 2 | ≤ 0.75 IL, ≥ 20 RL |
| Durability (500 cycles) | 21 | ≤ 0.75 IL, ≥ 20 RL |
| Cable Retention (0°C and 90°C) | 6 | ≤ 0.75 IL, ≥ 20 RL |
| Flex (100 cycles) | 1 | ≤ 0.75 IL, ≥ 20 RL |
| Twist (10 cycles) | 36 | ≤ 0.75 IL, ≥ 20 RL |

Table 1

AMP NETCONNECT Data Backbone Termination Hardware:

| | |
|---|---|
| MT-RJ Patch Panel Jack, 50-micron | Part No. 1588880-1 |
| MT-RJ Patch Panel Jack, XG | Part No. 1558880-3 |
| 24 Port Slim-Line MT-RJ Enclosure, Black | Part No. 1206704-4 |

## 2.3 TELECOMMUNICATIONS ROOM

A. The telecommunication room shall house racks, voice termination fields and required cable routing hardware. Racks shall be placed in a manner that will allow a minimum of 3 feet of clearance from the front and rear mounting surfaces and on one side on racks. If one mounting rail of the rack is placed against a wall, the mounting rail shall be no closer than 6" to the wall to allow room for vertical management. Where there is more than one rack, the racks shall be ganged with vertical management hardware to provide interbay management. Ganged rack frames will be placed in a manner that will allow a minimum of 3 feet of clearance from the front and rear mounting surfaces and on one side of the ganged assembly

In all telecommunications rooms the racks shall be on the opposite side of the room from the voice termination fields. Voice termination fields shall be mounted on 4' x 8' x .75" virgin fire retardant plywood, unless otherwise noted in drawings, and shall be on the opposite side of the room from the room entrance. Backbone termination fields shall be mounted to the left of the horizontal voice fields. There shall be a minimum of 3 conduits a minimum of 4" in diameter in telecommunications

rooms as required. Conduits for data backbone shall be located adjacent to the racks and conduits for voice shall be located adjacent to the voice termination fields. The contractor shall provide Innerduct for all backbone fiber runs. Contractor shall provide required ladder and wall mount management rings to properly support and dress cables from conduits to racks and frames.

## 2.4 HORIZONTAL CABLING SYSTEM

A. Telecommunication Room Hardware:
All hardware specified is designed to be mounted on a standard 19" telecommunications rack.

1. Horizontal Cabling Racks

   Horizontal cabling racks shall be standard EIA 19" wide x 7' tall telecommunications racks. They are to be self-supporting and constructed from 6061-T6 aluminum with a black painted finish. Racks shall be Chatsworth part number 55053-703.

2. Vertical Cable Managers

   Vertical cable managers shall be designed to install on a standard EIA 19" x 7' telecommunications rack and shall be 4" x 5" front and back and 78" high. They are to be double-sided with finger ducts and removable covers. The base of the vertical cable managers are to be constructed of black aluminum and the finger ducts and cover constructed of black plastic. Vertical cable managers shall be AMP NETCONNECT part number 1375257-1 for side mount and AMP NETCONNECT part number 1375259-1 for center mount.

3. Patch Panels

   Patch panels shall have a capacity of 24-48 ports and be 1U – 2U of rack space high. Ports shall be blank to accept snap-in unshielded RJ45 jacks in four snap-in interface housings, six jacks per housing. Patch panel base shall be constructed of 16 gauge cold rolled steel and powder coated with a polyurethane finish. Interface housings shall be constructed of UL 94V-0 rated polyphenylene oxide and provide space for port identification labeling. Patch panel shall be AMP Part Number

   SL Series Category 6 Patch Panel 24 Port: 1479512-1

   SL Series Category 6 Patch Panel 48 Port: 1479516-1

   a. Category 6 SL Series modular (data) jacks used in the Multimedia Jack Patch Panels shall be unkeyed 4-pair and shall fit in a .790" X .582" opening. Modular jacks shall be terminated using a non-impact termination tool to eliminate connector damage and promote consistent terminations. The jacks shall be color-coded for both T568A and T568B wiring. Each jack shall be wired to T568B. Modular jacks shall be UL Listed under file number E81956.

4. Horizontal Cable Managers

   Horizontal cable managers shall be capable of front and rear cable management, and have capacity for 48 cables in both front and rear They shall be designed to be installed on a standard EIA 19" x 7' telecommunications rack and shall be 1.5"x3.0" front and 1"x4" back. They are to be double-sided with finger ducts and removable covers. The

base of the vertical cable managers are to be constructed of black aluminum and the finger ducts and cover constructed of black plastic. Horizontal cable manager shall be AMP NETCONNECT Part Number 1375159-1.

Specifier Notes: Specify Plenum Cable for environmental air handling applications in accordance with National Electrical Code Article 300-22(c). Specify Non-Plenum Cable for applications that are not used as an environmental air handling space.

B. Horizontal Cable:

1. Category6Cabling: Plenum

   Horizontal cabling shall be 23 AWG, 4-pair UTP, UL/NEC/NFPA CMP rated, with a plenum-rated PVC jacket. Individual conductors shall be FEP insulated. Cable jacketing shall be lead-free. Cable shall meet the performance requirements listed in Table 3 in addition to all other standard Category 5E performance requirements. Cable shall be supplied on wooden reels or in reel-in-box. Cable shall be safety listed to NFPA 262/UL910. Cable shall be UL Listed for safety, and UL verified for performance as well as be a part of the UL verification program.

   AMP NETCONNECT part number 216567-X (where X denotes color and reeling)

2. Category6Cabling:Non-plenum

   Horizontal cabling shall be 24 AWG, 4-pair UTP, UL/NEC/NFPA CMR rated, with a PVC jacket. Cable jacketing shall be lead-free. Cable shall be 3rd party verified to ANSI/TIA/EIA-568-B.2.1 and meet the standard Category 5e performance requirements. Cable shall be supplied on wooden reels or in reel-in-box. Cable shall be safety listed to ANSI/UL 1666. Cable shall be UL Listed for safety, and UL verified for performance as well as be a part of the UL verification program.

   AMP NETCONNECT part number 219560-X (where X denotes color and reeling)

C. Work Area

1. Work are outlets shall be configured with a minimum of 3 Category 5E cables with appropriate Category 5E connectors as listed in section 2.4.D.

D. Horizontal Connectors

1. Category 6 modular (data) jacks shall be unkeyed 4-pair and shall meet the Category 5e performance requirements. Modular jacks shall fit in a .790" X .582" opening. Modular jacks shall be terminated using a non-impact termination tool to eliminate connector damage and promote consistent terminations. The jacks shall be color-coded for both T568A and T568B wiring. Each jack shall be wired to T568B. Modular jacks shall be

UL Listed under file number E81956.

## 2.5 WORK AREA AND PATCH CORD CABLE ASSEMBLIES

A. Patch cords used at the telecommunication rack and at the workstation shall be Category 6, 4-pair assemblies. Patch cords shall be factory-assembled by the manufacturer of the cabling system. Each workstation shall require one 10-foot Category 6 patch cord. The phone cords shall be provided by the owner.

In the telecommunications room, 8-, 10-, and 12-foot patch cords shall be provided to cross-connect between the data patch panels and network equipment. One patch cord per user outlet is provided. The total quantity of telecommunications room end patch cords required are equally divided between three assembly lengths. Optical patch cords shall be provided to patch the network equipment to the enclosures and shall be 1 meter in length. [MT-RJ to MT-RJ, MT-RJ to SC, or MT-RJ to ST] fiber optic patch cords shall be provided depending upon LAN electronic interface. Four optical patch cords are provided for each closet.

AMP NETCONNECT Patch Cords:

| | |
|---|---|
| Cat 6 Patch Cable, 8 ft, Black | Part No. 219884-8 |
| Cat 6 Patch Cable, 10 ft, Black | Part No. 1-219884-0 |
| Cat 6 Patch Cable, 12 ft, Black | Part No. 1-219884-2 |
| Optical Fiber, Zip Cord, MT-RJ to MT-RJ, 1M | Part No. 1278128-1 |
| Optical Fiber, Zip Cord, MT-RJ to SC, 1M | Part No. 1278126-1 |
| Optical Fiber, Zip Cord, MT-RJ to ST, 1M | Part No. 1278199-1 |

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Examine areas to receive network cabling system. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

## 3.2 INSTALLATION

A. Backbone Cabling

All backbone cables shall be installed in the following manner:

1. Backbone cables shall be installed separately from horizontal distribution cables.
2. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits or in separate innerducts within conduits.
3. Where cables are installed in an air return plenum, the cable shall be installed in conduit, or plenum cable shall be installed in a plenum innerduct to provide protection to the cable.
4. Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.

B. Telecommunication Room Hardware

1. Racks shall be installed in the following manner:
   a) Racks shall be securely attached to the concrete floor using 3/8" hardware.
   b) All racks shall be grounded to the telecommunications ground bus bar in accordance with Section 9.0 of this document.
   c) Rack mount screws (#12-24) not used for installing fiber panels and other hardware shall be bagged and left with the rack upon completion of the installation.
   d) All installed racks shall also comply with regional Seismic requirements.
2. Cable Tray and wireracks shall be installed in the following manner and in compliance to manufacturers recommendation:
   a) Trays shall be securely attached to the walls and ceiling using appropriate hangers for the tray and not attached to any other ceiling support fixtures.
   b) All tray shall be grounded and bonded to the telecommunications ground bus bar in accordance with Section 9.0 of this document.
   c) Screws and other mounting hardware not used for installing tray and mounting hardware shall be packaged and left in telecommunications room for the end-user.

C. Horizontal Distribution Cable Installation

1. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.
2. Cable raceways shall not be filled greater than the NEC maximum fill for the particular raceway type.
3. Cables shall be installed in continuous lengths from origin to destination (no splices) unless specifically addressed in this document.

4. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
5. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
6. Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
7. Unshielded twisted pair cable shall be installed so that there are no bends less than four times the cables outside diameter (4 X cable O.D.) at any point in the run.
8. Pulling tension on 4-pair UTP cables shall not exceed 25-pounds for a single cable or cable bundle.

D. Coordinate installation of network cabling system with other work in progress.

## TELECOMMUNICATIONS ROOMS AND CABLING DESIGN

### General

The Telecommunications Room (TR) differs from the Entrance Facility and the Equipment Room in that the Telecommunications Room generally serves a specific floor or part of a floor, rather than an entire building. However, the entrance facility or equipment room may serve as the TR.

The Telecommunications Room is generally the connection point between the building backbone cable

and the horizontal cable. There are some instances such as centralized fiber cable plan where the Telecommunications Room may not serve as the connection point between the horizontal and backbone cables.

The Telecommunications room also serves as the central connection point of the pathways that serve the floor from that TR.

In designing the Telecommunications Room the designer should take into consideration:

· Existing standards such as TIA/EIA 568-B, TIA/EIA 569, TIA/EIA 606 and TIA/EIA 607.
· Existing codes such as the NEC and the NFPA.
· Client needs for today and future.

The TR also has to contain the facilities to maintain the proper environment for the electronics located in the room, i.e.: HVAC (heating, ventilating, air conditioning). Since electronic components such as hubs, switches, monitors etc give off heat, the room needs to have the proper environmental controls to avoid early failure of the electronic and other components.

**Horizontal Connections**

The horizontal cabling that extends from the Work Area Outlet is terminated in the TR. The horizontal cabling can be either fiber or copper. If it is copper that is being terminated it may be data grade cables, voice grade cables or coax.

**Data Grade Cable**

Data Grade cable, under current standards, is a Category 5e cable or higher. Category 6 is the newest addition (June, 2002) to the TIA/EIA 568-B standard. In Europe, a shielded cable is generally used and current standards support a Category 7 cable in Europe.

In the case of data cables, the horizontal cables are generally routed into the Telecommunications Room through the pathways and terminated on a patch panel or an IDC (Insulation Displacement Connector) block such as a 110 or BIX connector. Each Telecommunications Outlet in the Work Area Outlet should have its corresponding connection located somewhere in the Telecommunications Room.

Each connection on the patch panel or IDC block should be labeled as per ANSI/TIA/EIA 606.

**Voice Grade Cable**

Voice cabling is still being installed despite its increasing costs. Voice cabling is used, obviously for connecting telephone systems, or connecting directly to the Public Switched Telephone Network (PSTN) via a fax machine or other device. Just as the data cable is routed back to a hub or switch, voice cable is routed back to the telephone system from each telecommunications outlet. One of the main differences between voice and data cabling is that voice cabling can be run over longer distances because the impact of noise and attenuation on voice cable has less of an impact on the signal transmitted and received. For example, cross talk on a voice cable will cause you to hear two

conversations at once, but hearing them will not normally cause you to terminate the conversation. However, crosstalk on a data cable may cause the signal to be sufficiently impacted so that data cannot be transmitted properly.

Another major difference between voice and data cabling is that voice cable does not necessarily have to be 4 pair cable. In fact, today's phone systems can operate on 1, 2 or 3 pair cable depending on the phone system. However, by installing 1, 2 or 3 pair cable, the user is forced to continue to use the voice cable runs for voice only. With voice over IP becoming a reality, a Category 3 or inside wire may not allow VoIP to work, thereby limiting the customer's cabling flexibility and perhaps forcing him into a costly rewire.

Voice cable is not normally terminated on a patch panel because of the cost of the patch panel and patch cords, but rather on a 110 or BIX termination. Normally, these termination fields are located on the wall, but both systems come with a rack mounted version.

**Coax**

Coax cable is not a recognized cable for data communications, however, coax may be used for Closed Circuit Television (CCTV), Community Access Television (CATV) or security applications.

**Fiber**

While fiber in the horizontal, as in a fiber to the desk application, is still a costly investment, the price of fiber cable and the corresponding electronics continues to drop. At some point, the cost of fiber to the desk will be lower than a copper solution.

If fiber is the media of choice, the installer/designer will have to determine which type of connector will be used both at the work area and in the Telecommunications Room. Current standards recommend the 568SC connector. ST connectors can be used where ST connectors are already in use.

Small form factor connectors such as the MT-RJ do not seem to be able to support single mode fiber so they should not be used for backbone applications where single mode is the media of choice.

Regardless of what type of termination is used, ANSI/TIA/EIA 606 Administration procedures should be followed.

**Other Services**

Although the main purpose of the TR is to house the Horizontal Cross Connect, it may also contain:

· The Main Cross Connect
· The Intermediate Cross Connect
· The demarcation point for one or more service providers
· Passive and/or active network components for the above

**DESIGN REQUIREMENTS**

**Administration**

All telecommunication systems should adhere to the ANSI/TIA/EIA-606 Administration Standard. With respect to the Telecommunications Rooms, each room should be identified. The identifier should show the building (in a campus environment), the floor and in the case of more than one TR per floor, each TR should be identified. For example, a TR located in Building D, third floor, and the 3rd of 3 closets could be labeled TR-D-3-3. In this case TR refers to Telecommunications Room.

Proper documentation must also be maintained by the system administration. In the case of a Telecommunications Room, many of the pathways, support devices, cables etc will not change. However, there may be network devices added, as well as cable runs from new Work Areas. All of these, and any other changes to the system must be documented.

In order to document the changes, there must be some form of work order showing the changes. Once the work has been completed, the changes are then input into the database to keep all information current. These changes may be completed by internal staff, or by an outside contractor. In any event there should be some methodology in place to document and input the changes.

See our ANSI/TIA/EIA 606 Standards Module for more information on this topic.

**Bonding and Grounding**

Proper bonding and grounding techniques should be employed as per ANSI/TIA/EIA 607.

Bonding is the connection(s) of a metallic conductor to form a single path for electrical energy. Bonding is used in instances where armor or shielding is interrupted as in a splice point. The bonding strap is attached to each end of the armor or shield, thereby completing the electrical pathway.

There are two types of grounding, earth grounding and equipment grounding. Earth grounding accomplishes 3 things. It helps protect against the affects of lightning, assists in the reduction of static discharges and brings a zero voltage reference to system components.

The other grounding category is equipment grounding. This type of grounding also has 3 purposes. It maintains a zero voltage on all metal enclosures which protects from injury or death from electrocution. It also provides a path of high current carrying capacity and low impedance to carry ground faults, and to establish a zero voltage reference point for electronic component operation.

Because the design of each system is different, it is difficult, if not impossible to give an absolute design scope that will encompass all systems. What can be said about the design here is what should be in the Telecommunications Rooms.

Each TR should contain a Telecommunications Grounding Busbar (TGB) located so that it minimizes the length and number of bends of the the bonding conductor. More than one TGB may be used provided all TGBs are bonded via a bonding conductor.

The TGB is the common point of connection for telecommunications systems and equipment in the Telecommunications Room. The TGB is a predrilled copper busbar with minimum dimensions of 6mm thick by 50mm wide, with a variable length determined by the system requirements.

For further information on grounding and bonding, consult ANSI/TIA/EIA 607, or see our ANSI/TIA/EIA 607 Standards Module for more information.

Service Providers (SPs) should also be consulted with for any special grounding and bonding issues they need to have addressed.

**Ceilings**

The minimum ceiling height above the finished floor is 2.6m (8.5 ft). No false ceilings (T-Bar) are permitted in a Telecommunications Room.

**Clearances**

It is important to note that clearance measurements given are from the outermost edges of the components located on racks or attached to walls and not from the centre of the racks, cabinets or backboard.

**Clearance Chart**

| **The Clearance From:** | **Should be:** |
|---|---|
| Equipment and cross connect fields | 1 m (3ft) |
| Wall mounted equipment to wall | 150 mm (6 in) |
| Centre line of rack to front and rear wall | 1.2 m (4ft) |
| Aisles | 810 mm (32 in) |
| Corners | 300 mm (12in) |

These clearances allow easy access for moves, adds, and changes.

**Conduits, Tray, Slots, Sleeves and Ducts (Pathways)**

Conduit, tray, slots, sleeves and ducts are used to distribute the backbone cable to each Telecommunications Room, and in some instances used to distribute the horizontal cable to the various zones served by each TR.

Conduits and tray that enter the TR should do so at a height above 2.4 m (8 ft), and should enter at a minimum of 1-2 inches without a bend.

Where TRs are connected they should be connected with a Trade Size 3 conduit or equivalent pathway.

Where conduits and tray enter the TR and form part of the horizontal distribution, their size should be at a minimum the size used for the horizontal distribution and should enter the room as per the above measurements. This ensures that the horizontal pathway is not larger than the pathway entering the TR, and thus possibly causing an overfill situation.

The preferred location of the conduit, tray, sleeves and ducts are on the left side of the room, so that cabling flows from left to right around the room. This design is not mandatory and may have to be adjusted based on the size and layout of the room.

**Cross Connect Fields**

Where cross connect fields (IDC Style) are used, the components should be mounted on the appropriate backboard and designed and routed as per the manufacturers specifications. The two major IDC types

are 110 and BIX. Since 110 is used by the majority of component manufacturers, the installation requirements will generally be the same, however, there may be certain requirements by each manufacturer required to meet specific warranties. The designer and installer should be aware of these warranty issues.

Cross connection may be accomplished by using patch panels, but this method is much more costly than a 110 or BIX block.

The cross connects should be identified as per ANSI/TIA/EIA 606. See our ANSI/TIA/EIA 606 module on Color Codes for more information.

**Dimensions**

ANSI/TIA/EIA recommends that there be at least one TR per floor. If the useable square footage exceeds 10,000ft$^2$ or the length of the horizontal run exceeds 90 mtrs, then additional TRs are required.

The size of the Telecommunications Room depends on the size of the area the room is serving. Size calculations are based on the average work area size being 10m$^2$ (100$^2$ft) and having one telecommunications outlet per work area. If there are more telecommunications outlets per work area, then the size of the telecommunications room will have to be adjusted accordingly. Keep in mind that the installer can rarely alter the size of the Telecommunications Room, this is the job of the designer.

In smaller buildings a shallow or small closet may be used. Shallow closets can be used where the building is under 500m$^2$ (5000 ft$^2$), and, if the building is less than 100m$^2$ (1000ft$^2$) then a wall cabinet or self contained cabinet may be used.

**Dimension Chart for Standard Telecommunications Rooms**

| **Area Served** | **TR Minimum Dimensions** |
|---|---|
| 500m2 (5000ft2) or less | 3.0m X 2.4m (10ft X 8ft) |
| >500m2 <800m2 (5000ft2 - 8000ft2) | 3.0m X 2.7m (10ft X 9ft) |
| >800m2 <1000m2 (8000ft2-10000ft2) | 3.0m X 3.4m (10ft X 11ft) |
| **Small Building Telecommunication Room Dimension Chart** | |
| **Closet Type** | **Minimum Dimensions** |
| Walk-in Closet | 1.2m X 1.8m (4ft X 6ft) |
| Shallow Closet | .6m X 2.6m wide (2ft X 8.5ft) |

Note: Active equipment installation in closets is not recommended due to clearance issues.

**Fire Protection**

Telecommunications Rooms should have all applicable codes followed with respect to fire protection, including the use of fire stop materials, sprinklers and chemical fire protection. If sprinklers are used, cages should be installed to prevent accidental operation. Drainage troughs should be provided where wet sprinklers are used.

**Flood Protection**

TRs should be located away from wet areas such as washrooms, boiler rooms etc where water penetration could occur.

**Floor Loading**

Floor loading should be designed for 2.4 kPa (50blf/ft$^2$). Equipment installed in the TR should not exceed this limit.

**Lighting**

When measured at 1 meter above the finished floor, the lighting will be equivalent of 500 lux (50 foot-candles). Dimmer switches should not be used, and lighting fixtures should be located a minimum of 2.6 mtrs (8.5 ft) above the finished floor.

Lighting should not come from the electrical panel in the TR. One light should be on normal power and one light should be on emergency power if available. Light switches should be located for easy access upon entry to the TR.

**Location**

In order to minimize distances, the TR should be located as close to the centre of the floor being served as possible, and ideally the TR for each floor should be located above each other. If this is not possible, then the designer should ensure that no horizontal runs exceed 90 meters, including slack. If a run does exceed 90 meters, then other provisions will have to be made, such as a secondary room or smaller Telecommunications Closet.

If a TR serves multiple tenants, the TR should be located in a public hallway or other access way so that the tenants served by the TR have access to it.

**Power**

Each TR should have 2 dedicated, non switched 3-wire, 120 volt AC duplex outlets on separate branch circuits for equipment power. A separate 120 volt convenience outlet may also be supplied for power tool use, and should be marked as such. The outlets should be located a minimum of 375 mm (6 in) above the finished floor and at 1.8 mtr (6ft) intervals around the room.

**Security**

All TRs should be kept locked, and only building personnel who are on site throughout their entire shift should have keys.

In the case of a multi tenant environment, the building owner or agent should control TR access. An alternative would be to install an electronic security system that can track when TR facilities are entered, and by whom.

**Wall Linings**

At least one wall should be covered with AC grade, ¾ inch 4 x 8 sheet of plywood, securely fastened to the wall framing. The plywood should be void free and be covered with a flame retardant paint, or alternatively, it may be covered with sheet rock that meets local building codes.

**Summary**

There are two parts of the Telecommunications System that people see, the Work Area Outlet and the Telecommunications Room. It may be an unfair comparison, but lay person will equate the performance of the system with the aesthetics of the Telecommunications Room. Doesn't a clean car run better than a dirty one?

A well designed, laid out and maintained TR will help ensure that the system operates above its intended performance parameters, and then when and if maintenance is required, it can be completed in an efficient manner.