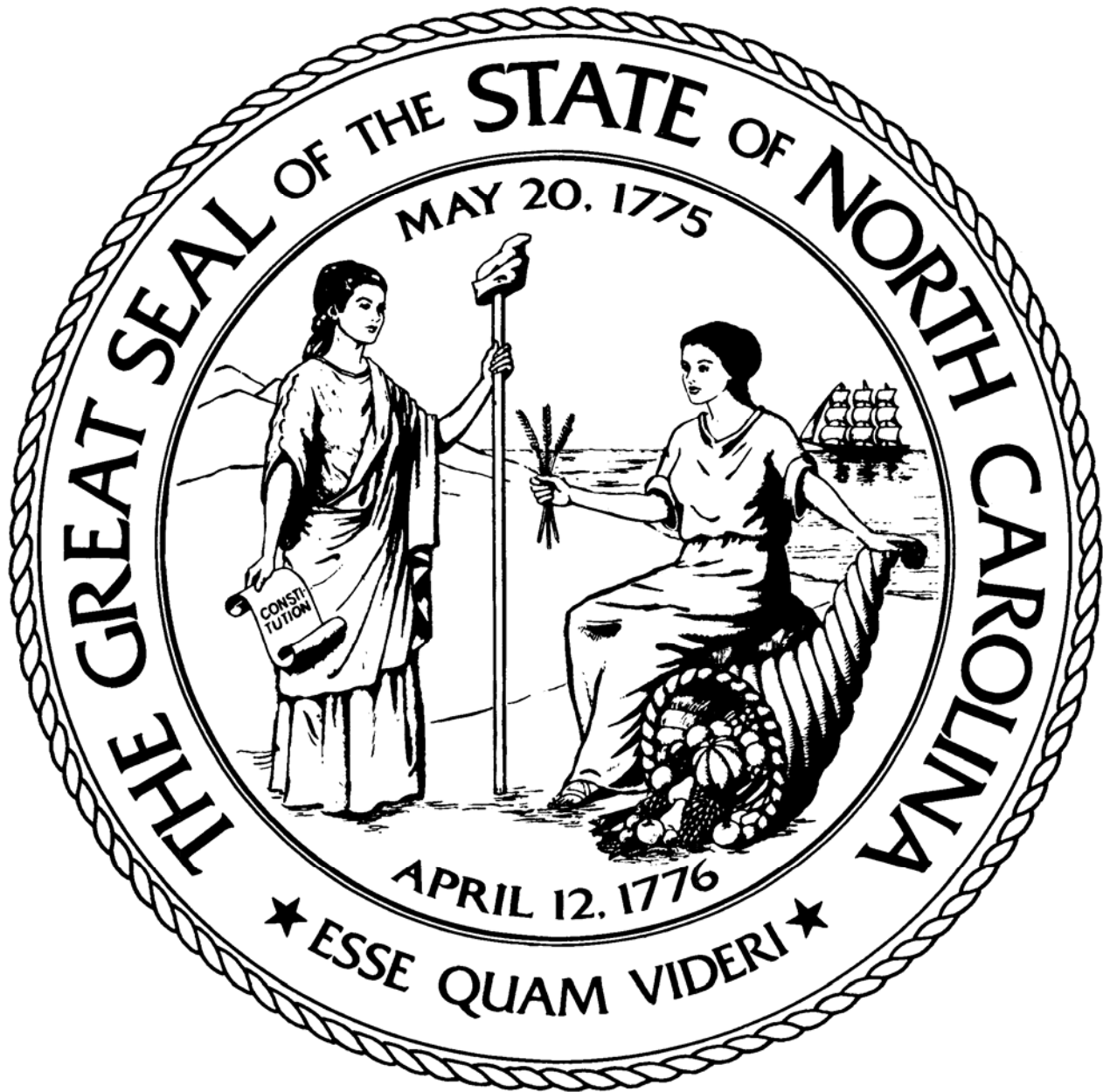


STS-1000
TELECOMMUNICATIONS
WIRING GUIDELINES



STATE TELECOMMUNICATIONS SERVICES
919-981-5555

TABLE OF CONTENTS

- 1.0 INTRODUCTION 5**
- 1.1 Subject:5
- 1.2 Intent:5
- 1.3 Authority:5
- 1.4 Scope:5
- 1.5 Hazardous Material Handling:.....6
- 1.6 Purpose:6
- 2.0 APPROACH 7**
- 3.0 WIRING SYSTEM ELEMENTS 7**
- 3.1 Horizontal cabling / wiring:7
- 3.2 Telecommunications rooms:7
- 3.3 Backbone wiring:8
- 3.4 Entrance facility:8
- 3.5 Campus distribution:.....8
- 4.0 HORIZONTAL WIRING 8**
- 4.1 Structure:8
- 4.2 Major items:9
 - 4.2.1 Conduit Cable Capacity:9
- 4.3 Outlets and Jacks:.....13
 - 4.3.1 Cable and Jack Specifications:13
 - 4.3.2 Location and Spacing:14
 - 4.3.3 Acceptable cables:14
 - 4.3.4 Electrical Service:.....14
- 5.0 TELECOMMUNICATIONS ROOMS 15**
- 5.1 Riser Rooms:15
- 5.2 Size:15

5.3	A C Power Outlets:	16
5.4	Wall Space and Layout:	16
5.4.1	Equipment Layout within Rack:	17
5.5	Cross Connect Field:	17
6.0	BACKBONE CABLING	19
6.1	Riser Design:	19
6.2	Acceptable cables:	19
7.0	ENTRANCE FACILITY	19
7.1	National Electrical Code Adherence:	20
7.3	Grounding:	20
7.4	Surge Protectors:	21
7.5	Sneak Current Fuses:	21
7.6	Entrance Conduit:	21
7.7	Innerduct:	21
8.0	CAMPUS DESIGN	22
9.0	HANDICAP AND OTHER SPECIAL REQUIREMENTS	24
9.1	Handicap Requirements:	24
9.2	Elevator Requirements:	25
9.2.1	Elevator Telephone:	26
9.2.2	Elevator Wiring:	26
9.2.3	Dial Tone:	26
9.2.4	Elevator Conduit:	26
9.2.5	Backboard:	26
9.3	Code Compliance:	26
10.0	ADMINISTRATION	27
10.2	Labeling:	27
10.3	Cable Tracking:	28
10.4	Color Coding:	28
10.5	Records:	29
11.0	TESTING:	34
11.1	Multipair UTP Feeder Testing:	34

11.2 UTP Category 5e and Category 6 Testing Parameters	34
11.3 Fiber Optic Testing:	34
GLOSSARY	37
APPENDIX A:	40
Recommended Cable Specifications.....	40
APPENDIX B:	42
Recommended Connector Specifications.....	42
REFERENCES – THE STATE OF NORTH CAROLINA EXPECTS AND ENFORCES STRICT ADHERENCE TO THE LATEST PUBLISHED VERSIONS OF THE CODES AND STANDARDS REFERENCED ON PAGE 45.	45

1.0 INTRODUCTION

1.1 Subject:

Telecommunications wiring guidelines apply to the State of North Carolina Executive Branch Agencies. Notwithstanding any other provision of law, North Carolina universities, community colleges, public school systems and local governmental entities may use the information technology programs, services, or contracts offered by the Office of Information Technology Services, including information technology procurement, in accordance with the statutes, policies, and rules of the Office of Information Technology Services. "Local governmental entities" includes local school administrative units, as defined in G.S. 115-C5, and community colleges. Local governmental entities are not required to comply with otherwise applicable competitive bidding requirements when using contracts established by the Office of Information Technology Services. Any other State entities may also use the information technology programs, services, or contracts established by the Office of Information Technology Services, including information technology procurement, in accordance with the statutes, policies, and rules of the Office of Information Technology Services.

1.2 Intent:

It is desired to have a uniform wiring plan for voice, data, image, and video to allow flexibility for personnel changes, office renovations and equipment migration and updates. This cabling system is based on a structured cabling system that is not vendor proprietary and conforms to the TIA / EIA-568-B Commercial Building Wiring Standards. **This document is meant to be dynamic and will change as official standards change.**

1.3 Authority:

N.C.G.S. 147-33.91 States the Powers and Duties of the Office of Information Technology Services. N.C.G.S. 147-33.82 States the Power of the State of NC Chief Information Officer (CIO).

1.4 Scope:

These guidelines are intended to provide advisory information for all new state buildings and major renovations. For retrofitting and telecommunications recabling, these guidelines should be used unless there is a strong business case for not doing so. Specifically these guidelines are for wiring in:

- * Newly constructed buildings
- * Buildings undergoing major renovations
- * New long-term leased occupancy
- * New multi-building networks with state owned fiber or wire cable

1.5 Hazardous Material Handling:

ANY CONTRACTOR WORKING UNDER CONTRACTUAL AGREEMENT WITH ANY STATE AGENCY, PUBLIC SCHOOL SYSTEM, COMMUNITY COLLEGE, UNIVERSITY, COUNTY, CITY OR LOCAL GOVERNMENTAL AGENCY WITHIN THE STATE OF NORTH CAROLINA SHALL BE RESPONSIBLE FOR CONTACTING THE OWNER OF ANY BUILDING (S) IN WHICH THE DESCRIBED WORK UNDER CONTRACT IS TO BE PERFORMED TO DETERMINE WHETHER ASBESTOS CONTAINING MATERIALS (ACM) AND/OR PRESUMED ASBESTOS CONTAINING MATERIALS (PACM) ARE LOCATED IN SAID BUILDING (S). ONCE THE EXISTENCE OF ACM OR PACM HAS BEEN IDENTIFIED, IT SHALL BE THE CONTRACTOR'S SOLE RESPONSIBILITY TO TAKE NECESSARY SPECIAL PRECAUTIONS AND ACTIONS TO PROTECT ITS EMPLOYEES, SUBCONTRACTORS, THE GENERAL PUBLIC, AND THE BUILDING AND STRUCTURE FROM EXPOSURE TO ASBESTOS WHILE PERFORMING ANY WORK UNDER CONTRACT. THE CONTRACTOR SHALL COMPLY WITH ALL RULES AND GUIDELINES SPECIFIED BY OSHA, EPA, AND THE CLEAN AIR ACT, AND ALL OTHER APPLICABLE LAWS RELATING TO THE EXISTENCE OF OR EXPOSURE TO ACM OR PACM.

These guidelines are based on TIA / EIA-568-B Commercial Building Telecommunications Wiring Standard and the latest published version of Building Industry Consulting Service International's (BICSI) Telecommunications Distribution Methods Manual and Customer Owned Outside Plant Manual. The BICSI manuals are a good source for detailed planning of telecommunications distribution systems.

These guidelines do not recommend a particular method of horizontal distribution (under floor, ceiling, under carpet, etc.) because of the wide disparity of buildings and designers used in this state. The BICSI manual cited above and the TIA / EIA - 569 are excellent references and should be followed for more detail on horizontal pathways and spaces.

The National Electrical Code (**NEC**) adopted by the State of NC, the National Electrical Safety Code (**NESC**) and other national, state and local building codes are recognized as having jurisdiction over related parts of these guidelines.

1.6 Purpose:

These guidelines are intended to give recommended minimum requirements for telecommunications service in general and administrative office space. This guideline addresses the physical pathways, media, and cable administration practices.

The purpose is threefold:

- To provide direction.
- To enable the planning of telecommunications facilities with little knowledge of the specific products that will be installed.

- To define a generic telecommunications wiring system that will support most state agency wiring needs in a multi-vendor and multi-product environment.

2.0 APPROACH

These guidelines follow the general cabling industry practice of using a "structured cabling system" (SCS). An SCS attempts to wire a building for information needs without knowing specifically what equipment will be utilized. An SCS is geared for long-term stability and flexibility and is based on the idea of wiring the building once. Figure 1 is an abbreviated pictorial of such a system. The structured cabling system approach allows the wire and outlets to remain unchanged while the connections and services vary. The main components of a structured cabling system are:

- * Common Media - Unshielded twisted pair (UTP) and fiber optic cables are capable of supporting voice, image and data communications. Services can change without affecting the media used to connect the services.
- * Star Topology - Media is distributed only from designated distribution points (rooms) within the system. The signal quality improves because the number of connections is limited.
- * Cross-connects – Cross-connects and patch panels provide the system with the flexibility to make changes to the service quickly and easily using jumper wires or modular jacks. Agency personnel with little training can make changes to the service in the work area, thereby reducing the amount of time, effort, and cost in making changes.
- * Universal outlet - Common universal outlets provide a standard interface that permits connectivity of devices to any service by changing the connection to the outlet and not the outlet itself. Connection to the outlet can be done directly or by using adapters when necessary.
- * Administration - An administrative system is used to record installations and should be maintained on a continuing basis.

3.0 WIRING SYSTEM ELEMENTS

3.1 Horizontal cabling / wiring:

Horizontal cable and connecting hardware provide the means of transporting telecommunications signals between the telecommunications outlet / connector in the work area and the horizontal cross-connect in the telecommunications room. These components are the “contents” of the horizontal pathways and spaces. **It is the State of NC minimum standard that the cabling shall be UTP Category 5e with pathway planning for fiber and or copper growth. The State of NC highly recommends researching costs vs. benefits of installing higher Categories (Category 6 & Category 6 Augmented) of Cabling in all new and renovated locations that do not presently have horizontal cabling installed.**

3.2 Telecommunications rooms:

The telecommunications room on each floor is a transition point between the backbone and horizontal distribution pathways. The telecommunications room shall be able to

contain telecommunications equipment, cable terminations, and associated cross-connection wiring. It is here that the logical topology wiring is accomplished. The physical star workstations may be connected in ring or bus topologies in addition to star.

3.3 Backbone wiring:

Backbone wiring is the riser wiring and / or telecommunications room/s interconnecting wiring in multi-story buildings or the main distribution system in a campus environment. It should be fiber optic cable, unless a strong business case can be made for UTP Category 5e or Category 6 for data and UTP Category 3 minimum for analog voice feeder cable.

3.4 Entrance facility:

This is the pathway where a service enters a property or building including the entrance point at the building wall and continuing to the entrance room or space. The demarcation point between the service provider and the user is typically located in the entrance room.

3.5 Campus distribution:

This is the interbuilding connectivity and campus backbone in a complex or multi-building environment.

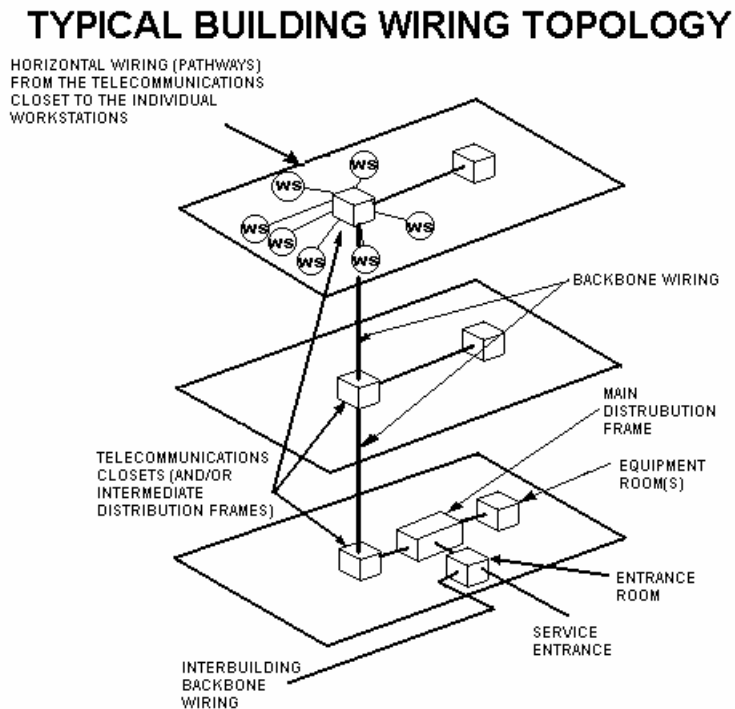


Figure 1 Structured Wiring Diagram

4.0 HORIZONTAL WIRING

4.1 Structure:

The horizontal wiring structure extends from the telecommunications room to the telecommunications outlet. It includes the outlet /connector, the horizontal distribution system cables, the cross-connect in the room and Horizontal Pathways and Spaces. Pathways and spaces are used to distribute and support horizontal cable and

connecting hardware between the work area outlet and the telecommunications room. These pathways are the “container” for the horizontal cabling.

Note: Horizontal cables do not include work area (patch) cables or equipment room (patch) cables. However, the length and type of cable required for connecting telecommunications equipment to the horizontal cabling will significantly affect end-to-end system performance and should be taken into consideration when planning any system.

4.2 Major items:

The major points of the horizontal system are:

- * Horizontal pathways and spaces are generally referred to as “horizontal distribution systems” and consist of structures that conceal, protect, and support horizontal cables between the telecommunications outlet / connector used to connect work area equipment (voice, data, and video) at the work area and horizontal cross-connect in the serving telecommunications room.

Select and design the type and layout of the horizontal distribution systems carefully. After a building is constructed, it may be more difficult to gain access to horizontal cabling. Therefore the skill, effort, and time required to make horizontal cabling changes can be very high. When selecting and designing horizontal distribution systems, it is important to consider the design’s ability to accommodate cabling changes and minimize occupant disruption when horizontal pathways and spaces are accessed.

In addition to providing for current occupant needs, the horizontal distribution system design must facilitate ongoing maintenance of horizontal cabling and accommodate future additions to and changes in cabling, equipment and services.

The pathway design should allow for a minimum of three cables run per individual work area. Although minimally, only two cables are required, the additional pathway capacity is needed to facilitate future additions and changes as the user’s needs evolve.

4.2.1 Conduit Cable Capacity:

The following table provides guidelines used by ANSI / TIA / EIA – 569 for cable fill capacity for conduits ranging from ½-inch trade size to 4-inch trade size that have no more than two 90 degree bends (180 degrees total) and are no longer than 100 feet. The number of cables that can be installed is actually limited by the allowed maximum pulling tensions of the cables.

IMPORTANT: Flexible conduit is not recommended for use in buildings because it tends to creep, shift and damage cable sheaths. Use only in situations where it is the only practical alternative and increase the conduit size by one trade size.

Conduit Inside Diameter (Inches)	Conduit Trade Size (Inches)	Cable Outside Diameter (Inches)									
		0.13	0.18	0.22	0.24*	0.29	0.31	0.37	0.53	0.62	0.70
.629	1/2	1	1	0	0	0	0	0	0	0	0
.826	3/4	6	5	4	3	2	2	1	0	0	0
1.06	1	8	8	7	6	3	3	2	1	0	0
1.37	1-1/4	16	14	12	10	6	4	3	1	1	1
1.61	1-1/2	20	18	16	15	7	6	4	2	1	1
2.08	2	30	26	22	20	14	12	7	4	3	2
2.48	2-1/2	45	40	36	30	17	14	12	6	3	3
3.07	3	70	60	50	40	20	20	17	7	6	6
3.58	3-1/2							12	12	7	6
4.05	4							30	14	12	7

Table of Conduit Capacities for Various Sized UTP Cabling used by ANSI / TIA / EIA-569-A

* Typical sizes for Cat 5e - UTP Cables

NOTE: New requirements were added to the National Electrical Code in 2002 for removal of abandoned cables:

- | | |
|------------------------------|--|
| 645.5 (D) (6) | Information technology equipment rooms |
| 760.3 (A) | Fire alarm systems |
| 770.3 and 770.54 (B) | Fiber optics |
| 800.52 (B) | Communications circuits |
| 820.3 (A) and 820.53 (B) (1) | CATV and radio distribution systems |

Avoiding potential sources of electromagnetic interference (e.g., motors and transformers that share distribution space & copiers used in work areas) must be a primary consideration when designing horizontal pathways.

All horizontal pathways that penetrate fire-rated barriers shall be fire stopped in accordance with applicable codes.

When telecommunications horizontal pathways or cabling are placed in a hazardous location, such as an explosive or combustible atmosphere, observe all requirements of the applicable electrical code.

The main types of horizontal pathways are:

Conduit. Cable Tray. Ladder Rack. Under Floor ducts.
Access (raised) floors. J-Hooks. Cellular floors.
Ceiling Zones. Mechanically Fastened Raceways.

Many buildings require a combination of two or more of these systems to meet all distribution needs. For example, an office area in a building may require an under floor or overhead system, while an isolated telecommunications outlet location may best be served by an individual conduit.

Overhead cabling above ceiling tiles shall be attached to an appropriate support system connected to the building structure rather than the ceiling tile grid or hangers. Special consideration shall be given to length of cable span between supports and maximum number of cables in a support for cable Category Compliance. [The maximum unsupported cable span when using Category Compliant hangers (often referred to as J-hooks) for open wire cable systems shall be no more than 5 ft. and the typical number of .25 in. diameter cables supported by either shall not exceed the hanger manufacturer's specifications for Category Compliance. A dual run shall be counted as 2 cables but one dual drop.] For large quantities of cables (50 to 75) that convene at the telecommunications room and other areas, provide sufficient support that is specifically designed to support the required cable weight and volume while maintaining Category Compliance (no more than 12 inches of cable sag between supports). There shall be a minimum of three inches of clearance between the cable support system and the ceiling tile support grid. Plenum rated cable shall be used if the space above the ceiling tile system is an environmental air space.

- * In the "ceiling zones" method of ceiling distribution, divide the usable floor area into zones of 365 square ft. to 900 square ft. each. When convenient, it is preferable that zones be divided by building support columns. Cabling to each zone may be placed within the ceiling plenum area (where permitted by applicable codes) or installed in enclosed conduits or raceways. The pathways should extend from the telecommunications room to the mid-point of the zone. From that point,

the cables (or pathway) should be extended to the top of the utility columns or wall, then down to work area outlet boxes.

- * Horizontal cabling must be designed to accommodate diverse user applications including:
 - Voice Communications
 - Data Communications
 - Local area networks (LANs)

The designer should also consider incorporating other building information systems (e.g., CATV, alarms, security, audio, video, automated building systems and other telecommunications systems) when selecting and designing horizontal cabling. In addition to accommodating existing telecommunications needs, consider accommodating a diversity of applications in order to reduce or even eliminate the need for horizontal cabling changes as user requirements evolve.

- * Star topology - each work area outlet shall be cabled directly to a horizontal cross-connect in the telecommunications room. This does not preclude physical bus and ring topology; this is done in the telecommunications room.

Splices are not permitted for twisted-pair horizontal cabling. Bridged taps (multiple appearances of the same cable pairs at several distribution points) are not permitted in horizontal cabling.

- * Advanced planning considers the use of fiber optic cabling to all training rooms, conference rooms and computer rooms. On a business case basis, pathways of innerduct, raceways and conduit are to be provided to support the use of fiber optic cabling.

- * Cable length maximums are specific to the media itself - e.g. 90 meters (295 feet) for UTP cabling from the horizontal cross-connect to the outlet / connector and 6 meters (20 feet) for patch cords and cross-connect jumpers in the horizontal cross-connect.

In establishing limits on horizontal cable lengths, a 10m (33 ft.) allowance was made for combined length of patch cables and cables used to connect equipment in the work area and telecommunications room. All equipment cables should meet or exceed the same performance requirements as the patch cords.

The 6m (20 ft.) maximum length specified for patch cables does not include additional cable lengths needed to connect to active equipment. For example, if 3m (10 ft.) of cable are used for each work area connection, the 10 m (33 ft.) total allowance provides for up to 7m (23 ft.) of combined length per channel for patch cables and equipment cables in the telecommunications room.

4.3 Outlets and Jacks:

4.3.1 Cable and Jack Specifications:

This suggested configuration would serve most needs. It consists of four pairs (8 wires) of unshielded twisted pair (UTP) for voice and another four pairs for data applications. These cables shall be Category 5e UTP cables as a **minimum standard**. **The State of NC highly recommends researching costs vs. benefits of installing higher Categories (Category 6 & Category 6 Augmented) of Cabling in all new and renovated locations that do not presently have horizontal cabling installed.** The performance for these cables shall be defined by TIA / EIA 568-B.

All voice and data pairs are terminated in RJ45 wiring configuration. The outlet looks like a regular telephone jack to the casual observer. This jack shall be Category 5e compliant or higher as defined by TIA / EIA-568-B. These jacks shall be wired with the T568A pinout configuration. A faceplate shall be provided.

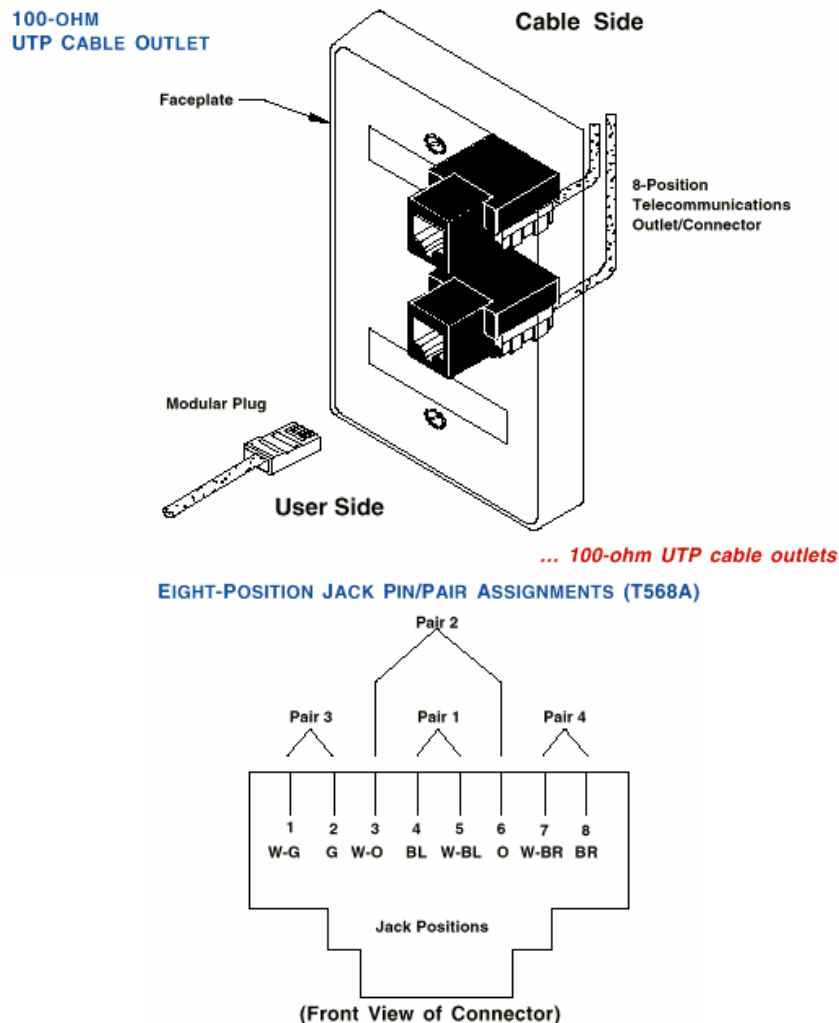


Figure 2 T568A Jack Pinout

HORIZONTAL CABLING SCHEMATIC

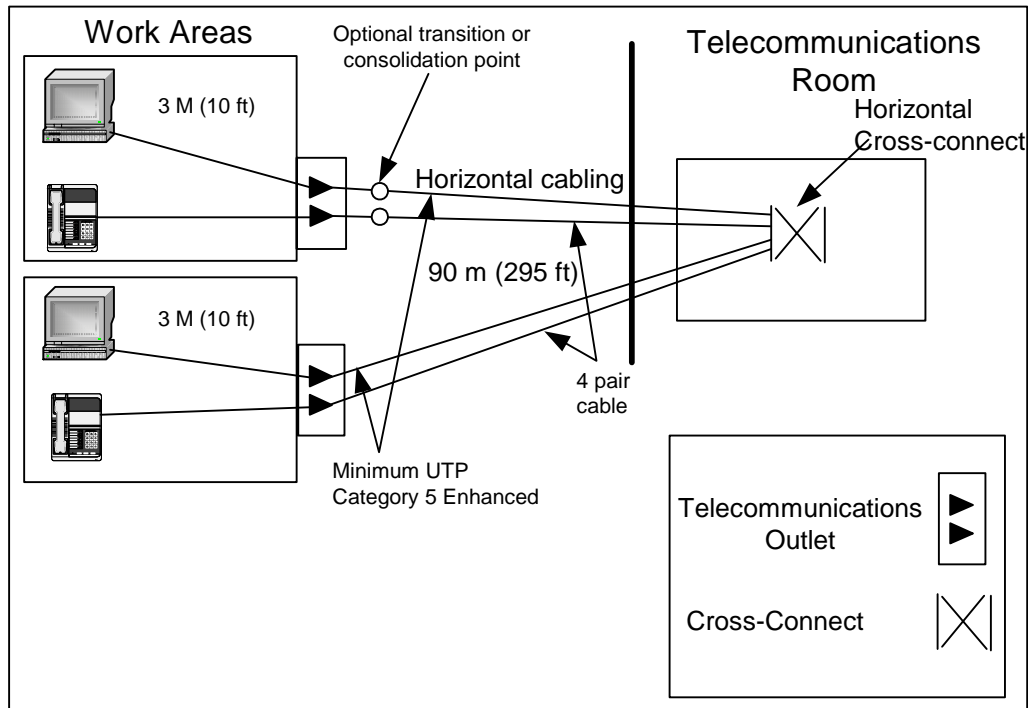


Figure 3 Horizontal Cabling Schematic

4.3.2 Location and Spacing:

Outlets should be located to provide connectivity to every workspace location. If workspace locations have not been determined, then outlets should be provided for every 100 square feet of usable workspace. Each conference room should be provided with at least one outlet. A power failure telephone outlet shall be placed at the location of the main answering position. Consideration should be given to spaces that may be eventually used as work spaces and outlets provided accordingly. Outlets shall be mounted 18" above the finished floor.

4.3.3 Acceptable cables:

Unshielded Twisted Pair - Category 5e, Category 6 (TIA / EIA-568-B) or higher
Unshielded Twisted Pair - TIA / EIA 568-B, -CMR or CMP NEC Rating.

50/125 Micrometers Laser Optimized Class 1a Graded Index - OFNR or OFNP
NEC Rating (Fiber
Distributed Data Interface - FDDI compatible).

62.5/125 Micrometers Class 1a Graded Index - OFNR or OFNP NEC Rating
(Fiber Distributed Data Interface - FDDI compatible).

4.3.4 Electrical Service:

A minimum of three duplex 120 Volt AC power outlets shall be provided for each workspace location or private office and fused at 20 amperes.

5.0 TELECOMMUNICATIONS ROOMS

The telecommunications room shall be located as close as practicable to the center of the area served and preferably in the core area. The telecommunications room space shall be dedicated to the telecommunications function and related support facilities. Telecommunications closet space should not be shared with electrical installations other than those for telecommunications equipment. This document assumes the shared use of the telecommunications needs of all occupants of the area served.

NOTE: All telecommunications backboards shall be void free and fire-retardant or treated on all six sides with at least two coats of fire retardant paint. **If fire retardant paint is used, plywood shall be repainted on all 6 sides at manufacturer specified intervals.**

5.1 Riser Rooms:

In multi-story buildings, rooms shall be centrally located and stacked, when practicable. Rooms are placed directly above each other with riser pathways between them.

5.2 Size:

Equipment rooms and telecommunications rooms must be large enough to house equipment, controllers, equipment racks, fiber optic equipment, and Service Provider lines.

Even if the customer does not anticipate any growth, the equipment room should include adequate space to support equipment changes with minimal disruption. There are likely to be many equipment changes during the useful life of any equipment room.

In addition to space for telecommunications equipment and cabling, an equipment room must include space for any environmental control equipment, power conditioners, and Uninterruptible Power Supply (UPS) systems that will be installed there.

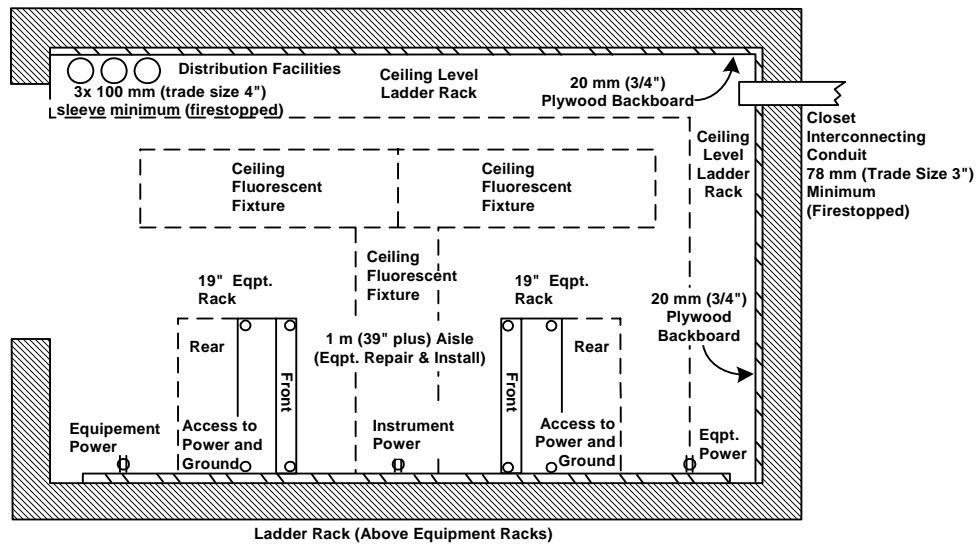
Special consideration to space should be given in the event a Local Area Network (LAN) now exists or will exist in the future. The minimum ceiling height is 8 ft 6 in. There shall be a minimum of one telecommunications room per floor. Additional rooms (one for each area up to 10,000 square feet) should be provided when:

- (1) The floor area to be served exceeds 10,000 square feet, or
- (2) The horizontal distribution distance to the workstation exceeds 90 meters (295 feet).

Based on square footage served, telecommunications rooms shall be minimally sized according to the table below:

<u>Serving Area</u> Square Feet	<u>Room Size</u>
10,000	10' x 11'
8,000	9' x 10'
5,000	7' x 10'

Layout of Telecommunications Closet



Telecommunications room doors should always swing to the outside!

Figure 4 Typical Telecommunications Room

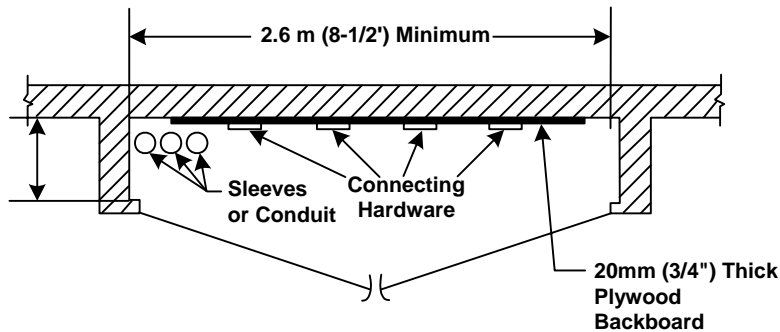


Figure 5 Typical Shallow Telecommunications Closet

5.3 A C Power Outlets:

A minimum of two dedicated 20 A, 120 V AC duplex electrical outlets, each on separate circuits, shall be provided for equipment power. In addition, convenience duplex outlets shall be placed at 6 feet intervals around the perimeter walls, at a height of 6 inches above the floor. If emergency power is available, consideration shall be given to automatic switchover of power. Specific outlets for equipment and convenience along with their locations shall be coordinated with the telecommunications system designer/s.

5.4 Wall Space and Layout:

Wall space should be provided that is adequate for termination of cables and equipment including equipment racks with access to the complete riser cable. Figure 4 and Figure 5 show typical telecommunications room layouts. The preferred equipment rack will be a floor mounted 7' high rack with horizontal supports connected to the wall at the upper 1/3 of the rack with clearance of 36" on all sides unless multiple racks are mounted side by side with cable management adjacent. A single wall mounted equipment rack is acceptable for a small installation where growth is not anticipated.

5.4.1 Equipment Layout within Rack:

Passive equipment (e.g., patch panels) shall be located in top of equipment rack with active equipment (e.g., switches, concentrators, hubs, multiplexers, routers) located in lower section. Any rack-mounted ac power bars should be located in the very bottom of the equipment rack. Equipment racks shall be fitted in front, sides and rear with cable management components such as wireminders of sufficient quantity for a neat and clean installation. Patch cables shall be arranged in a manner that will cause minimal disruption when changes are necessary. Equipment racks shall be mounted so as to leave 36 inches of clearance to wall from any piece of equipment protruding from the front or back of rack.

5.5 Cross Connect Field:

Non IP termination blocks shall be mounted on 4' X 8' sheets of 3/4" fire retardant plywood. The intermediate voice distribution frames located in the telecommunications rooms consist of plywood-mounted, quiet-front Krone type IDC blocks or 110 type cross connect blocks that terminate the interframe backbone and the horizontal distribution system.

Intermediate distribution frame blocks installed in racks should be divided into sections with the top section for fiber and copper patch panels and the bottom section for active electronics. Interframe backbone blocks will always appear closest to the backbone cable. Station blocks that terminate the horizontal distribution system wires should appear farthest from the backbone. All in-use blocks should be clearly labeled. Regardless of the block type used, the number of twists must be maintained all the way to the punch down.

110 type IDC connecting clips should be installed for every installed cable pair.

Patch cable type #110P connecting blocks may be used at some locations and punch down type #110A connecting blocks at other locations depending on frequency of change and expertise of personnel that perform cross connectivity. Access clearance for front and sides of equipment racks or backboard shall be 3 feet beyond any mounted items.

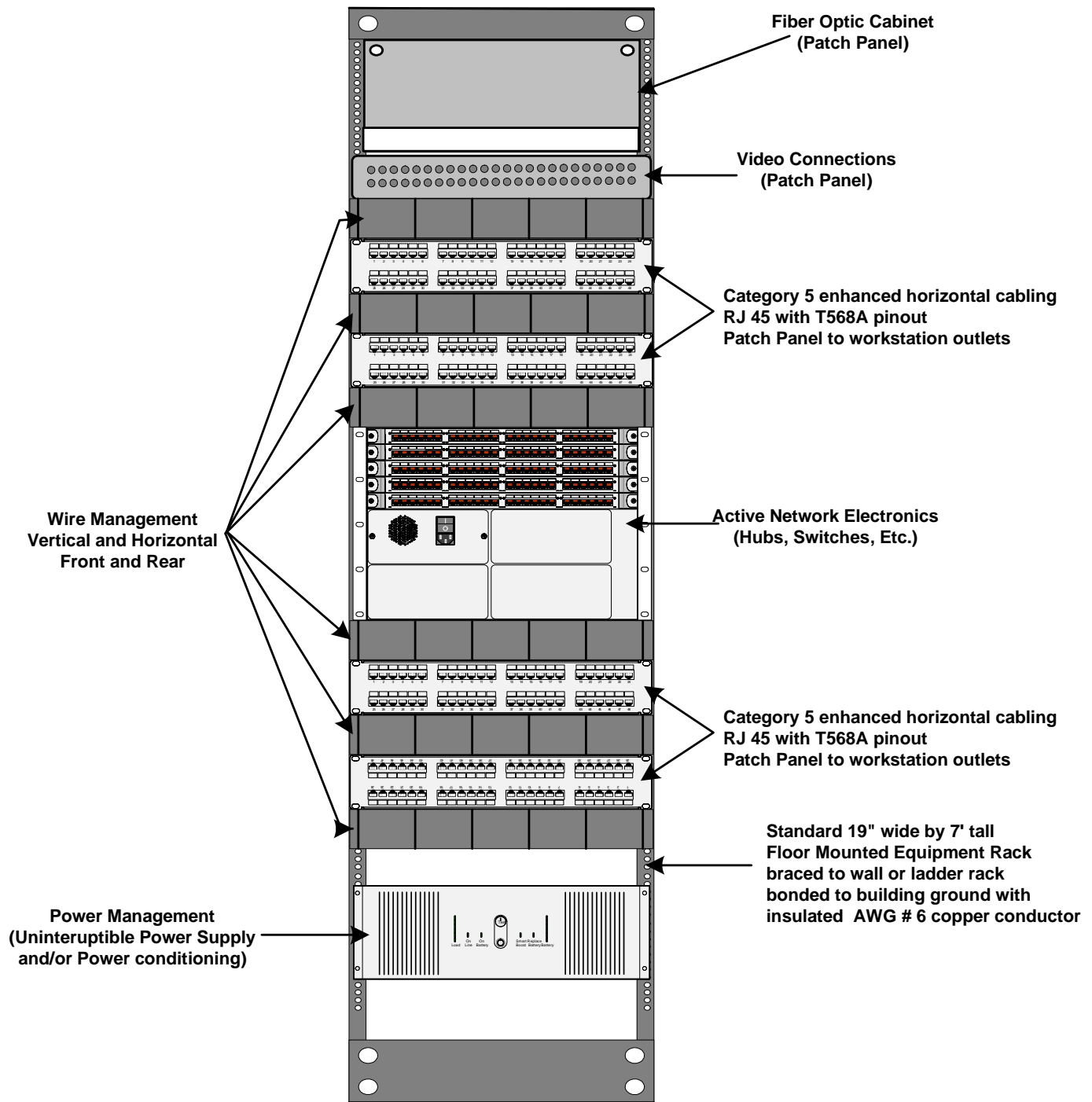


Figure 6 Data Distribution Frame Layouts

6.0 BACKBONE CABLING

6.1 Riser Design:

The riser connects telecommunications rooms with the common equipment providing a high capacity riser cable. Fiber should be used in data backbone and specific voice and video application backbone unless there is a strong business case for not doing so. Risers consist of a minimum of 6-strand multimode fiber optic cable in high-rise buildings and in any other buildings where the distance is greater than 295 feet.

For locations that do not anticipate the use of optical fiber, Unshielded Twisted Pair (UTP) riser cable should be sized to accommodate 50 percent growth over the number of initially installed dual 4 pair workstations. Even if no fiber is installed initially, the pathways of conduit and duct should allow room for the later addition of fiber.

6.2 Acceptable cables:

All Categories of cabling shall meet the TIA / EIA 568-B and 598 standard.

Inside plant fiber cable shall comply with ANSI / ICEA S-83-596.

Outside Plant fiber cable shall comply with ANSI / ICEA S-87-640.

Voice & Data:

Unshielded Twisted Pair – 100 ohm Category 5e Data Grade with transmission characteristics specified to a minimum of 100 MHz, CMR or CMP NEC Rating.

Unshielded Twisted Pair – 100 ohm Category 6 Data Grade with transmission characteristics specified to a minimum of 250 MHz, CMR or CMP NEC Rating.

50/125 μm Class Ia Graded Index Multimode Optical Fiber, OFNR, OFNP, Outdoor or Indoor / Outdoor (I/O) NEC Rating.

62.5/125 μm Class Ia Graded Index Multimode Optical Fiber, OFNR, OFNP, Outdoor or Indoor / Outdoor (I/O) NEC Rating.

8.3/125 μm Class IVa Dispersion-Unshifted Single-mode Optical Fiber, OFNR, OFNP, Outdoor or Indoor / Outdoor (I/O) NEC Rating.

Video:

* RG-11 and RG-6 broadband (75 ohm) Coaxial Cable, CL2 or CL2P NEC Rating

* UTP has proven to be capable of transmitting high quality video signals for certain applications by use of a commercially available video adapter. Products supporting true broadband (multiple channels) color signals on UTP are available. Coaxial Cables and Singlemode Fiber Optic Cables remain the media of choice for long distance video transmission and for backbone video feeder systems.

Note: ITS only recommends the use of polyethylene sheathed or interlocking armored cable for all “Outside Plant” applications.

7.0 ENTRANCE FACILITY

7.1 National Electrical Code Adherence:

All telephone communications circuits shall be installed in accordance with the latest published version of Article 800 of the National Electrical Code.

Exception: The "Protective Devices" requirements of paragraph 800-2 are to apply to all outside circuits of any length whether aerial or underground. All arrestors shall be solid-state type, tested and listed per ANSI/UL 497 1995 or later. They shall be installed on each telephone circuit entering a building as close as practicable to the point of entry.

7.2 Protectors:

All protectors shall be grounded using AWG 12 (minimum) copper wire for single line or double line, AWG 10 for three through six lines, and AWG 6 for seven or more lines. This conductor shall be connected to the building's Grounding Electrode System described by NEC 250-81 in accordance with NEC 800-31 (b) 5. The primary protector shall be 189B1 with AT&T 3C1SC equivalent protector units (solid state type).

7.3 Grounding:

TIA / EIA 607 covers requirements for telecommunications grounding and bonding as a system. The major guidelines are as follows:

- A permanent infrastructure for telecommunications grounding and bonding is specified to be independent of telecommunications cabling.
- Telecommunications bonding connections are always implemented in accessible locations with approved components.
- Minimum #6 AWG insulated copper bonding conductors (Telecommunications Bonding Backbone [TBB]) are installed through every major telecommunications pathway (backbone pathway) and directly bonded to a telecommunications grounding busbar (TGB) in each telecommunications equipment location.
- A Telecommunications Main Grounding Busbar (TMGB) is directly bonded to the electrical service ground. All TBBs end on this busbar.
- Generally, each TBB should be a continuous conductor from the TMGB to the farthest TGB. Intermediate TGBs should be bond connected to the TBB with a short bonding conductor.

The increasing need for the reliable transfer of massive amounts of information creates an environment where electrical protection takes highest priority. The main consideration in developing requirements for grounding, bonding, and electrical protection is safeguarding of personnel, property and equipment from the potential harm created by foreign electrical voltages and currents.

The protection of telecommunications facilities is an essential part of any distribution system. The National Electrical Code defines grounding and bonding parameters for telecommunications from the aspect of human safety. NEC Articles 250 and 800 cover the general requirements for grounding, bonding, and protecting electrical and

telecommunications circuits. NEC requirements are considered the minimum for safeguarding personnel and equipment.

It is the state standard that telecommunications systems be isolated to the building ground. Neutral ground current problems are so severe in some modern buildings that telecommunications systems fail to work. Equipment manufacturers' grounding and bonding instructions shall be closely adhered to.

Multi-line cable with separate shield is to be grounded per "7.2" above, where it enters any building, but by separate conductor. The cable shield is to be removed for a length of at least 12 inches on the equipment side of this ground connection, or non-shielded cable used from this point to the equipment.

The telecommunications equipment is to be Single Point Grounded (SPG). This single point ground consists of bonding together, at one point, the station equipment grounding connection, the green power wire, the inside cable shield (if any), and the station protector grounding conductors.

7.4 Surge Protectors:

The AC power circuit that feeds telecommunications equipment (cabinets, key switches, PCs, any and all peripheral equipment including digital announcers and music on hold devices) shall be provided with a surge protector. No equipment other than related peripherals shall be connected to this circuit.

7.5 Sneak Current Fuses:

Certain station equipment (usually with circuits of 100 OHM or less impedance to ground) may require secondary protection also referred to as "Sneak Current Fuses" to prevent equipment failure, line hazard, and danger to personnel. The vendor providing the devices that require secondary protection shall install secondary protection.

7.6 Entrance Conduit:

Sizes: Entrance conduit size will vary with number of cable pairs entering building, but the absolute minimum shall be two 2-inch conduits. Buildings larger than 10,000 square feet shall have at least three 4-inch conduits. Riser sleeves or conduit shall be at least three inches. (Provisions may be made for non-continuous sleeves for riser rather than conduit). Conduit for horizontal service from floor equipment rooms to jack locations shall be 3/4 inch or greater depending upon expected number of cables and planned growth. Planned capacity should be for 100% redundancy.

Entrance conduit shall extend from entrance (termination) room beyond any paved areas. All exposed portions of "Outside Plant" conduit shall be minimum schedule 80 PVC or rigid steel to a depth of not less than 24-inches below final finished grade.

Location: Elevator shafts shall be excluded for possible locations of any conduit.

7.7 Innerduct:

A sleeved physical channel shall be provided for fiber optic cable unless interlocking armored cable is deployed. This is to be within the conduit system, unless the "innerduct" is plenum rated. Above ceiling innerduct not encased in a conduit must be

UL Approved and bear designations stating so. Innerduct shall contain a pull string if no fiber is pulled at the time of the installation of innerduct.

8.0 CAMPUS DESIGN

This section is intended as a typical campus distribution structure. This type of distribution occurs primarily on state governmental, university and community college campuses, but can be used to interconnect buildings anywhere a number of buildings are functionally collocated with property rights of way.

Figure 7 shows a four building campus. The Service Provider (local telephone company) enters the property and continues cabling to Building A. The SP terminates connections on plywood-mounted 110-type cross connect blocks in the Entrance Facility. This is the demarcation point and the owner / agency is responsible for wiring beyond this point. It is the responsibility of the property owner to provide the pathway from the property line to the entrance facility.

The Main Cross-connect is the focal point for interbuilding communications. There is one Main Cross-connect where the Service Provider and outside facility cabling is terminated. Cables are then distributed to other floors and to other buildings. The Main Cross-connect should be centrally located.

A campus distribution system can be viewed as a common communications network, but each building should be treated individually for basic wiring considerations of:

- Bonding
- Grounding
- Electrical Protection
- Building codes and regulations
- Fire stopping.

Interbuilding cables should consist of optical glass fiber of not less than twelve (12) multimode fibers plus six (6) single mode fibers. Fiber cables should be in innerduct inside conduit.

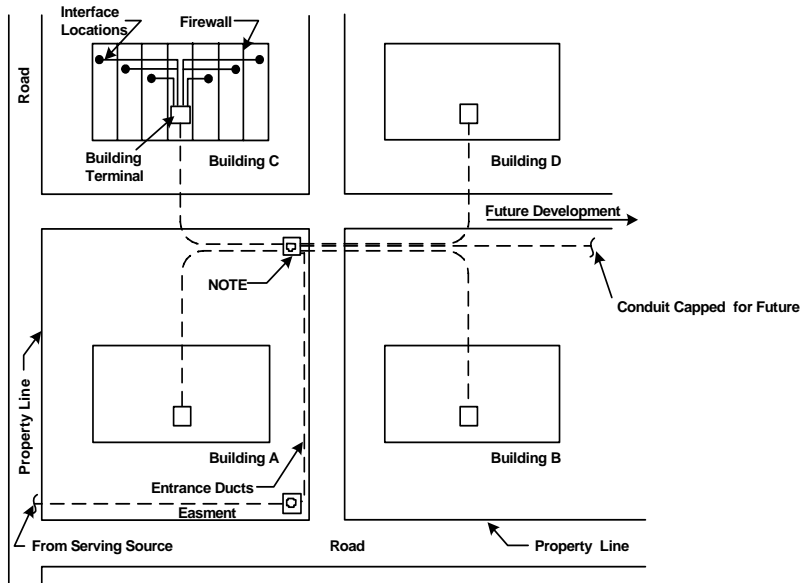


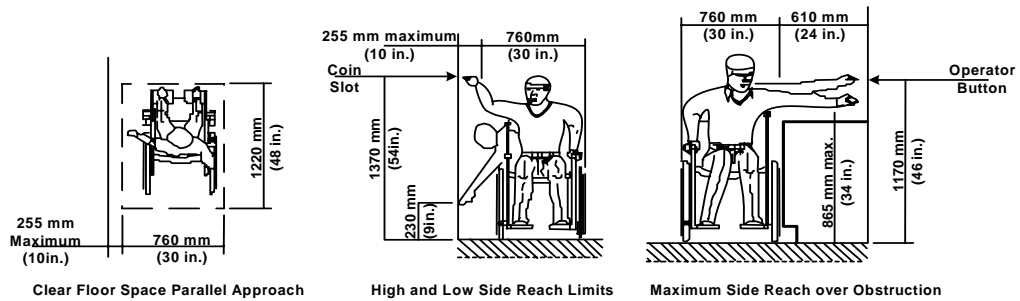
Figure 7 Typical Campus Wiring System

9.0 HANDICAP AND OTHER SPECIAL REQUIREMENTS

9.1 Handicap Requirements:

Compliance with The Americans With Disabilities Act (ADA) (36CFR Part 1191) shall be maintained at all times. This act specifies text control telephones and volume control telephones be provided along with signage wherever banks of pay phones are installed. It also details mounting heights and clearances for telephones.

Allowed Dimensions for Side Reach Telephones



NOTE:

The minimum height for all electrical and communications systems receptacles on walls (i.e., outlets, and jacks) must be 380 mm (15 in.) above finished floor.

Figure 8 ADA Mounting Heights & Clearances For Side Reach

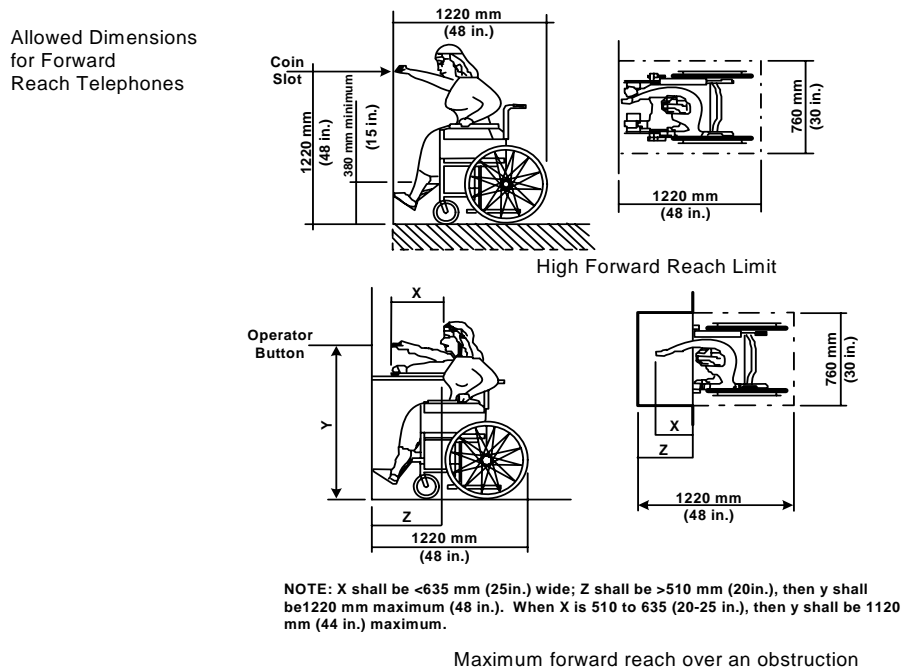


Figure 9 ADA Mounting Heights & Clearances For Forward Reach

All "banks" of public telephones shall have at least one telephone, which can be used by physically disabled, including those in wheel chairs and those with hearing and sight disabilities. The following are minimum requirements:

A clear floor or ground space at least 30" by 48" that allows either a forward or parallel approach by a person using a wheelchair shall be provided at telephones. Bases, enclosures, and fixed seats shall not impede approaches to telephones by people who use wheelchairs. The highest operable mechanism shall be placed no more than 48 inches above the floor for forward reach telephones and 54 inches above the floor for side reach telephones. If side reach occurs over an obstruction 24 inches wide and 34 inches high, the maximum height allowed is 46 inches.

The telephone shall be hearing aid compatible with volume control capable of a minimum of 12dbA and a maximum of 18dbA above normal for the handset with instructions for use. If an automatic reset is provided then 18dbA may be exceeded.

Text telephones used with a pay telephone shall be permanently affixed within, or adjacent to, the telephone enclosure. If an acoustic coupler is used, the telephone cord shall be sufficiently long to allow connection of the text telephone and the telephone receiver.

Pay telephones designed to accommodate a portable text telephone shall be equipped with a shelf and an electrical outlet within or adjacent to the telephone enclosure. The telephone handset shall be capable of being placed flush on the surface of the shelf. The shelf shall be capable of accommodating a text telephone and shall have 6" minimum vertical clearance in the area where the text telephone is to be placed.

The telephone shall be equipped for those with sight disabilities with visual and tactile instructions for use. Large tactile letters shall be used for instructions. On every floor where telephones are installed, at least one should be placed so that the dial and handset are no more than 4 feet above the floor, equipped for those with hearing and sight disabilities and so identified with visual and tactile instructions for use.

Controls and operating mechanisms shall be operable by a force of five pounds or less; operation shall not require the use of a fine grasp, tight pinching motion or a turning, wrist-twisting motion for activation.

9.2 Elevator Requirements:

Emergency two-way communication systems between the elevator and a point outside the hoist way shall be provided. The highest operable part of a two-way communication system shall be a maximum of 48" from the floor of the car. If the system uses a handset then the length of the cord from the panel to the handset shall be at least 29". The emergency intercommunication system shall not require voice communication (e.g., autodial to enunciator with location identification).

9.2.1 Elevator Telephone:

A single line wall telephone set shall be installed in each elevator in a telephone box supplied by the company installing the elevator.

9.2.2 Elevator Wiring:

The telephone for each elevator shall be wired so it is independent of the telephone system in the rest of the building. A separate line is required for each elevator.

9.2.3 Dial Tone:

The telephone system in each elevator shall have dial tone in order to pass inspection.

9.2.4 Elevator Conduit:

A three-quarter-inch conduit should be placed between the elevator control room and the nearest telecommunications room.

9.2.5 Backboard:

A one-half inch backboard should be glued to the inside rear wall of the telephone box in the elevator.

9.3 Code Compliance:

All wiring shall comply with Article 800 of the National Electrical Code, the American National Standards Institute and the National Electric Safety Code (NEC) and shall be subject to acceptance tests as described in FCC Rules and Regulations, Title 47, Section 28.215, Chapter 1, Part 68. The primary application of these guidelines for communications is directed to (a) protective devices and methods for "exposed" cable and wiring, (b) separation of power circuits, and (c) fire stopping and special fire resistant and low-smoke producing cable in specified environments. All new cable and wire installed in air plenums and ducts shall be flame resistant and have low smoke properties in accordance with Article 800-3 (d) of the *latest published version of the National Electrical Code and shall be so classified by Underwriters Laboratories, Inc. All cable installed in steam tunnels must be able to withstand temperatures of 125 degrees centigrade.

* The NEC is revised every three years.

10.0 ADMINISTRATION

- TIA / EIA 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings is incorporated by reference. Compliance shall be maintained.
- Each pathway (conduit, tray, raceway, etc.) that conveys telecommunications media from space to space shall be given a unique identifier and labeled at each end-point.
- Each telecommunications space (equipment room, telecommunications room, work area, entrance facility, manhole and handhole) shall be uniquely identified and labeled.
- Each cable shall be uniquely identified and labeled at each end.
- Each cable record must indicate the cable type by manufacturer and manufacturer's designation, and document every pair/conductor in the cable. Cable identifier must be linked to all pathways in which it runs.
- Each piece of termination hardware such as a patch panel or wiring block shall be uniquely named and labeled.
- Termination position on cross-connect shall be identified by type, the pair / conductor terminated and a user code.

10.2 Labeling:

Each work area shall be labeled with a unique identifying number. A consistent labeling and numbering scheme shall be used. The labeling shall be clearly legible on the outlet face and the termination end. The numbering plan shall identify the source and destination of the cable for horizontal runs.

A sample numbering plan is: 208A-A1/241B

Where 208 is the telecommunications room #:

"A" is the patch panel identification,

"A1" is the "A" Block and the first position,

"241" is the workstation room #,

And "B" is the workspace of the user in room 241.

Horizontal cable shall be labeled at the workstation end and the cross-connect end. Backbone cables (whether riser or horizontal) shall have an identifying number that is labeled at each end. Labels shall be the same color on each end. Performance documentation must use the same labeling scheme.

10.3 Cable Tracking:

To support future expansion, reconfiguration and maintenance, complete records of all system characteristics should be developed and maintained. On each element in the route, identification labels should be completed and attached. Labels should meet the requirements of UL 969 Standard for Marking and Labeling Systems. A Final Report should record system configuration, unique identifier, fiber labels, pathways and "as built" details. The mandatory elements of Figure 10 must all be included. Loss measurements and OTDR traces should also be included with the records.

As a part of any cable installation, records of the connections are required. Changes to wiring should be maintained and accurate records made available at all times. A physical inventory should be performed on a periodic basis.

Tracking can be done manually, with a computer-based system or both. It is recommended that any installation having 200 or more devices (telephones, PCs, terminals, printers, LAN devices, plotters, etc.) pursue a computer-based system. There are reasonably priced systems available that can be implemented compliant to the TIA / EIA-606 standard this document references.

For major renovations or extensive additions, records are required. Existing buildings shall have records modified as moves, adds and changes (MACs) are done in the building. Work orders for wiring changes should be retained with other records for backup and research reasons.

10.4 Color Coding:

<u>TERMINATION TYPE</u>	<u>COLOR</u>	<u>COMMENTS</u>
Demarcation Point	Orange	Central Office Terminations
Network Connections	Green	Network connections or auxiliary circuits
Common Equipment, PBX, host, LANs, Muxes	Purple	Used for all major switching & data terminations
1st Level Backbone	White	Main cross-connect to
2nd Level Backbone	Gray	Intermediate cross-connect to telecommunications room
Station	Blue	Horizontal cable terminations
Interbuilding	Brown	Campus cable terminations
Key systems	Red	Key Telephone Systems
Miscellaneous	Yellow	Auxiliary, maintenance alarms, security

10.5 Records:

Figure 10 shows a summary of required records and linkages. Figures 11 - 14 are examples of what results from these requirements. Following these guidelines will provide detailed information that can save many labor hours in trouble shooting and planning.

	RECORD	REQUIRED INFORMATION	REQUIRED LINKAGES
PATHWAYS & SPACES	PATHWAY	Pathway identifier Pathway type Pathway fill Pathway loading	Cable records Space records Pathway records Grounding records
	SPACE	Space identifier Space type	Pathway records Cable records Grounding records
WIRING	CABLE	Cable identifier Cable type Unterminated. Pair / conductor numbers. Damaged pair / conductor numbers. Available pair/cond. numbers.	Termination position records Splice records Pathway records Grounding records
	TERMINATION HARDWARE	Term. hardware identifier Term. hardware type Damaged position nos.	Termination position records Space Records Grounding records
	TERMINATION POSITION	Term. hardware identifier Term. position type User code Cable pair/cond. nos.	Cable records Other term. position records Termination hardware records Space records
	SPLICE	Splice identifier Splice type	Cable records Space records
GROUNDING BONDING	TMGB	TMGB identifier Busbar type Grounding conductor identifier Resistance to earth Date measurement taken	Bonding conductor records Space records
	BONDING CONDUCTOR	Bonding conductor identifier Conductor type Busbar identifier	Grounding busbar records pathway records
	Telecommunications Grounding Bar	Busbar identifier Busbar type	Bonding conductor records Space records

Figure 10 Summary of Record Elements

	SAMPLE DATA
REQUIRED INFORMATION	
Pathway identifier	CD34
Pathway type	2 in. EMT
Pathway fill	20%
Pathway loading	n/a
REQUIRED LINKAGES	
Cable records	C0001, C0002
Space record (end 1)	D306
Space record (end 2)	3A
Space records (access)	
Pathway records (other)	n/a
Grounding record	n/a
OPTIONAL INFORMATION	
Pathway length	132 ft
Pathway max. fill	40%
Pathway max. load	n/a
Pathway condition	ok
Pathway usage	horizontal distribution
Number of bends	2
Drawing number	C3
UPC	n/a
Misc. information	
OTHER LINKAGES	
Other record 1	B35
Other record 2	

Figure 11 Example of a Single Pathway Record for a conduit

	SAMPLE DATA
REQUIRED INFORMATION	
Space Identifier	3A
Space type	TC
REQUIRED LINKAGES	
Pathway Records	CD34, CT64, SL02-05, CD02
Cable records	C0001, C0011, CB02
Grounding record	TGB35
OPTIONAL INFORMATION	
Space size	10 ft x 11 ft
Space locations	3-A4
Area serviced	Q-4
Door lock key number	1425
Misc. Information	
OTHER LINKAGES	
Other record 1	E34
Other record 2	AC304
Other record 3	AU1
Other record 4	

Figure 12 Example of a Single Space Record for a telecommunications closet

	SAMPLE DATA
REQUIRED INFORMATION	
Space identifier	D306
Space type	W A
REQUIRED LINKAGES	
Pathway records	CD34
Cable records	C0001
Grounding record	n/a
OPTIONAL INFORMATION	
Space size	10 ft x 12 ft
Space location	n/a
Area served	n/a
Door lock key number	n/a
Misc. Information	
OTHER LINKAGES	
Other record 1	PC569
Other record 2	TR3
Other record 3	Smith, John
Other record 4	

Figure 13 Example of a Space Record for a work area

SAMPLE DATA		
REQUIRED INFORMATION		
Cable identifier	C0011	
Cable type	4-pr. UTP, EIA-568A spec.	
Unterminated pair conductor numbers	0	
REQUIRED LINKAGES		
	End 1	End 2
Pr 1-4, Term. pos. record	J00011	3A-C17-005
Splice records	n/a	
Pathway records	CT64	
Grounding record	n/a	
OPTIONAL INFORMATION		
Cable length	165 ft	
UPC	n/a	
Ownership	n/a	
Misc. information		
OTHER LINKAGES		
Other record 1		

Figure 14 Example of a Cable Record for a horizontal UTP cable

11.0 TESTING:

All test data shall be documented and provided to the purchasing agency at the time of acceptance.

11.1 Multipair UTP Feeder Testing:

All cable pairs shall be tested for the following conditions:

1. Polarity
2. Reversal of pairs
3. Wire transpositions
4. Continuity
5. Opens
6. Shorts

11.2 UTP Category 5e and Category 6 Testing Parameters

The current field acceptance test parameters for twisted-pair cabling are:

- Wire Map (continuity)
- Insertion Loss
- Length
- NEXT loss, pair-to-pair, measured from local end
- NEXT loss, pair-to-pair, measured from far-end
- NEXT loss, power sum, measured from local end
- NEXT loss, power sum, measured from far-end
- ELFEXT, pair-to-pair
- ELFEXT, power sum
- Return loss, measured from local end
- Return loss, measured from far-end
- Propagation delay
- Delay skew
- ACR
- Power Sum (PSACR).

NOTE: The above parameters will also apply to Class D and higher as specified in ISO / IEC 11801.

11.3 Fiber Optic Testing:

SYSTEM TESTING

Optical fiber splices, fusion or mechanical, shall not exceed a maximum optical attenuation of 0.3 dB when measured in accordance with ANSI / EIA / TIA- 455-34, Method A (factory testing) or ANSI / EIA / TIA-455-59 (field testing).

Optical fiber splices, fusion or mechanical, shall have a minimum return loss of 20 dB for multimode, 26 dB for singlemode, when measured in accordance with ANSI / EIA / TIA-455-107. The minimum singlemode return loss for broadband analog video (CATV) applications is 55dB.

Upon completion of the passive optical cable system, the system must be tested to ensure compliance with the design and link loss specifications.

The single most important test is end-to-end attenuation test that measures the optical power loss between cable termination points. The attenuation of a system at one wavelength is not necessarily related to the attenuation at the other, except for short links such as horizontal cabling. The best way to verify the cabling meets the loss limit is to measure each segment between patch panels. Because of the stress and bending that cables undergo during installation, measurement of the attenuation of each link with connectors in place is required after installation.

The tests include:

Power meter tests - For building risers, power meter tests are required. Disregard OTDR testing for runs less than 2 km.

Testing of End-to-End Attenuation on each fiber span at both operational wavelengths:

- 850 / 1310 nm for multimode fiber
- 1550 nm for single mode fiber

Testing in one direction is required. Test results shall be retained for inclusion into the documentation package. Link attenuation does not include any active devices or passive devices other than cable, connectors and splices (e.g., link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers).

Connector loss readings of each mated connector should be recorded using an OTDR at 850 nm and 1310 nm in one direction.

Optical Time Domain Reflectometer (OTDR) Signature Traces of each terminated fiber should be recorded at 850 nm and 1310 nm for fiber continuity purposes. OTDR testing is mandatory for runs longer than 2 KM.

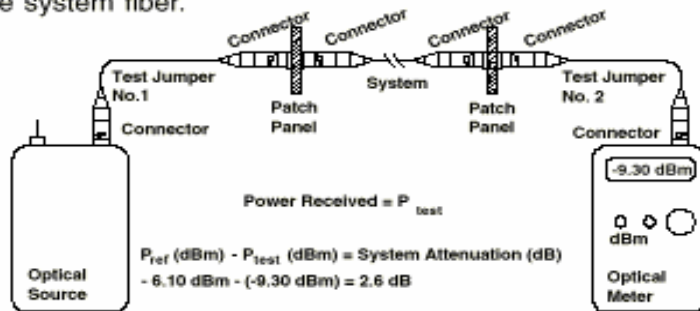
A Final Report shall be compiled that records system configuration, fiber labels, cable routes and "as built" details. Loss measurements with calibrated light source and power meter shall be included. OTDR traces shall also be included when requested in advance.

Leave the jumpers attached to the optical source and optical power meter.

Disconnect the two jumpers at the adapter.

Attach the optical source/Test Jumper 1 to one end of the system fiber to be tested.

Attach the optical power meter/Test Jumper 2 to the other end of the system fiber.



Record the test power (P_{test}).

Subtract the test power (P_{test}) from the reference power (P_{ref}) recorded in Stage 1 to determine the end-to-end attenuation:

$$\text{Attenuation (dB)} = P_{ref} - P_{test}$$

Figure 15 Fiber Link Test Setup

GLOSSARY

ADMINISTRATION - The process of documenting the initial wiring and management of the wiring system after the initial installation. It includes two major components: a standard labeling system and a records system.

AMERICAN WIRE GAGE (AWG) - An American industrial standard for measuring the diameter of copper, aluminum and other conductors; e.g. AWG #22 is a 0.64 millimeter (0.0253 inches) diameter solid conductor and AWG #24 is a 0.5 millimeter (0.0201 inches) diameter solid conductor.

ANSI - American National Standards Institute.

BUILDING MAIN DISTRIBUTION FRAME (MDF) – Old term removed from standards language but left in this document for reference. The interface between the public network and/or the interbuilding backbone, and the interframe backbone.

The MDF is usually in the Entrance Room (ER) or Main Telecommunications Room (MTR).

EIA - Electronics Industries Alliance.

ENTRANCE FACILITY (EF) - Facility where outside circuits/wiring enter a building through weatherproof sleeves and are terminated on blocks providing electronic protection to guard against damage from electrical disturbances such as lightning. In a single building, this is the point of demarcation between the serving telephone utility and the user.

EQUIPMENT ROOM - An area within a building where major components of large telecommunications systems (PBX's, data switches and communications processors) are housed. Equipment rooms are often distinct from telecommunications closets due to the size and quantity of the equipment they contain.

HORIZONTAL DISTRIBUTION SYSTEM (HDS) - The wiring that connects the intermediate distribution frame in the telecommunications closet to the telecommunications outlet. Horizontal distribution cabling is commonly run through the space provided by drop-tile ceilings or routed through ducts in floors and walls.

IEEE – The Institute of Electrical and Electronics Engineers, Inc.

IEEE 10 Gb/s Ethernet over copper – Category 6e / Class e Cabling – Only ratified by IEEE at the time of publication of this document. Category 6e / class e standards describe a new performance range for unshielded and screened twisted-pair cabling. Category 6 / class e is intended to specify the best performance that UTP and STP cabling solutions can be designed to deliver. Category 6 / class e is specified in the frequency range of at least 1 - 500 MHz. For Category 6 / class e, the 8-position modular jack interface will be mandatory at the work area. Category 6 / class e will be backward compatible which means that applications running on lower categories / classes will also be supported. If different category / class components are to be mixed with Category 6 / class E components, the combination shall meet the transmission requirements of the lowest performing category / class component. TIA, CENELEC, ISO, and others have collaborated closely on the development of these standards and their requirements are very much in harmony.

INTERBUILDING BACKBONE - The transmission facilities that connect the campus/complex main distribution frame to the building main distribution frames of each building in the complex. Includes multi-agency metropolitan areas with state right of way.

INTERFRAME BACKBONE - The transmission facilities that originate from the building main distribution frame and are vertically or horizontally distributed to each intermediate distribution frame in the building.

INTERMEDIATE CROSS CONNECT - Typically the equipment used to link the backbone and horizontal wiring systems. The intermediate cross connect is usually located in a telecommunications closet.

LINKAGE - A connection between a record and an identifier or between records.

INTERMEDIATE DISTRIBUTION FRAME (IDF) – Old term removed from standards language left in this document for reference. Replaced by Auxiliary Telecommunications Room. The cross connect between the interframe backbone (IFB) and the horizontal distribution system (HDS). The IDF may also serve as a connection point for per-floor Local Area Networking equipment. The IDF is normally in the Auxiliary Telecommunications Room (ATR).

MAIN CROSS CONNECT - Typically the equipment used to link the interbuilding and intrabuilding wiring systems. The main cross connect is usually located in the building entrance facility.

NETWORK INTERFACE (NI) - Contains the demarcation point between outside provider networks and the campus/complex or building distribution. Includes carrier test, loop back, and disconnect capability.

MEGAHERTZ (MHz) - Unit of frequency equal to one million cycles per second.

NEC - National Electrical Code.

NEXT - Near End Cross Talk - Signal distortion caused by the coupling of an outgoing signal at the originating end of a circuit with the incoming signal being received from the other end of the circuit

NFPA - National Fire Protection Association.

OSHA - Occupational Safety and Health Administration.

PATCH CORD - A length of wire, or fiber cable, with connectors on each end used to join telecommunications circuits.

PATHWAY - A raceway, sleeve, or exposed location for the placing of telecommunications cable.

TELECOMMUNICATIONS ROOM (TR) - The space in a building designed to provide a secure, suitable environment for the installation of cable, telecommunications equipment, and termination and administration systems. Telecommunications rooms are the points where the backbone and horizontal distribution facilities intersect. They are floor-serving rooms whose function is to terminate and connect the backbone cable system to the horizontal cable system and to house electronics that assist in the distribution of information to that floor.

TELECOMMUNICATIONS INFRASTRUCTURE - The components (telecommunications spaces, cable pathways, grounding, wiring and termination hardware) that together provide the basic support for the distribution of all telecommunications information.

TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB) - Primary grounding for the entire telecommunications in a building or structure.

TELECOMMUNICATIONS GROUNDING BUSBAR (TGB) - Auxiliary grounding for the telecommunications in a satellite telecommunications closet and tying into the telecommunications bonding backbone.

TELECOMMUNICATIONS BONDING BACKBONE (TBB) - A #6 AWG or larger insulated bonding conductor that provides direct bonding between different locations in a building.

TIA - Telecommunications Industries Association.

UNSHIELDED TWISTED PAIR - (UTP) wiring consisting of two insulated wires twisted around each other to reduce induction, thus interference, from one wire to the other. Twisted pair wire comes in bundles with varying numbers of pairs of wires, from two pair (four wires) to many thousands of pairs. UTP wiring is used to wire voice and data networks within buildings because it is relatively easy to install.

STAR - A network topology in which each telecommunications outlet is connected only to a distribution frame by a point-to-point link and connections between distributions frames are by point-to-point links.

TELECOMMUNICATIONS OUTLET (TO) - The interface between the building network (horizontal distribution system) and the work area connection to the user's equipment (phone and/or terminal device).

WORK AREA CONNECTION - The interface between the outlet and the user/terminal equipment. Includes media converters and media adapters, such as baluns and / or patch cords.

APPENDIX A: Recommended Cable Specifications

This guideline recognizes the following type cables:

Fiber optic Multimode - Riser, Inter-building applications, and horizontal pathways

Fiber optic Singlemode - Inter-building applications, video applications

Unshielded Twisted Pair (UTP) - Category 5e, Category 6 and above (TIA / EIA 568-B)
-Horizontal Distribution

Copper Data Cable Specification

The standards recognizing the data handling characteristics of all twisted pair cable and connectors are the ANSI / TIA / EIA-568-B. Although other levels are specified in these standards, this specific guidelines document standardizes on a minimum standard of Category 5e for all voice and data telecommunications UTP horizontal wiring. Category 5e cable is intended for LAN speeds at 100 Megabits per second at a frequency up to 100 MHz. Category 6 cable is intended for LAN speeds at 1000 Megabits (1 Gigabit) per second at a frequency up to 250 MHz. Category 6 augmented cable is intended for LAN speeds at 10 Gigabits per second at a frequency up to 625 MHz.

Note: ITS only recommends the use of polyethylene sheathed or interlocking armored cable for all “Outside Plant” applications.

Multimode Fiber Specification

Fiber type: 50/125 micron Laser Optimized Class 1a Graded Index Multimode, FDDI Compliant

Cladding Diameter:	125 Microns
Core Eccentricity:	7.5% maximum (1.5% typical)
Numerical aperture:	.275 plus or minus .015
Attenuation:	3.50 dB/km @ 850 NM 1.50 dB/km @ 1300 NM
Bandwidth:	500 MHz at 850 NM 500 MHz @ 1300 NM
Fiber connectors: SC type	.75 dB maximum insertion loss
Cable bend radius:	10 times diameter during installation

Fiber type: 62.5/125 micron Class 1a Graded Index Multimode, FDDI Compliant

Cladding Diameter:	125 Microns
Core Eccentricity:	7.5% maximum (1.5% typical)
Numerical aperture:	.275 plus or minus .015
Attenuation:	3.50 dB/km @ 850 NM 1.50 dB/km @ 1300 NM
Bandwidth:	160 MHz at 850 NM 500 MHz @ 1300 NM
Fiber connectors: SC type	.75 dB maximum insertion loss
Cable bend radius:	10 times diameter during installation

Single Mode Fiber Specifications

Fiber type: 8.3 Micron Class Ia Dispersion-Unshifted Singlemode Optical Fibers

Cladding diameter:	125 Microns
Attenuation:	0.5 dB/km @ 1310 NM 0.5 dB/km @ 1550 NM

Zero dispersion wavelength 1300 -1320 NM

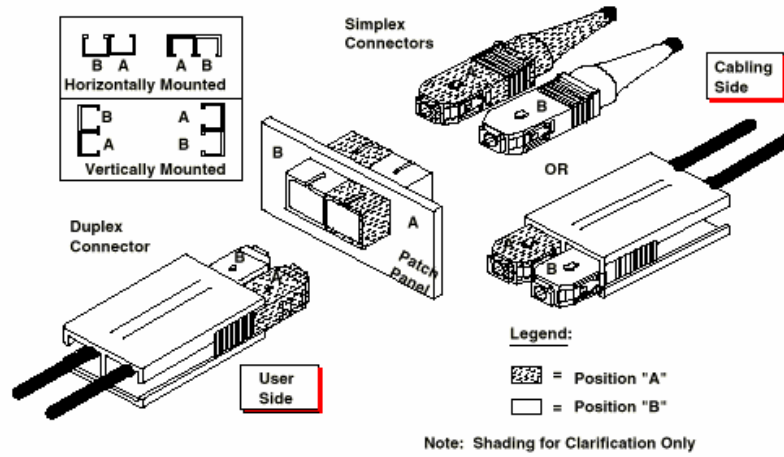
UL Ratings:	OFNR for riser usage OFNP for Plenum usage
Cable bend radius:	10 times diameter during installation

APPENDIX B:

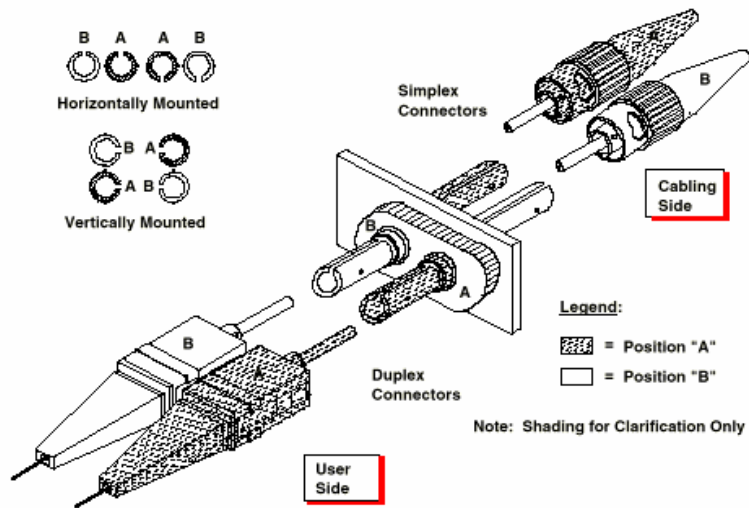
Recommended Connector Specifications

- | | |
|---|---|
| Using Standard Connectors | The 568SC connector is recommended throughout the optical fiber network. If the optoelectronics require other connectors, jumpers can act as a transition between connectors in a system and connectors in the electronics. |
| Migration Path for ST Compatible Users | <p>Because of the large number of users with an installed base of ST-compatible connectors, the ANSI / TIA / EIA-568-A specification previously recognized a number of viable options for these users.</p> <p>The options are:</p> <ul style="list-style-type: none">• Remain with ST-compatible simplex connectors for both future and existing networks.• Switch to a duplex ST-compatible interface which will allow the user to re-use existing connectors and adapters (see the illustrations below).• Retrofit existing networks by using a hybrid adapter of 568SC to ST compatible.• Switch to the 568SC interface for both future and/or existing networks. |

THE 568SC INTERFACE



DUPLEX ST-COMPATIBLE INTERFACE



568SC HYBRID ADAPTER

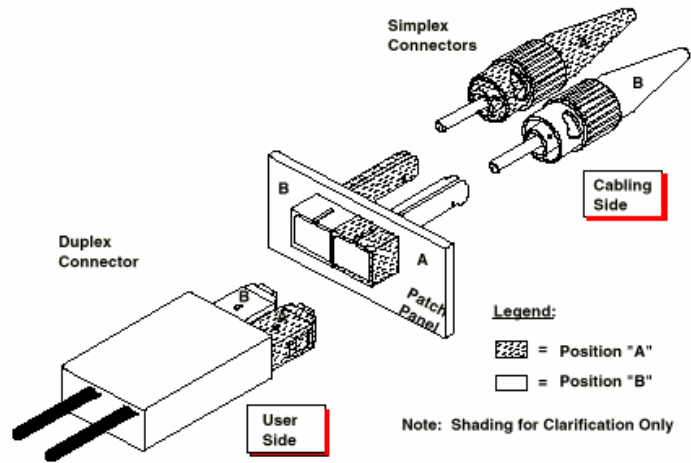


Figure 17 Fiber Connector Types

REFERENCES – The State of North Carolina expects and enforces strict adherence to the latest published versions of the codes and standards referenced on page 45.

Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Final Guidelines (July 1991) – 36 CFR Part 1191

Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – TIA / EIA-526 -7 (OFSTP-7)

Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – TIA / EIA-526 -14 (OFSTP-14A)

Commercial Building Telecommunications Wiring Standard – TIA / EIA-568 - B.1

Commercial Building Telecommunications Wiring Standard – TIA / EIA-568 - B.2

Commercial Building Telecommunications Wiring Standard – TIA / EIA-568 - B.3

Telecommunications Pathways and Spaces – TIA / EIA - 569

Residential Telecommunications Cabling Standard – TIA / EIA - 570

Optical Fiber Cable Color Coding – TIA / EIA - 598

Administration Standard for the Telecommunications Infrastructure of Commercial Buildings – ANSI / TIA / EIA-606

Commercial Building Grounding and Bonding Requirements for Telecommunications – TIA / EIA - 607

Customer-Owned Outside Plant Telecommunications Standard – TIA / EIA -758

Detail Specification for 62.5- μ m Core Diameter / 125- μ m Class 1a Multimode Graded Index Optical Waveguide Fibers – TIA / EIA - 492AAAA

Generic Requirements for Optical Fiber and Optical Fiber Cable – Bellcore TR-TSY-000020

National Electrical Code (NEC) Articles 600, 700 & 800

National Fire Protection Association (NFPA) NFPA - 71, - 72, - 75, - 780.

BICSI - Telecommunications Distribution Methods Manual (Newest Edition)
Building Industry Consulting Service International

BICSI - Customer-Owned Outside Plant Design Manual (Newest Edition)
Building Industry Consulting Service International

Customer –Owned Outside Plant Telecommunications Cabling Standard TIA / EIA –758 - 1