

2017

Wiring Standards and Guidelines

Longwood University

This document and its references are intended to assist the architect/designer and the installer in the base guidelines and standards utilized at Longwood University to complete an effective and efficient wiring infrastructure.



CHARGE

The Division of Communications and Technology Services (CTS) has the responsibility for planning, developing, managing and maintaining the most effective, efficient and economical communications network system. In its role as a system integrator of networks, the Division supports all University needs by approving and coordinating all voice, data and video communications systems policies. With the convergence of voice, data and video technologies, the Division is committed to a seamless communications services network.

In recent years, the focus on communications system planning, operations and procurement for voice, data and video communications have moved increasingly into the forefront of the attention of University administrators and department directors. Communications systems are now seen as a tool for improving employee productivity, facilitating the education process and reducing operating costs. By providing communications and applications compatibility between acquired communications systems and related services, the University will meet its goal of achieving a totally integrated information systems environment.

Communications and Technology Services will continue to maintain a sophisticated and comprehensive communications infrastructure through which the University community can share access to costly technology resources, and therefore minimize expensive and unnecessary duplication. The Division will develop and expand network systems to enhance and facilitate the growth of the infrastructure by providing leadership and coordination for the planning, development, acquisition and utilization of new technologies.

There are 12 numbered sections to this document:

- 1 -- SERVICE ENTRANCE AND TERMINATION -- OUTSIDE PLANT
- 2 -- TELECOMMUNICATIONS ROOMS AND CABLE TERMINATION
- 3 -- VOICE AND DATA OUTLETS--INSIDE PLANT WIRING AND RACEWAYS
- 4 -- TELEVISION CABLE AND OUTLETS
- 5 -- PROTECTION, GROUNDING AND BONDING
- 6 -- INSPECTION AND TESTING
- 7 -- FIRE STOPPING
- 8 -- LOCAL AREA NETWORKS
- 9 -- FIBER OPTIC TECHNOLOGY
- 10 -- MISCELLANEOUS AND SPECIAL SITUATIONS
- 11 -- CODES, STANDARDS AND REGULATIONS
- 12 -- GLOSSARY AND ACRONYMS

This document is intended to be a guideline for the designer and the installer. There are many variables that affect the design and construction of a building, but with the coordination of the designer and the IT department at Longwood University each building will be a success.

CONTENTS

1 -- SERVICE ENTRANCE AND TERMINATION -- OUTSIDE PLANT	
CABLE.....	4
CONDUIT	4
MANHOLES.....	6
2 -- TELECOMMUNICATIONS ROOMS AND CABLE TERMINATION	
SPACE.....	7
GENERAL	7
ENVIRONMENT.....	7
ELECTRICAL.....	8
GROUNDING	8
LABELING.....	8
CABLE	8
RACKS AND PANELS	9
WIRE DRESS	9
RACK AND PATCH PANEL.....	9
PUNCH DOWN	9
3 -- VOICE AND DATA OUTLETS--INSIDE PLANT WIRING AND RACEWAYS	
OVERVIEW.....	10
LABELING.....	10
WIRING.....	10
OUTLET LOCATION AND QUANTITIES.....	10
OUTLET INSTALLATION/MOUNTING.....	11
CONDUIT	12
LADDER TRAYS.....	12
4 -- TELEVISION CABLE AND OUTLETS	
LABELING.....	14
CABLE	14
VIDEO/PROJECTION DEVICES, CABLING AND OUTLETS.....	14
5 -- PROTECTION, GROUNDING AND BONDING	
LIGHTNING PROTECTION	15
MATERIALS	15
GROUNDING.....	15
BONDING	15
6 -- INSPECTION AND TESTING	
INSPECTION OF WORK.....	16
TESTING.....	16
LOCAL AREA NETWORK	16
7 -- FIRE STOPPING	
GENERAL	17
8 -- LOCAL AREA NETWORKS	
OVERVIEW	18
DETERMINING REQUIREMENTS	18
WIRING TYPE	18
9 -- FIBER OPTIC TECHNOLOGY	
OVERVIEW	19
INSTALLATION	19
10 -- MISCELLANEOUS AND SPECIAL SITUATIONS	
HANDICAPPED ACCESS	20
PUBLIC PAY PHONES	20
SWIMMING POOLS.....	20
11 -- CODES, STANDARDS AND REGULATIONS	21
12 -- GLOSSARY AND ACRONYMS	22

1 -- SERVICE ENTRANCE AND TERMINATION -- OUTSIDE PLANT

This section provides the necessary guidelines to install service entrances to buildings and information for the termination of cables entering buildings. Topics addressed voice, data and video and current CATV.

All outside plant voice, data, and video cabling, conduit and manholes shall be designed and/or approved by the University's Division of Communications and Technology Services.

Longwood University Facilities Management is responsible for the Energy Management System and campus Fire Alarm System.

CABLE

Prior approval and coordination with Communications Systems, Facilities, and other concerned parties is necessary when the situation requires pulling cable through a conduit occupied by another cable.

All cables associated with the campus telecommunications network (telephone, data, LAN, WAN, campus TV, CATV and fiber optics) shall be connected and disconnected by Communications Systems.

Only those cables specified, will be installed in any facility.

There shall be no cable with voltages higher than 48 volts in communications duct banks. Electrical feeders for sump pumps, lights and outlets must be installed according to the National Electrical Code requirements for wet locations. All conduits must be extended in the manhole. These conduits must be clearly tagged.

All cables entering a building shall be terminated on protection blocks. Only gas and solid state protectors shall be used.

Damages incurred to any cable are the responsibility of the party involved. All damages shall be reported immediately to Communications Systems and Facilities Managers.

CABLE - LABELING

All cables in each manhole shall be identified by the owner of the cable, cable number, cable type, number of pairs and the termination point. Labels shall include, for example: Communications Systems, Cable 05, SS 100, 101-200, B58. The tag shall be made of aluminum or stainless steel.

Whenever possible, all abandoned cable shall be removed from tunnels, manholes and conduit. If it is not feasible to remove abandoned cable, it shall be clearly tagged as abandoned, with appropriate labeling as above, and shall be reported to Communications Systems and Facilities Managers.

CABLE - AERIAL

Most university low voltage cabling is underground. No aerial wiring shall be done on campus unless approved by Communications Systems, Facilities Manager, and Capital Planning.

CONDUIT

Conduit sizing and quantities between buildings shall be determined by the Division of Communications Systems and will be communicated to Capital Planning for inclusion in the project. Minimum requirements are outlined in the following statements:

All campus buildings shall be connected to the nearest manhole or new manhole if one is to be installed.

Damages incurred to any conduit are the responsibility of the party involved. All damages shall be reported to Communications Systems and Facilities Managers immediately.

CONDUIT - REQUIREMENTS

All new facilities or renovations will be required to meet minimum requirements. Minimum voice, data, and video conduit required for each building shall be 4 conduits.

- Two (2) of which shall be 2" Schedule 40, PVC.
- Two (2), four inch, Schedule 40, PVC.

No more than the equivalent of two 90 degree long sweeps allowed in a run, including offsets.

A pull wire shall be installed and tied off in each conduit. Pull wires used in outside facilities shall be nylon and used to pull heavier rope as needed to install cable. Pull wire shall be installed with new cable to allow future installs. Pull wires used inside facilities shall be nylon.

CONDUIT - UNDERGROUND

All underground conduits and ducts, rigid or PVC, added to a project shall be added in groups of 2, 4, 6, 8, 10, 12 or more. Communications duct shall be 66.6 percent four (4) inch Schedule 40. Under no circumstances are single underground conduit runs acceptable.

All underground conduit, duct bank and raceways shall be steel reinforced, concrete (3500 psi minimum) encased PVC or direct buried threaded rigid steel. Additional reinforcement is to be used when crossing roadways.

All communications ducts shall be a minimum of 12 inches from power duct banks or cables. All communications ducts shall also be a minimum of 24 inches from steam pipes and condensation lines if crossing perpendicular.

When communication ducts run parallel to steam lines a minimum of a six (6) foot separation is required to avoid conduction of heat. All other duct separations must comply with the National Electric Code.

Rigid steel conduit, encased in reinforced concrete, shall be used in any location subject to abuse, such as under slabs or foundations.

All necessary precautions shall be taken during construction to prevent the lodging of dirt, plaster or trash in all conduit, tubing, fittings and boxes. All conduit in floors, concrete or below grade, shall be swabbed free of debris and moisture before wires are pulled.

All diggings and excavation on Longwood Property shall be approved by Facilities Manager and Communications Systems.

CONDUIT - TUNNELS

Where conduit or ducts are in tunnels, they shall be kept at least 24 inches from parallel runs of flues, steam pipes, hot gas pipes, hot water pipes or any other utility line which is hot during normal operation of the facility it serves. Unless written exception is provided by the University, all conduit sections crossing steam lines shall be rigid and shall be provided with a means of insulation from the steam lines.

CONDUIT - CONDENSATION

Duct banks shall be pitched to drain to manholes.

CONDUIT - TRAPS

All conduit, tubing, raceways, ducts and duct banks shall be installed in such manner to insure against collection of trapped condensation. Raceway runs shall be arranged to be void of traps.

When conduit passes through exterior concrete walls of any facility, the entrance shall be watertight. Provide pipe sleeves in the concrete with 1/2 inch minimum entrance seal.

All conduit shall have watertight connections and be sloped properly so they will drain into the manhole and away from the building entrance.

CONDUIT - TYPES

Gas pipe and water pipes shall not be used for conduit under any circumstances.

1 -- SERVICE ENTRANCE AND TERMINATION -- OUTSIDE PLANT - continued

Two types of conduit are accepted for underground conduit systems.

- Rigid galvanized steel conduit with threaded fittings -- This conduit shall be installed with reinforced concrete casing. If not concrete encased, this conduit shall be painted with two coats of coal tar base paint or have epoxy coating applied by manufacturer.
- Schedule 40 PVC conduit -- This conduit shall be installed with reinforced concrete casing. No PVC conduit is acceptable without reinforced concrete.

Rigid steel conduits installed underground shall be field-wrapped with 0.01 inch thick pipe-wrapping plastic tape applied with a 50 percent overlap, or shall have a factory applied plastic resin, epoxy or two coats of a field applied asphalt tar specifically made for this purpose. Where the asphalt tar coating method is used, the contractor shall notify the University Capital Planning Manager prior to backfilling so that the University may inspect the coating and approve before the conduit is covered.

Painting shall extend to six (6) inches above ground level where conduit is installed by a pole or side structure or inside pedestal.

The duct envelope shall be rectangular in the cross section and be a minimum concrete thickness of three (3) inches around any conduit. The duct envelope shall be sized and placed as shown on construction documents.

A minimum of four (4), # 4, steel reinforcing rods shall be installed in all duct bank envelopes. Where conduit enters a building or a manhole the rebars must be doweled into the existing structure to prevent shearing of the conduits in case of settlement.

Where a connection is made to an existing manhole or building the envelope shall be doweled into the existing encasements to prevent shearing due to settling.

All conduit and ducts must be terminated with bell ends at the manhole, facility or other termination point. Where trench walls are unstable or the trench width is wider than the envelope, the envelope shall be formed as required.

Duct spacers shall be provided at a maximum of seven feet intervals. Conduit shall be anchored at three (3) foot six (6) inch intervals and at each spacer to prevent duct floating during concrete installation.

Each duct run shall be done with a continuous concrete pour. Broken pours are not allowed without written exception from the University, and provided #4 rebar or larger is extended twelve (12) inches beyond the end of the envelope at the end of each day's pour and at all stub-outs.

MANHOLES

The University uses Quazit boxes in various sizes to accommodate the conduits either as splice points or pass through. Current part numbers are: Top-PG3060HH00, Box- PG3060BA36 or equivalent.

Boxes shall be installed to allow the top of the box to be at grade level with the surrounding landscape.

The boxes shall not be stacked more than two deep. The bottom six inches shall be filled with gravel, #56 in size, and not exceed past the top six inches of the conduit.

Boxes shall not be installed in locations where heavy traffic could damage the top.

The maximum depth of all manholes shall be ten (10) feet from the bottom unless otherwise approved by Communications Systems.

2 -- TELECOMMUNICATIONS ROOMS AND CABLE TERMINATION

Telecommunication rooms are special-purpose rooms that house telecommunications equipment. These equipment rooms have stringent requirements due to the nature, size and complexity of the equipment housed in the room. Refer any questions specifically not addressed in this document to CTS.

SPACE

The minimum dimension for a communications walk-in room is 150 square feet when the room is to be shared with computers, telephone switches, and equipment racks, such as a PBX or large key system. Other exceptions may apply; Communications Systems shall be contacted for final footage approval.

GENERAL

An approved fire extinguisher must be provided just outside the door of each closet. All work shall comply with the National Electrical Code, Commonwealth of Virginia Building Codes and Longwood University Communications Systems Guidelines and Capital Planning Design and Construction Standards.

Telecommunications rooms vary according to the size of the building, number of floors, tenancy characteristics and telecommunications services required. Consideration to the future needs of the facility and the end users is a necessity.

Electrical panels are strictly prohibited in communications rooms.

A 50 percent growth factor shall be built in and provided in each riser unless otherwise specified, consequently any cable or conduit work that pertains to telecommunications must be designed and/or approved by Communications Systems.

To facilitate the proper installation, routing and placement of cables, wires, premise equipment and terminal fields, communication rooms shall be located in the middle of the building instead of either end, unless otherwise instructed by Communications Systems. If multiple rooms are needed due to distance limitations, the rooms must be stacked one above the other. Architects must pay extra attention to room locations to overcome distance limitations. The total distance of the conduit path, from outlet to the communications room shall not exceed 275 feet including termination loss.

There must be 4" conduits from the communications room to each floor it serves, opening into the dropped ceiling spaces.

An "As Built" drawing shall be submitted with each job upon acceptance.

All communications room doors are to be keyed alike. Locks shall be spring lock (self-locking). All communications rooms will utilize access control key cards.

Doorways shall be designed with minimum measurements of 3 feet by 6 feet 8 inches and shall open outward into the corridor.

Floors shall be sealed concrete or tile, carpet is prohibited.

Telecommunication rooms shall be located above any threat of flooding. Rooms located in basements shall have floor drains with positive drainage otherwise sump pumps must be provided.

Fire treated plywood, 3/4 inch thick, must be mechanically fastened to a minimum of one wall and painted with two (2) coats of fire resistant paint of a neutral color. The fire treated plywood is to begin at four (4) inches AFF and end at 8 feet, 4 inches AFF.

The recommended ceiling height is 8 feet, 6 inches. Avoid false ceilings, if possible.

Install sleeves between stacked communications rooms, with sleeves extended 4 (four) inches AFF and 4 (four) inches below the ceiling of the room.

ENVIRONMENT

All communications rooms shall be environmentally controlled to maintain the room environment at a temperature range of 65 to 75 degrees Fahrenheit, with a maximum relative humidity level of 50 percent, 24 hours a day, 7 days a week. Communications rooms shall be conditioned with a fresh air exchange of three (3) air changes per hour. If HVAC must be shut down then an exhaust must be provided to remove heat.

2 -- TELECOMMUNICATIONS ROOMS AND CABLE TERMINATION - continued

No plumbing, HVAC, or electrical conduit shall pass through or be directly above the communications room. The space above the ceiling is needed for broadband amplifiers and/or assorted equipment.

ELECTRICAL

Lighting shall be four (4) feet fluorescent and provide a minimum of 100 FC/SF and connected to the emergency generator when available.

Multiple, four-plex, AC outlets must be provided to power telephone key systems, computer interfaces and other telecommunications requirements. Outlets must be flush when cut through plywood. All outlets shall be connected to a dedicated circuit breaker. Each dedicated electrical circuit shall be 20-amp, 110V, 60 Hz's type. All circuits must be tied to an emergency generator.

All breaker boxes are to be labeled and identified to avoid being turned off in error.

*Some equipment will require additional amperage, this will need to be verified during the design stage.

GROUNDING

All communications rooms shall have a grounding bar which shall be twelve (12) inches by one (1) inch with pre drilled 1/4 inch holes. This bar shall be attached to the main building grounding system with a wire not smaller than #2 AWG copper.

Each distribution point shall be grounded to the main building ground, NEC requirement shall be followed.

There shall be a grounding bar at each distribution panel. The ground bar shall be connected to building ground with a maximum resistance of 0.5 ohms or less.

LABELING

Communications, computer and television conduit is to be clearly identified, at every junction box, via a painted section or by use of conduit stickers indicating each conduit run; Blue = telephone, Green = computer, Yellow = television, Orange = fiber optic.

All Intermediate Distribution Frames, Building Distribution Frames and connecting blocks must be properly identified by destination.

All riser cables shall be properly marked. Marker is to be a flat piece of aluminum or stainless steel. This marking shall be permanent and indicate:

- The Origination (Cable it is feeding from).
- The Destination (Telecommunications room it is feeding).

All voice and data cable pairs in riser cables or the entrance cable must be terminated on a connecting block and identified.

CABLE

A 50 percent growth factor shall be built in and provided for unless otherwise specified; consequently any cable work that pertains to telecommunications must be designed and/or approved by Communications Systems.

Each telephone and data cable shall have a minimum of four (4) pairs; in some cases a larger cable may be required. Communications Systems will inform the contractor in such cases.

Plenum communications cable may be run exposed above ceilings, provided this cabling is supported independent of other utilities, such as conduits, pipes, ceiling support systems, and not laid directly on the ceiling panels. Use of Plenum cable must be approved by CTS.

All cables from the BDF must be 100 percent terminated in each IDF if applicable and approved by Communications Systems.

To facilitate future cable installations a new pull string, tied off at both ends, shall be installed in conduit simultaneously with the pull-in of cable.

2 -- TELECOMMUNICATIONS ROOMS AND CABLE TERMINATION - continued

In general all communication wires shall be copper, #24 AWG minimum, Category 6 for voice, Cat 6 for data, however user needs shall dictate the cable type and level. The type and level of wire required must be obtained from Communications Systems. The University is utilizing the AMP product line as the standard for campus.

RACKS AND PANELS

Under no circumstances shall electrical or any other utility panel be located in the communications room. All walls are to be used for blocks and terminations.

Each distribution panel shall have a 3/4 inch fire treated plywood backboard which has been painted with two (2) coats of fire resistant paint of a neutral color. The backboard will facilitate installation of terminal blocks and associated wiring. Each distribution point shall be identified as a building entrance and/or a floor service panel.

Junction boxes are to be provided on any conduit run longer than 100 feet.

All voice terminations at the BDF (Building Distribution Frame) will be on standard raised 66M150 type connecting blocks. All terminations at the IDF (Intermediate Distribution Frame) will be raised 66M150 type connecting blocks.

WIRE DRESS

VOICE STATION WIRES - Organize and label the cables in numeric room number order. For example; with multiple outlets label clockwise as you enter the room; A, B, C or 1, 2, 3.

Individually bundle and route the unshielded voice pair groups to each of the voice punch down block columns, located on the wiring surface labeled "Voice".

TYPE I AND TYPE-II STATION WIRES - Drop from communications room cable tray behind patch panel rack. Organize and label the cables in numeric room number order. When using Type II, separate shielded and unshielded pairs 6 inches below cable tray. Insure that the shielding braid does not contact the cable tray. Individually bundle and route the Type II unshielded twisted pairs to the punch down block columns, located directly behind the rack or in a rack patch panel.

RACK AND PATCH PANEL

Mount a 7-foot, 19-inch 2-post rack, (EIA standard or equivalent), in the indicated position. Position the rack to maintain a minimum of three (3) feet clearance from the front of the rack to the front facing room wall and three (3) feet clearance from the rear of the rack to the rear facing room wall. If a row of racks is to be installed in a communications room, maintain a minimum of two (2) foot clearance from the rightmost or leftmost rack to the opposing wall. Anchor racks to the finished floor with a Newton rack mounting kit. Ground the rack to the communications room grounding buss bar with #6 AWG copper wire.

Mount the patch panel (with grounding tower) in the top most rack position. Lay out the patch panel in ascending room number order from top left to bottom right.

Route the shielded pairs through the patch panel wire guides and through the grounding tower shield, fastening clamps enroute to the connector on the face of the patch panel.

PUNCH DOWN

Lay down all station wire pairs in numeric room number order from lowest room number at the top left most position to the highest room number at the bottom right position. Use Siemons block mounting brackets, part number 89B, with every installed block. Route all cables to be punched down to these blocks under the mounting bracket. Fasten the mounting brackets to the plywood wiring surface with #10 screws x 3/4 inch.

Voice 4-Pair -- Use Siemons, part number 66MI-50, white 50 pair 66 blocks with #89-B mounting brackets. Locate the punch blocks on the plywood wiring surface in the area designated as Voice Station Wires. Use one block width spacing between adjacent rows of blocks and lay down a maximum of four blocks in a column. Punch down the four (4) unshielded pairs on the block as indicated on the accompanying diagram.

Data 4-Pair – All data wiring terminates directly to the patch panels.

3 -- VOICE AND DATA OUTLETS--INSIDE PLANT WIRING AND RACEWAYS

OVERVIEW

All telephone and data station wiring shall be continuous wire from the IDF to the communication outlet.

The department's present and future requirements will determine the needs of multiple jack outlets. Final approval for the layout of jack outlets shall rest with Communications Systems. During the programming stage information will be provided to the consultant for inclusion in the project.

The following termination devices are acceptable AMP. Consult Communications Systems for final approval of alternate devices.

All voice outlets shall terminate in USOC RJ-11(X) six (8) conductor modular jack assemblies and extra pairs shall be marked as spare at its location on the terminal block.

Wire color coding shall be per AT & T 258 and Western Electric specifications.

The total wire path length from the outlet to the communications room must not exceed 275 feet in any case. This is important to meet Ethernet requirements of IEEE 802.3.

LABELING

Each end of all cables and all pairs will be labeled at their termination locations.

All jacks shall be marked at the point of manufacturer with engraved letters and/or symbols indicating that the top jack is voice and that the bottom jack is data. Horizontal mounted jack positions shall be data on the left and voice on the right. All jacks will be marked alphabetically and begin clockwise around the room, e.g. through the main entrance to the left, jacks shall read 102A, 102B, etc..

All modular jack assemblies must be labeled and identified.

All communication outlets not in use, either wired or empty, must have a blank plate covering the outlet and the wire shall be tagged and identified with the location of the originating IDF or BDF. When a contractor provides the wiring, an "As-Built" drawing with all room jacks identified must be provided.

WIRING

The following cable and wiring, because of their durability and reliability among certified brands, are recommended for use at the Longwood University. Only with the approval of Communications Systems can an alternative or equivalent be used. A sample of the equivalent cable or wire must accompany the request.

Voice 4 Pair - Use only AMP Level/Category 6 wire, blue in color.

Data 4 Pair - Use only AMP Level/Category 6 wire, blue in color.

OUTLET LOCATION AND QUANTITIES

Unless otherwise specified, the following number of outlets shall be installed in the following locations AND quantities, depending on the function for that particular office/room.

- Faculty/Administrative Offices: Each office shall have two (2) communication outlets per designated occupant.
- Clerical/Staff Offices: Two (2) communication outlets, one (1) at the location of each desk and one (1) additional outlet for a facsimile or printer. Each additional staff member in the same area will require additional outlets.
- Conference Rooms: A minimum of four (4) communication outlets per room. One (1) outlet shall be located on each wall. Rooms with more than 500 square feet shall have additional outlets equally spaced on each wall. These outlets are not to be located on entry or window walls. Some areas may require the conference table to be wired.

3 -- VOICE AND DATA OUTLETS--INSIDE PLANT WIRING AND RACEWAYS - continued

- Laboratories/Graduate Student Offices: Two (2) wired communications outlets for every occupant. Additional outlet requirements will be determined based on size and in the design phase of the project.
- Classrooms/Lecture Halls/Auditoriums: One (1) to four (4) communication outlets depending on room and student occupancy size.

NOTE: * Three outlets in the front of room at the instruction podium. Wireless connection ports will need to be above ceiling grid. Number of ports required will depend on occupancy. Standard is 1 port per twenty occupants.

- Residence Halls: One (1) communication outlet per occupant of each room. The location will be determined during design stages of the project.
- Storage Areas: One (1) communication outlet per room. Two (2) outlets for rooms over 500 square feet and one (1) additional outlet for each additional 2000 square feet.
- Janitor Closets: Some closets may require communications outlets for telephones, computers or time reporting devices.
- Vending Areas: Specific requirements for vending areas will be determined during the design stages of the project.
- Access Control: Specific requirements for access control will be determined during the design stages of the project.
- Security Cameras: Specific requirements for security cameras will be determined during the design stages of the project.
- Laundry Services: Specific requirements for laundry devices will be determined during the design stages of the project.
- Point-of-Sale Devices: Specific requirements for point-of-sale services, to include cash registers, will be determined during the design stages of the project.
- Pay-for-Print Devices: Specific requirements for pay-for-print services will be determined during the design stages of the project.
- Attendance Readers: Specific requirements for attendance readers and associated devices will be determined during the design stages of the project.

OUTLET INSTALLATION/MOUNTING

Use a dual gang outlet box similar to Steel City, part number 72171-1. When mounting the outlet box in a steel studded wall, use a back brace.

Use only Steel City plaster rings, part number 72-C13, (single gang) or 72-C-17 (double gang) or equivalent. It is absolutely critical that the inside opening area match the outlet installation enclosure.

The plaster rings must be level and positioned flush with the finished surface.

For wall telephone only outlets use a single gang plaster ring.

Outlets are to be mounted at standard industry heights and positions, unless otherwise specified by Communications Systems. Standard mounting height of communication outlets:

- Desk 18 inches, AFF. (Dual gang plaster ring)
- Wall 60 inches, AFF. (Single gang plaster ring only)
- Handicapped wall mount 48 inches, AFF. (Single gang plaster ring only)
- CATV is normally installed at the height of TV mounting. Use only a single gang plaster ring.

Note: Electrical outlets shall be provided for TV and projection devices.

CONDUIT

All conduit work shall meet the specifications of National Electrical Code conduit installations.

All voice, data and video wiring inside rooms shall be protected by metallic conduit or other means such as wire mold or troughs in the floor. PVC conduit and plastic molding are not acceptable except in caustic environments. Aluminum is not acceptable in caustic environments. EMT conduit shall be used for all interior wiring. All conduit is to be concealed.

No more than one (1) 90-degree bend is allowed in a run between junction boxes or pull boxes.

The use of plenum cable instead of conduit shall be determined on a case-by-case basis. Communications Systems must be contacted for approval.

All EMT fittings shall be compression type. Set screw type fittings are NOT acceptable on conduit less than 2 1/2 inches in diameter.

In major renovation and new construction projects, the contract shall include provisions for installation of four (4) riser conduits (4 inches minimum diameter) from the BDF to each IDF. A pull string and appropriate junction pull box shall also be provided in each conduit run to facilitate future installation of cable(s).

All conduit in slab shall be a minimum of 1 1/4 inches galvanized steel with threaded fittings.

All exceptions shall be determined during the design stage of the project and shall be subject to the approval of Communications Systems.

All sleeves must protrude four (4) inches AFF and below and be capped at both ends.

Coordinate with Communications Systems for the number of conduits entering the facility.

No horizontal conduit run shall be more than 100 feet between pull boxes, per NEC requirements.

Conduit for telephone or computer outlets shall be terminated in a dual gang box. Steel City, part numbers 52151-1, 72151-1, 52-C-17 or 72-C-17 for one (1) inch with dual gang plaster ring and 72151-1, 52-C-13 or 72-C-13, for 1-inch with single gang plastic ring.

All communications outlets shall be one (1) inch conduit, with an absolute minimum of bends, from the outlet to the cable tray, wire way or homerun directly to the communications room. Pull boxes must be installed every 270 degrees or 100 feet of the conduit run. Use only compression fittings at every joint.

- In the case of a conduit terminating in a cable tray, the conduit must be mechanically fastened to the side of the cable tray and the conduit end at the tray must be terminated in a grounding bushing and wire bonded to the tray. Note: A metal strap is not acceptable as a means of grounding the conduit to a cable tray.
- In the case of conduit terminating in the communications room, the conduit must be terminated with a grounding bushing and wire bonded to the room ground bus bar.

Conduit capacity will be dependent on number and type of cables utilized. Cable jacket has varying thickness which will minimize the number of cables installed.

LADDER TRAYS

All ladder trays shall be designed to accommodate voice, video, and data cabling; consequently any cable work that pertains to telecommunications must be designed and/or approved by Communications Systems.

The minimum dimensions for a ladder tray shall be 12 inches wide and 4 inches deep.

Contract documents shall show cross section of the communication wire way or cable tray. The drawing must show reference to other utilities in the building.

Consideration may be given for installation of other types of cables in a ladder tray to prevent interference on unshielded cables. Location of such installation shall be approved by Communications Systems.

3 -- VOICE AND DATA OUTLETS--INSIDE PLANT WIRING AND RACEWAYS - continued

Ladder tray (cable tray) or wire way is to be supported with all thread rods in a trapeze form as diagrammed. Supports for cable trays larger than 12 inches in width are to be installed at a maximum distance of five (5) feet apart or according to the manufacturer's specifications, whichever is more stringent. Supports for cable trays 12 inches or less may be farther apart but must meet the manufacturer's installation requirements. A single support is not acceptable.

Communications Systems will not install any cable or perform any work until all installations are made to comply with specifications.

LADDER TRAYS - MOUNTING

Cable trays must be a minimum of one (1) foot from the ceiling and a minimum of eight (8) feet AFF. Trays are to be looped the entire parameter of the room.

Install sweeping factory 90's for all turns. Use end-of tray termination's where wire drops down to walls to prevent abrasions and cuts from metal tray edges. Use a trapeze cable tray mounting method suspended by 1/2 inch all thread. Fasten all thread to ceiling anchors, allowing no bends in all thread. Support the cable tray in this manner at every section-to-section junction and at five (5) feet to six (6) feet intervals (mid span) between joints. In no case shall the tray be closer than eighteen (18) inches from the structural ceiling, ducts or pipes, considering all other possible obstructions. A minimum of two (2) feet distance from lighting, especially fluorescent lighting, is required.

4 -- TELEVISION CABLE AND OUTLETS OVERVIEW

LABELING

Television cables are to be clearly identified via a painted section or by use of conduit stickers indicating each conduit run; Yellow = television.

CABLE

Television outlet cable shall be RG-6/U type coaxial, 75 ohm, Belden part number 1189A or equivalent.

Television riser cables in multistory buildings or buildings with first floor IDF's shall be 75 ohm's and cable design must be obtained. As a rule the minimum acceptable riser cable is type 500 coaxial cable. Obtain all cable sizes from Communications Systems.

All cable shall be run within conduits.

Each outlet shall be home run to the nearest communications room.

VIDEO/PROJECTION DEVICES, CABLING AND OUTLETS

Communications Systems or Instructional Telecommunications shall provide the specifications and cable parts for projection devices and /or monitors.

Projection devices are either ceiling or table type mounts. In each case the conduit must be connected to the front of the classroom at the podium or instructor station.

5 -- PROTECTION, GROUNDING AND BONDING

LIGHTNING PROTECTION

Lightning protection of telecommunications facilities is essential. While federal and state standards must be adhered to, local conditions may require additional investigations and/or modifications to meet site, equipment, environmental or safety requirements.

NEC Articles 250 "Grounding" and 800 "Communications Circuits" cover general requirements for grounding, bonding and protecting electrical and communications circuits. NFPA 78 "Lightning Protection" addresses zone protection and other items which are beneficial.

All cabling and wiring (including grounding) within the building and entrance facilities with protection from lightning and power failure via grounding and bonding will be accomplished under the construction contract.

MATERIALS

The three most frequently used lightning protectors are listed below. Contact Communications Systems for a determination of the most appropriate protection for the condition.

- AT & T Protection Housing -- AT & T, part number 189 ECT1-100, the last three (3) digits vary depending on pair size, i.e., 100 = 100 pair protector. The protection module shall be Cook Electric, part number 303-855.
- Krone Protection Housing -- Krone, part number 6637-1-44014/25 for 100 pair protection, includes protection modules. Krone, part number 6637-1-48018/25 for 200 pair protection, includes protection modules.
- Use Cook Electric, part number 500-LCGX for single drops of 6-pair or less.

GROUNDING

All grounding shall use single point schemes from the building main transformer, with a minimum of #2 AWG solid copper wire which has been tested to a maximum of 0.5 ohms.

All shields shall be bonded to a common ground.

All riser cable must be shielded and properly grounded to the building ground through grounding facilities provided at the BDF.

All Type II station cable must be grounded at the IDF by using a properly sized ground wire (#10 or larger) which is grounded at the BDF with a connection to the building earth ground.

The shield of the riser cable is not a proper ground for the IDF.

BONDING

Bonding is to be durable, strong and of low impedance to assure electrical continuity.

All conduit terminating to cable trays and wireways shall be mechanically fastened, equipped with ground bushings and wire bonded to the tray. The cable tray or wire way shall be grounded to the main building grounding system with a wire not smaller than #2 AWG copper.

A resistance of .001 ohm or less indicates a high-quality junction (BICSI).

Refer any questions specifically not addressed in this document to Communications Systems.

6 -- INSPECTION AND TESTING

INSPECTION OF WORK

Communications Systems designees shall have access to construction sites.

To enable Communications Systems to inspect telecommunications facilities work, the contractor must:

- Provide a progress schedule with the installation of telephone raceways and spaces shown as a separate item.
- Immediately notify Communications Systems of any change in architectural drawings and/or plans affecting telecommunications.
- Provide proper access and facilities for inspections.
- Notify Communications Systems when any work is ready for inspection.
- All underground work must be inspected and approved by Communications Systems before the site is covered with dirt or concrete. Failure to have the work inspected shall result in uncovering the area at the contractor's expense.

The contractor shall provide a final checkout certification letter and inspection reports to CTS on all telecommunications work.

TESTING

The contractor shall submit to Communications Systems, a detailed test procedure to be used for every project. All cables shall be tested for length, attenuation, impedance, grounds shorts, continuity of communications conductors and shields.

Upon completion, test results shall be submitted to Communications Systems for final approval and acceptance and made part of the document. The contractor shall guarantee 100 percent good pairs on all cables.

Communications will perform necessary testing before accepting a job. Failure during testing will result in new cable installation at the contractor's expense.

LOCAL AREA NETWORK

All Local Area Networks cables must be tested to conform to 1000BaseT standards. All tests shall be performed at the rate of 1 Gigabit and will be tested for the following:

- Continuity
- Length
- Loss
- Resistance
- Crosstalk
- Noise
- RMS
- Impulse
- Active Hub
- Network Monitor

Test results are to be provided to Communications Systems prior to acceptance of the building.

7 -- FIRE STOPPING

GENERAL

Provide fireproof seals in accordance with the National Fire Protection Association (NFPA) and the National Electric Code (NEC), Article 300-21.

Fire stop all penetrations in accordance with the current edition of the National Electrical Code.

Fire treated plywood, 3/4 inch thick which has been painted with two (2) coats of fire resistant paint of a neutral color, must be mechanically fastened to the wall of each room. The fire treated plywood is to begin at four (4) inches AFF and end at 8 feet, 4 inches AFF.

8 -- LOCAL AREA NETWORKS

OVERVIEW

All connections must be clearly labeled at both ends.

Use a one (1) inch home run conduit from the outlet to the cable tray, wire way or directly to the communications room, with pull boxes every 100 feet. In the case of an outlet's conduit terminating in a cable tray, the conduit must be mechanically fastened to the side of the cable tray and the conduit end at the tray must be terminated in a grounding bushing and wire bonded to the tray.

The total wire path length from the outlet to the communications room, including loss due to terminations, must not exceed 275 feet from the IDF in any case.

DETERMINING REQUIREMENTS

Consult Communications Systems Data Communications and Local Area Technical Reference books for details.

WIRING TYPE

AMP category 6 wiring is utilized for data drops. Wire jacket may be plenum or non-plenum depending upon HVAC type. Termination will be AMP jacks with 568b standards.

9 -- FIBER OPTIC TECHNOLOGY

OVERVIEW

All fiber optic planning and installation shall be approved by Communications Systems. When installing fiber optic cable, it shall be pulled in a protective liner inside the conduit and protected inside the manhole, to allow future use of conduit and also prevent damage to the cable. The liner could be extended, however this may vary due to circumstances.

All new outside plant conduit shall include at least two (2) conduit sleeved for Fiber Optics or use Tele-Duct. Proper parts are to be used, consult Communications Systems. Inner ducts are only used on existing facilities.

All cable that is to be connected or disconnected from the campus telecommunications network; telephone, data, video, to include, Local Area Network, Wide Area Network, CATV cable and fiber optics, shall be done by Communications Systems.

Contact Communications Systems for the type of fiber optic cable to be used.

INSTALLATION

All fiber optic cables shall be terminated via an LC connector and properly connected to the distribution points in a fiber panel.

Jumper or patch cords are to be used to connect different pairs of cables together for continuation of service.

10 -- MISCELLANEOUS AND SPECIAL SITUATIONS

HANDICAPPED ACCESS

All conduit outlets for house phones, corridor phones, courtesy phones and pay phones are to meet height and location requirements in the American with Disabilities Act for handicapped access. This standard only refers to telecommunication requirements. All other utilities are the responsibility of the department involved.

PUBLIC PAY PHONES

TT, Text Telephones (formally TDD), must be accessible to handicapped individuals.

The height of the coin slot shall be 48 inches for all installations.

If a total number of four (4) or more public pay telephones (including both interior and exterior phones) is provided at a site, and at least one (1) is in an interior location, then at least one interior public text telephone shall be provided.

SWIMMING POOLS

PVC conduit and plastic molding are not acceptable except in caustic environments such as swimming pools. Aluminum is not acceptable in caustic environments.

When poolside telephone service is desired and there is no building near to hang attachments on, install a pedestal and run a 1 1/4 inch conduit to the location. If the conduit length is longer than 100 feet, install a pullbox according to NEC.

11 -- CODES, STANDARDS AND REGULATIONS

To design facilities for an effective telecommunications system, the designer and installer must be familiar with national and local regulations. Both the designer and the contractor must be familiar with and adhere to the standards of the telecommunications and building industries.

AGENCIES

The following agencies and their codes, standards and regulations shall govern all telecommunications work performed at the University.

- ANSI American National Standards Institute
- BICSI Building Industry Consulting Service International
- BOCA Building Officials and Code Administrators (Standard Building Code)
- EIA Electronic Industries Association
- FCC Federal Communications Commission
- ICBO International Conference of Building Officials (Uniform Building Code)
- IEEE Institute of Electrical and Electronic Engineers, Inc.
- NBC National Building Code
- NFPA National Fire Protection Association
- NEC National Electrical Code
- TIA Telecommunications Industry Association
- UL Underwriters Laboratories
- Longwood University Wiring and Cabling Guidelines
- Commonwealth of Virginia Communications Standards

12 -- GLOSSARY AND ACRONYMS

AFF Above Finished Floor

AWG American Wire Gage

BDF Building Distribution Frame

CDF Combined Distribution Frame

COMMUNICATIONS SYSTEMS Communications and Technology Services

DOWELED Drilled hole for rebar

ECL Type of token ring connector

EMT Electrical Metallic Tubing

FC Foot-candle

HVAC Heating, Ventilation and Air Conditioning

Hz Hertz

IBM International Business Machines

IDF Intermediate Distribution Frame

LAN Local Area Network

OHM Unit of resistance

PBX Private Branch Exchange

PVC Type of conduit

SF Square foot

TT Text Telephone (formally TDD)

WAN Wide Area Network