



PDHonline Course E124 (3 PDH)

**Telecommunications Premises
Distribution Planning, Design, and
Estimating**

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2020

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MILITARY HANDBOOK

TELECOMMUNICATIONS PREMISES DISTRIBUTION PLANNING,
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FOREWORD

This handbook has been developed from an evaluation of facilities at DOD establishments, from surveys of the availability of new material and construction methods, and from selection of the best design practices of the Naval Facilities Engineering Command (NAVFACENGCOM), Army Corps of Engineers, other Government agencies, and the private sector. This handbook was prepared using, to the maximum extent feasible, national professional society, association, and institute standards. Do not deviate from this criteria in the planning, engineering, design, and construction of DOD facilities without prior approval of the respective component office of responsibility--U.S. Army, HQ USACE/CEMP-E or USAISEC CONUS or the appropriate USAISEC geographical office, U.S. Navy, NAVFACENGCOM Code 15C.

The following applies to Army projects: The cost estimating guidance in this handbook will not be used. The Information Systems Cost Estimator (ISCE) for Windows shall be used to establish cost estimates for all Army projects. The use of a Registered Communications Distribution Designer (RCDD) is not mandatory. For all Army Medical projects, any further deviation from this criteria must be approved by the HQ USACE Medical Facilities Design Office - CEMP-EM.

The following applies to Navy projects: The outside plant backbone telecommunications cabling should be single mode fiber optic media installed in a modified star architecture to allow migration to asynchronous transmission mode (ATM) architecture without media replacement. The backbone cabling shall also comply with Navy Base Communications Standards prepared by the Navy Computer and Telecommunications Command. Navy designs should be prepared and approved by a registered communication distribution designer (RCDD). Navy planners, engineers, designers, telecommunications specialists, and base communications officers should use the Navy telecommunications software cost estimating program TELECOM which is provided on the Construction Criteria Base (CCB). A partial listing of commercial and Government standards, that addresses telecommunications design and installation practices, is provided in Appendix A. This list should be reviewed jointly by the major claimant and the RCDD to confirm the adequacy of the commercial standards to meet the telecommunications requirements of the facility.

FOREWORD (Continued)

Recommendations for improvement are encouraged. Submit recommendations using the DD Form 1426 provided inside the back cover to the respective component office of responsibility. Approved recommendations will be forwarded to Commander, Naval Facilities Engineering Command (NAVFACENGCOM), Code 15C, 1510 Gilbert Street, Norfolk, VA 23511-2699; telephone commercial (757) 322-4208, facsimile machine (757) 322-4416.

THIS HANDBOOK SHALL NOT BE USED AS A REFERENCE DOCUMENT FOR PROCUREMENT OF FACILITIES CONSTRUCTION. IT IS TO BE USED IN THE PURCHASE OF FACILITIES ENGINEERING CRITERIA MANUALS. DO NOT REFERENCE IT IN MILITARY OR FEDERAL SPECIFICATIONS OR OTHER PROCUREMENT DOCUMENTS.

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Section 1: TELECOMMUNICATIONS PLANNING AND DESIGN

1.1 Overview

1.1.1 Responsibilities. The DOD construction agency responsible for the construction of facilities is either the United States Army Corps of Engineers or NAVFACENGCOR, as assigned within the respective geographic areas by the Office of the Secretary of Defense. DOD directives 5136.10, Defense Medical Support Activity and 6015.16, DOD Policies for Planning Fixed Military Health Facilities provide additional information. Telecommunications support for MILCON projects is outlined in MIL-HDBK-1190, Facility Planning and Design Guide. This handbook addresses only the requirements for telecommunications pathways and cabling necessary to support voice, data, and video systems permanently installed in the facility. Other systems, such as security, fire alarms, and environmental monitoring, which are not addressed here, also have similar cabling requirements.

The designer should consult with the electrical and security designers to consider joint use pathways, where economically feasible. In general the construction agency is responsible for providing inside and outside cabling and support structures (pathways) necessary to provide a complete and usable telecommunications distribution system. The handbook contains planning, design, and installation criteria. Parametric cost estimating software is provided on the CCB system optional cost databases identified as TELECOM. This software currently provides cost data for the interior building cabling, backbone cabling, and pathways to the closest maintenance hole connection. This handbook does not address an evaluation or expansion of the outside plant or central switching and routing systems.

1.1.2 Scope. As shown in the flowchart in Figure 1, given only the square footage per floor of the proposed facility and its function or functional areas, the estimator should be able to quantify and estimate the cost of the following telecommunications cabling items:

a) The maximum number of generic workstations per floor which the facility will support;

[retrieve Figure 1. DD Form 1391 Planning]

1.2.2Approach. The communications design process must begin with an analysis of the user workstations. Their number and configurations determine the amount and type of horizontal cables to be pulled, either through embedded floor ducts or through the ceiling, from the workstation outlets to the serving telecommunications closets. This information will also be used to determine the locations and sizes of the telecommunications closets and the composition and size of the backbone and entrance facilities.

1.3 User Workstation Requirements

1.3.1Workstation Capabilities. A workstation is defined as the place, such as a desk or fixed position, where an employee performs his or her daily duties. It consists of a voice instrument and a personal computer (PC) or terminal, as shown in Figure 3. Workstations, whether within a walled office or an open bay area, will be provided with voice access to the resident network via a unique telephone number. This is referred to as the "single line concept." Workstations will also be provided with connectivity to the LAN for access to the applications, utilities, and files resident on the network server. It is the responsibility of the RCDD to ensure that cabling and support structures required to connect the workstation via intermediate telecommunications closets to the equipment room and building entrance facility are in accordance with applicable standards.

1.3.2Cables to the Workstation. The voice and data station cables leaving the workstation are connected to the building horizontal cabling system by means of a faceplate configured with the appropriate voice and data modular inserts. A typical faceplate configuration is shown in Figure 4. The faceplate should be flush mounted on the wall rather than surface mounted wherever possible. Faceplates specifically designed for installation in the baseplate of modular furniture are available for open bay areas. See Figure 5.

1.3.2.1 Unshielded Twisted Pair (UTP). Four pair, 24 AWG, 100 ohm, UTP is the preferred media for bringing voice and data to the workstation. The two categories of UTP cable approved for general use are categories (CAT's) 3 and 5. CAT 3 cable is manufactured to specifications that will support voice and data at operating rates not to exceed 16 MHZ. CAT 3 components are tested to 16 MHZ but are

not recommended for operations above 10 MHz because of their susceptibility to wide variations in attenuation as a result of variations in temperature. To support rapidly rising data rates over a 10-year period, the use of CAT 3 cable should be restricted to voice or alarm systems. CAT 5 cable may also be employed for voice circuits where specified by the military department (MILDEP) or to avoid excessive levels of cross talk. UTP is not specified as the transmission media for data circuits which exceed a transmission rate of 100 MHz. However, UTP cables are being researched for use at data rates in excess of 100 MHz for applications such as the transmission of asynchronous transfer mode (ATM). Additionally, the National Electrical Manufacturers' Association (NEMA) is developing a specification, WC-66, for a high frequency low loss, extended frequency 100 ohm screened or shielded cable for operations up to 300 MHz.

1.3.2.2 Fiber Optic Cable. Fiber optic media must comply with EIA/TIA 568, EIA TSB-72, Centralized Optical Fiber Cabling Guidelines, and Article 770 of NFPA 70. Fiber optic media in vertical pathways must conform to UL 1666, Flame Propagation Height of Electrical and Optical Fiber Cables Installed Vertically in Shafts. Fiber optic media in air handling plenums must pass NFPA 262, Fire and Smoke Characteristics of Wires and Cables. Multimode, 62.5/125 micron, tight buffered, tight tube, fiber distributed digital interface (FDDI) grade fiber optic cable should be installed in the vertical backbone to support data systems and may be substituted for the CAT 5 horizontal data cable when required by user terminal equipment. Installation and termination of fiber optic cable is comparable to that of CAT 5 in cost and level of effort; however, the cost of the electronics necessary for electro-optic conversion results in a somewhat higher total cost for the fiber optic installation. This cost is decreasing. When employed, the fiber optic jack will be a duplex device housing two unidirectional fiber optic terminations. The duplex 568SC connector specified in EIA/TIA 568 is shown in Figure 6. Activities currently employing ST connectors may continue to do so.

Single-mode fiber may be required for inter-building backbone applications and may be specified by the major claimant for vertical backbone support of high data rates.

1.3.2.3 Screened UTP. CAT 5 100 ohm UTP is available with a grounded screen for additional EMI containment or rejection. Unique eight-pin modular plugs and jacks are required to provide a path for the ground circuit between the workstation and the network equipment.

1.3.2.4 Coaxial Cable. Fifty ohm coaxial cable is not normally recommended for new construction, but may exist in refurbished buildings where existing Ethernet electronics are to remain. If existing 50 ohm coaxial systems are to be modified, the RCDD should consult the original equipment manufacturer (OEM) for: recommended maximum cable lengths, approximately 200 m (600 ft.); minimum distances between drops, approximately 2.5 m (8 ft.) and the maximum number of drops per run (approximately 28) prior to modifying any coaxial runs. Connection of equipment designed for unbalanced coaxial distribution cable to a balanced UTP network requires the use of a BALUN device.

1.3.2.5 Shielded 150 Ohm Cable. Two pair 150 ohm shielded cable is not recommended for new construction but may be encountered in the refurbishing of older buildings. Its presence may indicate an area of increased EMI and should be approached accordingly. Shielded cable is prevalent in Europe where electronic emission standards are more stringent.

1.3.3Wall-Mounted Outlets and Conduit. Provide flush-mounted faceplate attached to a 103 cm (4 in.) square by 56 mm (2-1/8 in.) deep wall box in accordance with EIA/TIA 569. This requirement is designed to provide sufficient space to allow coiling of the cables within the box without exceeding the minimum bend radii. A reducer may be added to allow the attachment of a single-gang faceplate. The box should be connected to appropriately sized conduit which is stubbed up into an accessible ceiling, homerun to the serving telecommunications closet, or connected to an in-floor distribution system. Conduit sizes to support wall box configurations are dependent upon the number and diameter of the distribution cables being run. Conduit should be sized to accommodate the future installation of fiber to the desktop. Refer to par. 1.5.1.3.c) of this manual or EIA/TIA 569, Table 4.4-1, for assistance in sizing conduit. Wall boxes should be installed at the same height as the electrical outlets which is normally 42.5 cm (17 in.) above the finished floor (AFF) measured from the center of the box. Provide wall mounted outlet in kitchen area within housing units. Outlet shall be installed 120 cm(48 in.) AFF. Pay telephones are to be installed 100 to 105 cm (40 to 42 in.) AFF. The Americans With Disabilities Act requires that the highest operable mechanism on a pay telephone be within 135 cm (54 in.) side reach and 120 cm (48 in.) forward reach.

1.4 Horizontal Cable Requirements

1.4.1Building Usage. The first step in quantifying building telecommunication cable requirements is the categorizing of the building by its type of telecommunications usage. Major usage types, as described below, each have both general and unique cabling requirements. When uncommon building types are encountered, the RCDD should consult the major claimant for specific distribution requirements. Cable distribution density within a building is dependent upon the buildings projected functions over a 10-year

period. Pathways should be designed for the life of the building. Premature recabling is time consuming, expensive, and disruptive to both users and system operations. To correctly size the cabling infrastructure, the RCDD is encouraged to select one of the various building usage types listed below prior to computing the quantity and types of cables required to support each workstation and the type and size of the horizontal pathway required to run the cables from the workstation to the telecommunications closets. This information will also be used in later subsections to size the telecommunications closets, backbone cables, pathways, and entrance facilities.

1.4.1.1 Administrative. Buildings being constructed or refurbished to house administrative personnel will most likely contain a combination of walled offices, usually adjacent to the windows, for supervisory personnel, conference facilities, and open bay areas toward the center of the floor plan. These open bays are commonly configured with modular furniture. Occupants of these buildings require general telecommunications support to each workstation for voice and LAN connectivity and specific telecommunications support to designated areas, as required to support the major claimant terminal equipment. Additional jacks not associated with a particular workstation will be required in common areas for the termination of facsimile machines, printers, and various terminal equipment. Activities which employ optical scanning and storage methods for large data files may require fiber optic cable to the workstations in designated areas for high-speed file retrieval. At a minimum, each walled office should contain a two-port faceplate, configured in accordance with EIA/TIA-568, for each occupant. At a minimum, it should contain an eight-pin modular voice jack, which is either CAT 3 or CAT 5 and either an eight-pin CAT 5 modular data jack or a duplex fiber optic data jack. The major claimant may specify a second or third data jack dependent upon anticipated LAN configurations. Installation of both CAT 5 UTP and fiber optic data cable to the workstation is allowed when required for compatibility with customer terminal equipment. When the major claimants' inputs are either not available or insufficient for detailed engineering, open bay areas should be engineered to provide for one workstation for every 10 sq. m (100 sq. ft.) of usable floor space. Each modular workstation should be equipped with one faceplate which is to be configured in accordance with the EIA/TIA 568.

Furniture arrangements in open bay areas and the construction or demolition of walled offices will vary over the life of the building but the maximum number of occupants requiring telecommunications services within the building will remain at approximately one for every 10 sq. m. (100 sq. ft.) of usable work space. Example One serves to illustrate this estimation process.

multimode fiber optic cable should be installed in the conduit for network connectivity and redundant routing. Figure 12 depicts a typical telecommunications closet.

1.6.1 Telecommunications Closet Requirements. The closet shall be sized in accordance with EIA/TIA 569, Table 7.2-1 which will result in a room ranging in size from 7 sq. m to 11 sq. m (70 sq. ft. to 110 sq. ft.). Refer to Example Four.

a) The ceiling should be a minimum of 2.6 m (8.5 ft.) high with no false ceiling.

b) Doors shall be a minimum of 1 m (3 ft.) wide and open outward.

c) A 1 m (3 ft.) clearance shall be maintained in front of cross connects and equipment racks.

d) A minimum of two dedicated 20 ampere 110 volt ac duplex receptacles shall be provided for equipment rack power, preferably served from the UPS power panel. Additionally, duplex convenience outlets shall be spaced at 2 m (6 ft.) intervals around the perimeter walls. Sleeves, slots, and wall penetrations shall penetrate the room 27 mm to 78 mm (1 to 3 in.) and shall be properly firestopped.

e) HVAC shall be provided on a 24-hour basis.

f) A 41 mm (1-1/2 in.) conduit shall be provided from the equipment room to the building grounding electrode. Closets shall be connected to a single point ground. In accordance with EIA/TIA 607, Commercial Building Grounding and Bonding Requirements for Telecommunications.

g) Lighting shall be a minimum of 540 lux (50 footcandles) at 1 m (3 ft.) AFF.

h) A minimum of two walls shall be covered with 21 mm (3/4 in.) fire rated, void free plywood. The plywood shall be painted with two coats of light colored fire retardant paint.

[retrieve Figure 12. Telecommunications Closet]

FIPS-PUB-174 Federal Building Telecommunications
Wiring Standard.

(Unless otherwise indicated, copies are available from U.S.
Department of Commerce, Gaithersburg, MD 20899.)

NAVELEX 0101/102 Naval Shore Electronics Criteria,
NCS Design, Chapter 12, Communications
Electronic Grounding.

NACSIM 5203 Guidelines for Facility Design and RED/
BLACK Installation.

(Unless otherwise indicated, copies are available from Naval
Publishing and Printing Service Office (NPPSO), Standardization
Document Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia,
PA 19111-5094; private organizations may purchase from the
Superintendent of Documents, U.S. Government Printing Office,
Washington, DC 20402.)

USA FM 11-490-9 Communications-Electronics Facilities:
Grounding, Bonding, and Shielding.

(Unless otherwise indicated, copies are available from U.S. Army
Publications Distribution Center, 1655 Woodson Road, St. Louis, MO
63114.)

NON-GOVERNMENT PUBLICATIONS:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2 National Electrical Safety Code.

(Unless otherwise indicated, copies are available from American
National Standards Institute (ANSI), 11 W. 42nd Street, New York,
New York 10036.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E814 Fire Tests of Through-Penetration
Fire Stops.

(Unless otherwise indicated, copies are available from American
Society for Testing and Materials (ASTM), 1916 Race Street,
Philadelphia, PA 19103-1187.)

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BUILDING INDUSTRY CONSULTANT SERVICES INTERNATIONAL (BICSI)

BICSI Telecommunications Distribution Methods (TDM) Manual
Telecommunications Cable and Pathway Design Parameters and
Installation Practices.

(Unless otherwise indicated, copies are available from Building
Industry Consultant Services International (BICSI), 10500 University
Center Drive, Suite 100, Tampa, FL 33612-6415.)

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA/TIA 472B	Fiber Optic Communication Cables for Underground and Buried Use.
EIA/TIA 526	Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
EIA/TIA 568	Commercial Building Telecommunications Cabling Standard.
EIA/TIA 569	Pathways and Spaces.
EIA/TIA 570	Residential and Light Commercial Telecommunications Wiring Standard.
EIA/TIA 606	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
EIA/TIA 607	Commercial Building Grounding and Bonding Requirements for Telecommunications.
EIA TSB-67	Field Testing of Unshielded Twisted- Pair Cabling Systems.
EIA TSB-72	Centralized Optical Fiber Cabling Guidelines.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 802.3	Information Technology - Local and Metropolitan Area Networks - Part 3: Carrier Sense Multiple Access With Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.
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IEEE 802.5 Information Technology - Local and
 Metropolitan Area Networks - Part 5:
 Token Ring Access Method and Physical
 Layer Specifications.

(Unless otherwise indicated, copies are available from Institute of
Electrical and Electronics Engineers, Inc. (IEEE), 445 Hose Lane,
P.O. Box 1331, Piscataway, NJ 08855-1331.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 63 Premise Telecommunications Cables
 (ICEA S-90-661).

(Unless otherwise indicated, copies are available from National
Electrical Manufacturers Association (NEMA) 1300 North 17th Street,
Arlington, VA 22209.)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 National Electrical Code.

NFPA 262 Fire and Smoke Characteristics of Wires and
 Cables.

(Unless otherwise indicated, copies are available from National Fire
Protection Association (NFPA), One Batterymarch Park, P.O. Box 9101,
Quincy, MA 02269-9101.)

RURAL ELECTRIFICATION ADMINISTRATION (REA)

REA PE-22 Specification for Aerial and Underground
 Telephone Cable (REA Bulletin 345-13).

REA PE-38 Self Supporting Cable
 (REA Bulletin 345-29).

REA PE-89 Filled Buried Service Wire
 (REA Bulletin 345-86).

REA TE&CM, Section 602, Clearances.

REA TE&CM, Section 605, Right of Way Clearances.

REA TE&CM, Section 611, Pole Lines.

REA TE&CM, Section 626, Staking.

REA TE&CM Section 630, Design of Overhead Lines.

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REA TE&CM Section 640, Buried Cable Plant Specification.

REA TE&CM Section 643, Underground Conduit and Manhole Design and Construction.

(Unless otherwise indicated, copies are available from Rural Electrification Administration (REA), Department of Agriculture, 14th and Independence Avenue, S.W., Washington, DC 20250.)

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| UL 497 | Safety Protectors for Paired Conductor Communication Circuits. |
| UL 497A | Safety Secondary Protectors for Communication Circuits. |
| UL 1479 | Safety Fire Tests of Through-Penetration Firestops. |
| UL 1666 | Flame Propagation Height of Electrical and Optical Fiber Cables Installed Vertically in Shafts. |

(Unless otherwise indicated, copies are available from Underwriters Laboratories, Inc. (UL), 333 Pfingsten Road, Northbrook, IL 60062.)