

**BY ORDER OF THE COMMANDER  
TRAVIS AIR FORCE BASE (AMC)**

**TRAVIS AIR FORCE BASE  
INSTRUCTION**



**17-211**

**7 FEBRUARY 2023**

**Cyberspace**

**STANDARD COMMUNICATIONS  
INFRASTRUCTURE**

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OPR: 60 CS/SCXP

Certified by: 60 CS/CC  
(Lt Col Joseph S. Peterson)

Supersedes: TRAVISAFBI33-110, 13 May 2016

Pages: 16

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This publication implements Air Force Policy Directive (AFPD) 17-2, Cyberspace Operations. This instruction applies to all military and civilian AF personnel, members of the AF Reserve, Air National Guard, contractors and individuals or organizations authorized by an appropriate government official who plan, design, review, and evaluate telecommunications cabling and distribution system, or to conduct cyberspace operations and access the AF Information Network (AFIN). It provides policy, direction, and guidance for planning and implementation of communication infrastructure for Military Construction (MILCON) and building renovation projects. This instruction also implements the Unified Facilities Criteria (UFC) 3-580-01, *Telecommunications Building Cabling Systems Planning and Design*. It establishes responsibilities and procedures for base agencies, architects, engineers, and contractors to plan, design, review, and evaluate telecommunications cabling and distribution systems. It contains base standards for pre-wiring new construction under Military Construction Program (MCP), Combined Defense Improvement Projects (CDIP), and remodeled facilities. Furthermore, it identifies minimum essential factors to be considered when telecommunications pre-wiring support is addressed. This instruction applies to all units, assigned and/or associated with Travis Air Force Base (TAFB).

Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using the AF Form 847, *Recommendation for Change of Publication*. Ensure that all records created as a result of processes prescribed in this publication are maintained

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### ***SUMMARY OF CHANGES***

This publication is revised to update guidance and comply with planning, requirements, and architectural processes of systems and capabilities in accordance with the Telecommunications Industry Association, Building Industry Standards and the AF E&I Criteria and Business Rules. Changes include cable removal and replacement to comply with the Air Force Base Area Network Functional Specification (AFBAN-FS), installation and maintenance of Maintenance Hole Duct System (MHDS), Wireless Local Area Network (WLAN) and security of the entrance and telecommunications room.

**1. Overview.** The purpose of this instruction is to provide design criteria for planning telecommunications cabling and distribution systems in building construction and renovation efforts. Pre-wiring shall be included in all military facility construction projects accomplished with 3300 series funding. All pre-wiring must comply with the UFC 3-580-01, and this instruction. Compliance with these instructions will improve maintenance by establishing a standard for communications systems facility. Department of Defense (DOD) publications direct the use of commercial standards whenever they meet DOD needs. The standards referenced in UFC 3-580-01 shall be followed along with this instruction. To minimize the long-term cost of infrastructure, local standards are established and can only be changed when approved by the Communications and Information Systems Officer (CSO) or designee.

### **2. General.**

**2.1. Military Construction (MILCON):** Any construction, development, conversion, or extension of any kind carried out with respect to a military installation. MILCON includes construction projects for all types of buildings, roads, airfield pavements, and utility systems and is funded using the MILCON 3300 appropriation.

**2.2. Unspecified Minor Military Construction (UMMC):** A military construction project costing \$6M or less and received MILCON 3300 appropriated funding IAW DAFMAN 65-601V1, 31 Mar 21.

**2.3. Facility Sustainment, Restoration & Modernization (FSRM):** A sustainment maintenance/sustainment repair or restoration repair/modernization repair project that expends 3400 O&M funding to keep the inventory of facilities in good working order, restore a facility to a condition prior to damage, or modernization of components to new facilities or building codes and standards.

**3. Scope.** Project design packages will comply with:

**3.1. Local minimum communications standards.**

**3.2. Building communications and distribution system.**

3.3. **Telephone/Local Area Network (LAN) entrance cables.**

3.4. **Communications equipment rooms.**

3.4.1. **Telecommunications cabling and termination.**

3.4.2. **Telecommunications outlets.**

3.4.3. **Testing requirements.**

#### **4. Requirements.**

4.1. **Renovation may include removal of telecommunications cabling and infrastructure inside the facility.** No communications system will be removed without the approval of the 60<sup>th</sup> Communications Squadron (60 CS). If necessary, the 60 CS will remove and cap the outside plant cable serving the facility prior to demolition or renovation. The 60<sup>th</sup> Civil Engineer Squadron (60 CES) must notify the 60 CS NLT 45 days prior to building demolition or renovation to ensure all networking equipment including Land Mobile Radio devices and antennas that are impacted during the demolition or renovation are removed. If inside premise wiring are removed, it will be replaced with CAT 6A cable or the latest base standard and funded by the project. If funding is not included, it is the responsibility of the building occupant or users to fund. All new construction will require the installation of fiber optic and copper cabling. Copper cable will only be installed when fiber cannot support the requirement.

4.2. **Fiber Optic Cabling (FOC) Installation/Replacement.** Fiber Optic Cabling must meet the latest Air Force Base Area Network Functional Specification (AFBAN-FS). Justification must be provided for any variation. Outdoor rated, dielectric, single-mode (OS1) FOC will be used.

#### **5. Responsibilities.**

##### **5.1. 60 CES Construction/Renovation Design Package Office of Primary Responsibility.**

5.1.1. Present all communications requirements to 60 CS at the 35% level design review for design-built projects. Requirements must be finalized during the 65% level design.

5.1.2. Present 60 CS a complete design package for review to include a draft of the Requirements Document and drawings, the DD Form 1391, *Military Project Construction Data*, and a list of any deviations from the Communications-Computer Systems (C-CS) criteria which must be approved by the Communications and Information Systems Officer (CSO), Authority Having Jurisdiction (AHJ) or CSO representative.

5.1.3. Allow 10 days for communications squadron review of each phase for all design packages. The Base Telecommunications Manager and base telephone maintenance contractor may be needed to provide assistance with the incorporation of new infrastructure. The Cyberspace Systems Integrator-Base (CSI-B) may also need to provide communications engineering assistance. Any assistance requested will be coordinated through 60 CS Plans and Implementation.

5.1.4. Notify 60 CS Plans and Implementation of any changes in project scope that may affect any cyber portion of the project as early as possible

5.1.5. For planning purposes, provide 60 CS/SCXP a list of MILCON or Facility Sustainment Restoration and Modernization (FSRM) projects, or invite 60 CS to attend all

Facility Utilization Boards and planning charrettes to ensure the 60 CS/SCXP is up-to-date with MILCON and FSRM projects status in order to properly input requirements and tie-cost elements to the appropriate fiscal year.

5.1.6. Maintenance Hole Duct System (MHDS) are real property. Installation of MHDS require an approved Base Civil Engineer Work Request to install. Once installed, a DD Form 1354, Transfer and Acceptance of DoD Real Property is processed.

## **6. 60 CS Communications Plans and Implementation.**

**6.1. Coordinate design packages with all appropriate communications agencies including the CSI-B if necessary.**

**6.2. Receive and maintain comments on design packages.** Ensure design packages comply with standards in this document and support the current base blueprint document.

**6.3. Forward design review comments to the 60 CES and attend design meetings as required.**

**6.4. Ensure a compliant and efficient RCDD engineered wire or cable distribution system is included in the facility design and certified by the RCDD.**

**6.5. Check design packages to ensure recurrent and projected communications requirements are reconsidered for flexibility to accommodate future additions or changes.**

**6.6. Ensure appropriate 60 CS personnel are involved in all phases of the project.**

**6.7. Coordinate any changes or deviations to UFC 3-580-01 and this instruction.**

## **7. IT and Cyber Certification Requirements.**

**7.1. Personnel involved in design and construction shall have expertise in engineering and installation of telecommunications, cabling, and distribution systems.** If requested by the CSO, contract personnel shall provide adequate proof of their individual skill by demonstrating their technical expertise and methods of testing and documentation.

**7.2. The contracting company shall have a minimum of five years' experience in the design, application, and installation and testing of the specified systems and equipment.**

**7.3. The contractor shall employ Registered Communications Distribution Designers (RCDD) to perform systems engineering and design.**

**7.4. All Contractors, their employees and installers assigned to the installation of a system or any of its components shall have industry training for each area of installation and have factory certification on all components used in the installation.** General electrical trade staff (electricians) will not be used for the installation of the fiber optic and copper cables and associated hardware and peripheral components.

**7.5. All Contractors, their employees and installers assigned to the installation of a system or any of its components shall have a minimum of one year experience in the installation of the specified fiber optic and copper cable and associated hardware.** Installation supervisors shall have a minimum of three years' experience in the installation of the specified fiber optic and copper cable and associated hardware.

## 8. Manufacturers Minimum Qualifications.

8.1. The equipment and hardware provided under all contracts will be from manufacturers that have a minimum of three years' experience in producing the types of systems and equipment specified.

## 9. Local Minimum Standards.

9.1. **To minimize the long-term cost of the infrastructure, the following local standards are established and may only be changed when approved in writing by the CSO or AHJ.** These standards are intended to promote common framework throughout the base and to minimize the necessity for excessive variations in telecommunications equipment:

9.2. **Base Fiber Optic Cable (FOC) outside plant backbone connections in support of Core Nodes (CNs):.** Asynchronous Transfer Mode (ATM) or Switched/Gigabit Ethernet Connections 36-strand Single Mode (SM) FOC 8.3/125 micron.

9.3. **Base FOC outside plant satellite connection in support of End Building Nodes (EBNs):.** Switched Ethernet Connections 12-strand (maximum) SM FOC 8.3/125 micron. Installation of more than 12-strands must be justified.

9.4. **Install a maximum of 50 pair copper outside plant cable to support systems not supported by fiber for new construction.** Anything higher than 50 will be approved by the CSO or the CSO representative. The Air Force is pushing transition from copper to fiber; therefore, copper will only be installed when optical fiber cannot support the requirement. New copper premise wiring will be IAW UFC 3-580-01 Chapter 2 recommendations.

9.5. **All cable used for telecommunications outlets shall be four pair, solid copper conductor, green CAT 6A or higher standard, UL tested and certified.** Each cable shall be dedicated to one device or outlet only.

9.6. **Whenever exposed in air circulation areas, plenum rated cable will be used.** Cable will not be supported by suspended ceilings.

9.7. **Unless it is needed, all telecommunications outlets will have two Universal Service Ordering Code (USOC) CAT 6A RJ-45, or latest standard type jacks utilizing Telecommunications Industry Association (TIA) 568-B for voice/data/LAN.** All 4 pairs within the cable shall be terminated to USOC CAT6A RJ-45 or latest standard type jack. All CAT 6A patch panels shall have 110 interface on the back side. Panel width shall be as required to fit in a standard 19" equipment rack.

9.8. **Information outlet spacing in office areas shall be based on one duplex outlet unless otherwise stated, for each eight (8) linear feet of useable perimeter wall space.** All other locations will be provided with outlet density as determined by the CSO or his representative.

9.9. **Administrative telephone wiring will be based on the single-line instrument concept with individual cable running from the wall outlet to the ER/TR via the cross connect cabinet if required.** Each jack will be wired "homerun" from jack to the nearest ER/TR. Splitting cable pairs to multiple jacks is not authorized.

9.10. **All Outside Plant cable will be core filled type, and meet Rural Utilities Service (RUS) Professional Engineer 39 (PE-39) or PE-89 specifications.**

## 10. Wireless Local Area Network (WLAN).

10.1. **Wireless LANs allow users to connect to the network without a direct cable.** It enables mobility and connectivity in areas where it would not otherwise be feasible. The intent however, of the WLAN program, is not to replace all wired user connectivity across the base with wireless connectivity, but rather to add wireless connectivity options where they are needed and applicable.

10.2. **Access Points (APs) will be installed in visible and accessible locations to provide easy access for maintenance and troubleshooting efforts.**

10.3. **Exterior APs have unique requirements and will be handled on a case-by-case basis.**

10.4. **Outlets will be installed above the ceilings with a coil of extra cabling unless otherwise specified.** Installation of wireless equipment will be accomplished by using AP brackets.

**11. Comprehensive Requirements.** Comprehensive requirements apply to all telecommunications systems and network infrastructure on Travis Air Force Base.

### 11.1. Building Communications Distribution System.

11.1.1. All primary backbone conduits shall be installed in locations as determined by the CSO or his representative and shall provide adequate size and quantity to meet current requirements plus 100% growth for future use to preclude digging at a later date to meet emerging requirements.

11.1.2. When new construction or renovation takes place, the design, installation, and all related costs necessary to extend the conduit and maintenance hole (MH) system to the new location shall be included in the project in accordance with UFC 3-580-01 and AFI 65-601V1, *Budget Guidance and Procedures*. Multiple service entrance locations will be required for all facilities housing command and control systems to provide redundant survivable service.

11.1.3. An MH with a minimum of two 4" conduit/duct bank lateral systems with tracer and pull rope will be used for required cables plus 100 percent spare ducts (not less than 1 spare) for expansion and maintenance in all primary duct banks.

11.1.4. Maintenance Holes shall be installed for all connections to the existing cable plant as required and maintained at a minimum spacing of 350 feet but not to exceed 500 feet. Additional MHs may be required to provide adequate control of connection and distribution of the cable plant.

11.1.5. All MHs and hand-holes shall be designed and constructed to meet the requirements of Technical Order (T.O.) 31W3-10-22, *Telecommunications Engineering Outside Plant Telephone*. Manholes shall provide a clear inside floor space measurement of 8' x 10'. An alternate size of 6' x 8' may be approved only when no primary backbone cable passes through the manhole (lateral or dead end service only). All MHs shall provide a clear height no less than 7 ft. Conduits shall enter the MH 4 to 5 inches above finish floor on the end and be perpendicular to the wall in approximate location. Mandatory items include grounding bus bar and rod and related conductors and wiring, a ladder or step, cable rack support, a 50 cubic foot sump (French Drain), pull in iron/anchor, frame and a

manhole cover cast with the word "COMMUNICATIONS" exposed to the surface. All manhole covers will be round and provided with a locking bar or other locking device to allow use of a padlock or other restriction to unauthorized entry.

11.1.6. Power and communications cables will be separated by 12" of well tamped, fine earth protection in accordance with T.O. 31W3-10-12, *Outside Plant Cable Placement*. The cable at the top of the crossing, whether power or communications cable, will receive the same additional protection. In addition, if the cable crosses over the main, extend additional cable protection 3' from each side of the crossing. Where highway, railroad and runway crossings occur, cable at such crossings must be placed underground using a metallic conduit or Schedule 80 Polyvinyl Chloride (PVC) conduit. Polyvinyl Chloride conduit may be direct buried if 30-36" of cover is provided. If steel pipe conduit is used, boring procedures will be followed to ensure protection of existing utilities or resources. Where PVC conduits are installed, a metallic #10 AWG copper tracer wire at minimum will be installed within the conduit or 6" above the duct bank to assist in future location efforts, with bonding to occur inside each manhole and at CER grounding frame.

11.1.7. Stub up a minimum of two 4" lateral conduits no less than 6" above the finished floor level adjacent to the telephone punch down board continuous to the nearest splice or service point as determined by the CSO or AHJ if both fiber and copper are available from a single location. The two lateral entrance conduits will each have three 3-cell Maxcell innerduct to be used for fiber. If a diverse path is required for both fiber and copper, a minimum of four 4" conduits is required (two for fiber and two for copper). All conduits will have three 3-cell Maxcell innerducts. Conduits are to be sealed or capped air tight to prevent water from entering the ER/TR.

11.1.8. Provide 36" minimum cover for all conduit duct banks and 36" minimum cover for laterals measured to top of conduit. The 60 CS will provide termination of cable connections in the manhole.

11.1.9. When determined necessary to simplify installations, conduit will be curved to provide gentle sweeps with a minimum radius of 25 feet for a total bending radius not to exceed 180 degrees between manholes, hand holes, or pull locations.

11.1.10. All conduits shall be sloped toward each opposing manhole at a slope of 3" per 100' of run to promote drainage of any accumulated liquids.

11.1.11. When specified, hand-holes will be nominally 6'W x 8'L x 7'H inner dimensions or a standard 36" x 60" x 36" substructure box. Mandatory items include grounding bus bar and rod and related conductors and wiring, a sump hole (French drain), and a traffic rated cover with a locking bar or other locking device to allow use of a padlock or other restriction to unauthorized entry.

## 11.2. Telephone Entrance Cable.

11.2.1. The contractor will provide underground exterior service cable, gel filled, IAW RUS PE-39 or PE-89 from the main communications panel to the nearest manhole tie-in or service point with sufficient vacant pairs to provide each facility with currently required circuits plus 50 percent spare pairs as determined by the CSO or his representative.

11.2.2. Splice cases used to splice copper cable into the base infrastructure will be stainless steel. A transition splice will be made between the exterior copper gel-filled cable and dry-filled intra-building cable in the TR in accordance with TIA/EIA 569A standard.

11.2.3. In accordance with Underwriters Laboratories (UL) 497, all Building Entrance Terminals (BET's) will be provided with three-electrode gas tube or solid state type 5-pin rated for the application. Provide gas tube protection modules in accordance with RUS Bulletin 345-83 and shall be heavy duty, A>10kA, B>400A, C>65A where A is the maximum single impulse discharge current in accordance with National Electrical Manufacturers Association (NEMA) C62.61. The gas modules shall shunt high voltage to ground, fail short, and be equipped with an external spark gap and heat coils, in accordance with UL 497. Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly.

11.2.4. Building Entrance Terminals (BET) used for the termination of outside cables, 300 pair or less in size, will have a built in splice chamber with 710 type splice modules. Equipment side (house) of the BET will use 25 pair Telco type connections to station equipment. BETs of this type will not be stacked more than three high.

11.2.5. Building Entrance Terminals used to terminate cable sizes greater than 400 pair will be a #23 AWG stubbed 355 series type blocks with 3BIE type gas protectors and be mounted in a vertical buss arrangement.

11.2.6. The contractor shall conduct appropriate testing and provide 100% continuity test results to 60 CS Base Telephone Systems Office. Use Optical Time-Domain Reflectometer (OTDR) to perform the test.

### 11.3. LAN Fiber Optic Entrance Cable.

11.3.1. Single mode fiber optic (SM FOC) will be used for inside and outside premise. At a minimum, between 12 to 36 strands SM FOC (8.3/125 micron) will be designed as part of a new facility construction project. Facility use and user requirements will dictate whether more fiber optic cable is required. Refer to [Paragraph 9](#) of this document for local minimum standards.

11.3.2. All FOC will be home run from the closest primary or secondary core node (CN) to the new facility. Fiber optic cable will not be spliced in any manholes.

11.3.3. All FOC entering the building will terminate in the TR in a 19" rack floor mounted FOC patch panel with LC connectors.

11.3.4. Fiber optic cable terminations at the far end (primary or secondary CN) will be performed by the base. The contractor shall provide manufacturer test results and conduct industry standard OTDR testing on cable and provide 100% continuity test results to 60 CS.

### 11.4. Telecommunications Entrance Facility (EF)/Telecommunications Room (TR).

11.4.1. An EF will be provided for Communications-Computer System (C-CS) switching and transmission equipment, private branch exchanges (PBXs, gateways, power supplies, etc.) main distribution frame(s), LAN equipment racks, fiber optic cable termination, patch panels and other equipment needed for termination of the building's interior wiring systems and to interface the local service equipment with the exterior base cable system. The EF

on new construction will be located on the main floor having access from an exterior door outside the building to ensure easy and uninterrupted access by authorized network security personnel. The EF/TR will have a lockable door keyed to 60 CS specifications and will not be used as a storage under any circumstances. The TR is defined as an architectural space designed to contain telecommunications equipment, cable terminations, and cross connect cabling. It contains the telecommunications equipment for connecting the horizontal cabling to the backbone cabling system. The TR may also function as the Telecommunications Entrance Facility. They keys for the EF/TRs will be controlled and only provided to the 60 CS to protect the network from unauthorized personnel. As a minimum, the EF/TR will have ¾ inch plywood backboard from no greater than 1 foot above the finished floor level to no less than 7 feet above the finished floor level. Plywood will be sealed and fire rated. Building Entrance Terminals (BET) are required on the EF. The size of the EF will not be less than the specifications found in [Table 1](#).

**Table 1. EF Size Requirements.**

Building Usable Area (Square Feet)	EF Size (Square Feet)	Number of 4" Entrance Conduits
<20,000	400	3
20,000 to 100,000	500	4
100,000 to 200,000	900	5
Every additional 200,000	600+	+1

**NOTE:** Room size will have a 2:1 ratio in length to width.

11.4.2. Adequate installation and maintenance space, environmental control and power typical to an office environment (heated and cooled), shall be included to support equipment and any necessary cable entry requirements. No other building support equipment including mechanical equipment, plumbing equipment, and electrical panels will be placed in the EF/TR. Maintenance space and access space will not be utilized for any other purpose and will be free and clear of all obstructions to a height of 8 feet to allow for adequate cooling and servicing of equipment. Storage of any type is prohibited in the EF/TR.

11.4.3. The EF/TRs will be provided with space as required and will be so located that the distance measured along the routing path of the cable will not exceed 295 feet from the furthest outlet to maintain the integrity of the digital data signal. Where multiple TR rooms are required, attention must be given to their strategic placement to support interconnection via 4 inch conduit or 6 inch wide by 2 inch deep minimum cable trays between each room as well as to the primary EF in which the cable head/fiber connections are to be located. Where it is necessary to interconnect more than one TR, single-mode (SM) fiber optical cable will be used. If an armored cable is not used, a 1-inch innerduct will be provided inside the 4 inch conduit or conduit raceway with pull cord ensuring a direct path between each TR. For telephone interconnection, provide #23 AWG copper wire cable between the TRs.

11.4.4. Circuit connectivity from the telecommunications outlet jacks to the TR will be provided through 1-inch minimum conduit stubbed to 6-12 inches above the finished ceiling using the most direct route available, complete with pull cords. A 6 or 12 inch wide by 2 inch deep cable through/raceway will be used to connect rooms provided plenum type cable is used or provided. Where cable trays are provided, conduits will be extended to the cable tray and be terminated. The through/raceway will run above the ceiling on the top of proper support structures using the most direct route between the EF/TRs. Conduit fill will not exceed the 40% rule as stipulated in the National Fire Protection Association (NFPA) 70 and TIA/EIA.

11.4.5. Type 630B wall jacks will be provided for wall-mounted telephones in the EF/TR, electrical and mechanical rooms, mounted 60 inches above the finished floor.

11.4.6. A controlled and secured access to the TR is required to allow 24-hour uninterrupted access by authorized network technicians. The EF on the main floor will have exterior access only. Locking door knobs shall be utilized with key ways and locks keyed alike to match the 60 CS master key. Only authorized personnel by the CSO will possess key to the EF/TRs.

11.4.7. Temperature in the EF/TR will be maintained between 65-78 degrees Fahrenheit. The EF/TR will have either dedicated HVAC equipment or access to the main building HVAC delivery system. If environmental control is provided by the main building delivery system, the ER/TR will have separate controls from other rooms in the building. The EF/TR will have adequate lighting to promote a safe and acceptable work area, free of electromagnetic fields and will not be susceptible to water damage from water pipes or HVAC systems.

11.4.8. A minimum of two-gang 120 VAC power outlets on a separate 20-Amp power outlet circuit with isolated ground will be provided. Additionally, a minimum of two-gang 220-240 VAC 30-Amp power outlet circuit with isolated ground for use in powering uninterrupted power supply (UPS) will also be provided if necessary. An additional duplex convenience outlet will be located away from the telecommunications outlets to provide power to operate service and maintenance equipment.

11.4.9. Ground all devices, cable sheaths, protectors and other equipment in accordance with ANSI/EIA/TIA 607, MIL Standard 188-124B, and the NFPA 70. Provide a single-point ground for all communications/electronic equipment for the building within the TR. Provide a telecommunications main grounding bus bar (TMGB) at a minimum of 6 inches high by 24 inches long. The ground riser from the ground plate to the single main electrical service entrance ground must be a #1 AWG or larger copper conductor directly connected to the ground plate with no taps. The resistance of the ground riser must be 5 ohms or less measured from the main building ground point. All connections of wire-to-wire and/or wire-to-ground rod must be exothermic-welded. Extend #6 AWG or larger copper ground wires from the TR ground plate to each secondary TR within the building and connect a telecommunications grounding bus bar (TGB) in the TR. Bond each TMGB and TGB to non-current-carrying metal building parts such as metal framing in the TR as required by the NEC.

11.4.10. The EF will be provided as required to serve approximately every 10,000 ft<sup>2</sup> of usable floor space. The TRs will serve as a secondary interconnection point between the

telephone/LAN modular jack outlets and the main communications frame in the EF. Wall and floor space will be provided for installation and maintenance of equipment such as frames or backboards. Such equipment will be concealed and secured as required for TRs and will not be installed in common use areas. It must be fully accessible and maintainable as outlined for TR room equipment.

11.4.11. All cable in the EF will be tagged according to room and jack number to indicate its associated jack number and location. All LAN runs must be continuous from wall outlet to patch panels in the EF. Installation of plugs and plugging house cable into active electronic equipment is strictly prohibited.

**11.5. Cabling and Termination.**

11.5.1. Horizontal Cables (Telephone and LAN). Connect individual subscriber telephone and LAN outlets to their respective 110-type patch panels in the EF. Horizontal cable for both telephone and LAN must be 4-pair #23 AWG solid copper, 100 ohm, CAT 6A or better plenum rated unshielded twisted pair (UTP) cable. Use only cable that has passed UL network certification program and is UL-listed and labeled. Green CAT 6A cables will be used for voice, LAN, and data. Tag and label cables at least 6 inches at both ends.

11.5.2. Telephone Riser Cables. Provide connection between the telephone patch panel in the ER and the telephone patch panels or distribution frame in the EF. Telephone riser cable must be multi-pair (sized as required to support all horizontal cables terminated in the EF plus 50% spare pairs) #23 AWG solid copper, 100 Ohm, CAT 6A UTP cable. They must meet the requirements of EIA/TIA-568-B or latest standard.

11.5.3. CAT 6A wiring will be terminated in a standard 19" rack mounted CAT 6A patch panel located in the EF situated in a ideal location within the building. Cable length will not exceed 295 ft.

11.5.4. Pairing and color-coding for jacks will be in accordance with EIA/TIA-568B standards in [Table 2](#).

**Table 2. TIA 568-B LAN/DATA Wiring Standard.**

PIN #	COLOR	PIN #	COLOR
1	W/ORANGE	5	W/BLUE
2	ORANGE	6	GREEN
3	W/GREEN	7	W/BROWN
4	BLUE	8	BROWN

11.5.5. The 60 CS will have a minimum of ten working days to complete the cross connects, install equipment, and verify the system prior to occupancy by the tenant starting from receipt of the work order.

11.5.6. To clearly identify cables and their usage, each cable will be labeled at both ends by identifying their room and outlet number. Each outlet cover plate will also carry the outlet designation, as shall the termination jack on the patch panel or termination block. A permanent type label affixed to the cable or outlet jack cover to preclude damage due to age or other mechanical means will identify all cable and terminations. Automated embossed labels are required. Pen and ink label is not authorized.

### 11.6. Telecommunications Outlets.

11.6.1. In general office areas, a duplex modular telecommunications outlet plate with two each USOC RJ-45 or latest standard type jacks will be provided every 8 linear feet around the usable room perimeter. All wall outlet components will be certified as CAT 6A or higher and jacks will be USOC RJ-45 or higher type wall jacks with a removable outer bezel. Green jacks will be used to identify all CAT 6A jacks.

11.6.2. Telecommunications outlets will be mounted at 18" above the floor to the centerline of the cover plate unless noted otherwise.

## 12. Periodic, Pre-Final, Final Inspections to include Testing and Documentation.

12.1. **All telecommunications cable will be certified and tested utilizing the Optical Time-Domain Reflectometer (OTDR) test equipment in accordance with EIA/TIA standards with written test result to be provided to the 60 CS.** Where deficiencies of any type are discovered upon testing, the contractor will make all necessary repairs, including replacement if necessary, at no cost to the government.

12.2. **Revised drawings which reflect the actual "as built" conditions will be maintained throughout the construction phase.** A copy will be provided to the 60 CS with the cable certification records upon completion of the work but prior to final acceptance of the work to allow 60 CS to perform a final review of drawings and inspect installations.

12.3. **Cyberspace Infrastructure Planning System (CIPS)/CIPS Visualization Component (CVC).** The CVC is the basis of "as built" cable records and will be provided to the 60 CS NLT 30 days after facility is accepted by the government. upon final project acceptance. The drawings will show cross-connect and termination points for each cable pair, locations and identification number for each modular outlet, and the location and value of each line amplifier and multi-port device throughout the inside plant cable system. The outside plant drawings will be geospatial referenced and include the conduit, innerduct, cable types, cable count, cable size, and length. All MHs, hand-holes, and pull boxes will have complete butterfly details to include geospatial referenced location, entry points, grounding, bonding, racks/ladders, or other equipment installed. A copy of these drawings will be updated to final "as built" conditions by the construction contractor and turned over to the 60 CS along with one electronic copy of outside plant drawings utilizing Vizio.

12.4. **In-progress inspections by 60 CS personnel are required during construction.** Trenches may be inspected to verify conduit size and quantity, cable type, earth cover compliance, and accuracy of "red line" base cable record or contract drawings. The general contractor performing the work is solely responsible for requesting in progress inspections to the base before backfill or installation of walls during cable certifications.

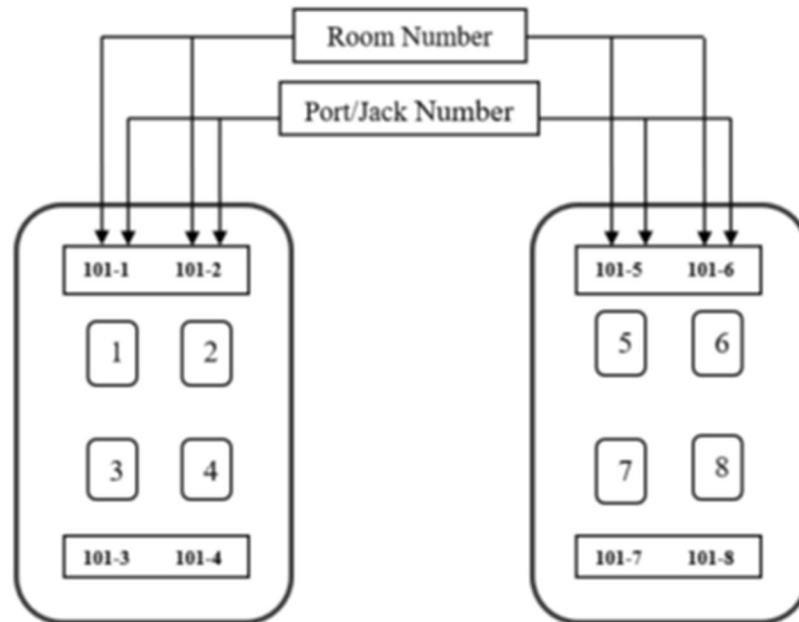
12.5. **All installed cables (fiber and copper) will be tested by the installer and may be in the presence of 60 CS personnel or its representatives.** Baseline test records will be provided to the 60 CS in printed and digital format. All CAT 6A cables will be tested and certified to 155 Mbps (500 MHz) to ensure they are usable at higher data transmission speed. UL testing standard for new cable including fiber optic testing of single-mode cable will be followed.

**13. Other Considerations.**

**13.1. Classified Systems (Secure Internet Protocol Router Network (SIPRNET)).** Classified requirements may vary and will be taken on a case-by-case basis. Customer units must identify classified LAN and telephone requirements to the 60 CS during preliminary design planning. Due to the specific nature of the security and COMSEC requirements for these systems, it is difficult to address these requirements in generalized terms.

**13.2. Modular Furniture.** Modular furniture configuration will be supported by the standard wall jack. Telephone and LAN wiring systems in areas with pre-wired workstations, furniture systems or modular walls must have sufficient flexibility and connectivity to enable rearrangement without modification to the permanent communications wiring in the facility. Suitable patch cords and connectors must be provided. Permanent splices/connections are prohibited. Patch cords will be permanently labeled with the corresponding outlet number and will be at the expense of the customer.

**Figure 1. CAT 6A Four-Gang Wall Plate Numbering.**



**Note:** Starting from the main room entrance location, use room number followed by ascending numeric for each telecommunications outlet and move clockwise around the room perimeter. Mark each cable end, each wall outlet on the face of the cover plate and at the patch panel under the corresponding panel jack. Post the drawing with the identification of outlets and room numbers in the TR upon completion.

DEREK M. SALMI, Colonel, USAF  
 Commander, 60th Air Mobility Wing

**Attachment 1****GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

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**AFI 1-2**, *Commanders Responsibilities*, May 2014

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**ANSI TIA-568.2-D**, *Balanced Twisted-Pair Telecommunications Cabling and Component Standard Addendum 2*, Aug 2020

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**BICSI**, *Building Industry Consulting Service International*, Vol I & II, 14<sup>th</sup> Edition

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**Joint Technical Architecture-Air Force**, *Building Wiring Architecture*

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**TO 31W3-10-22-WA-1**, *Telecommunications Engineering OSP*, Apr 2020

**TO 31W3-10-12-WA-1**, *Outside Plant Cable Placement*, Apr 2020

**UFC-3-580-01**, *Telecommunications Building Cabling Systems Planning and Design w/ Change 1*, 1 June 2016

***Prescribed Forms***

**AF Form 673**, Air Force Publication/Form Action Request

*Adopted Forms*

**e-AF Form 1768**, Staff Summary Request

**DD Form 67**, Form Processing Action Request

*Abbreviations and Acronyms*

**AFI**—Air Force Instruction

**AHJ**—Authority Having Jurisdiction

**ANSI**—American National Standards Institute

**ATM**—Asynchronous Transfer Mode

**AWG**—American Wire Gauge

**BET**—Building Entrance Terminal

**CAT**—Category

**COMSEC**—Communications Security

**CISO**—Communications and Information Systems Officer

**DRSN**—Defense Red Switch Network

**EBN**—End Building Node

**EIA**—Electronic Industries Alliance

**FOC**—Fiber Optic Cable

**ITN**—Information Transfer Node

**LAN**—Local Area Network

**NEC**—National Electric Code

**NFPA**—National Fire Protection Association

**SIPRNET**—Secure Internet Protocol Router Network

**SM**—Single Mode

**TEF**—Telecommunications Entrance Facility

**TR**—Telecommunications Room

**TGB**—Telecommunications Grounding Busbar

**TIA**—Telecommunications Industry Association

**TMGB**—Telecommunications Main Ground Busbar

**UL**—Underwriters Laboratory

**USACE**—U.S. Army Corps of Engineers

**USOC**—Universal Service Ordering Code

**UTP**—Unshielded Twisted Pair

VAC—Volt Alternating Current