Chapter 28

COMMUNICATION CABLE, ANTENNA AND COMMUNICATION SYSTEMS

28.1. Scope. This chapter addresses safety requirements for communications systems professionals when installing and maintaining radars, cable and wireless systems, antennas, and airfield and weather systems. Communications systems personnel are inherently susceptible to electrical, hazardous energy, climbing towers and utility poles, radiation, chemicals, falling from heights, soldering and confined hazards. Personnel shall be thoroughly familiar with safety-related work practices that prevent injuries resulting from falling from heights, direct or indirect contact with electrical contacts, or work performed near or on equipment or circuits, which are or may be energized. **(T-0)**

28.2. General Safety Practices.

28.2.1. Electrical Hazards. Specific safety-related work practices shall be consistent with the nature and extent of the associated electrical hazards or any other potential release of hazardous energy. Refer to **Chapter 8** or **Chapter 21** for specific and additional requirements.

28.2.2. Climbing Hazards. The primary hazards associated with climbing are falls and contact with electrical systems. A record of climbing certification shall be maintained on AF Form 1098, *Special Task Certification and Recurring Training,* or an electronic-approved product, for military and government civilian personnel. **(T-1)** Personnel who have not climbed within the last 12 months as a part of their normal job will require refresher training under the supervision of a qualified instructor. **(T-1)** The amount of training required shall be determined by the climbing instructor. **(T-1)** Records shall be updated whenever recertification is accomplished. **(T-1)** Refer to **paragraph 28.7** for additional guidance. (**Warning**: Pole Top rescue shall only be attempted by personnel who are certified or in a training status under the supervision of an instructor.) **(T-0)** Examples of climbing hazards include:

28.2.2.1. Pole conditions such as knots, knotholes, cracks, excessive gaff marks, crooked or raked poles, splinters, ice on poles and heavily creosoted or arsenic-treated poles.

28.2.2.2. Pole attachments such as conduits, molding, cable and ground wire, strain plates, signboards, nails and metal pole numbers.

28.2.2.3. Tower conditions such as cracks, rust, corrosion, loose/missing hardware, ice on climbing surfaces, bent/broken steps, improper grounding, dirt and excessive grease and oil.

28.2.2.4. Improper clothing such as badly worn shoes (e.g., loose heels, thin soles), low-cut shoes, trousers not worn correctly or securely inside of climbing irons.

28.2.2.5. Equipment items that do not fit properly, such as loose, short or dull gaffs; climber straps too tight, too loose, too long or broken; or the wrong sized climbers.

28.2.2.6. Failure to follow approved methods for climbing and working on poles and tower structures.

28.2.2.7. Wearing climbers while working on wooden poles and tower structures.

28.2.2.8. Failure to maintain good physical condition.

28.2.3. Radiation Hazards.

28.2.3.1. Non-ionizing Radiation. Refer to AFI 48-109 *Electromagnetic Field Radiation (EMFR) Occupational and Environmental Health Program*, and 29 CFR § 1910.97, *Nonionizing Radiation*, for additional guidance on management of hazards associated with non-ionizing radiation. (**Caution**: Employees with pacemakers and other electrically-active implanted medical devices must not be allowed to work in areas where the function of their device may be adversely affected by exposure to known non-ionizing radiation or electromagnetic fields. **(T-0) Note:** All communications equipment employees should be made aware of this requirement. If there are questions, refer employee(s) for a medical assessment, in coordination with the installation BE.)

28.2.3.2. Ionizing Radiation. Refer to 29 CFR § 1910.1096, *Ionizing Radiation,* and AFMAN 48-148 for guidance on hazards associated with ionizing radiation.

28.2.4. Chemical Hazards. Chemicals used in conjunction with communications equipment maintenance may present health hazards due to skin contact and/or inhalation of toxic vapors. All employees who may be potentially exposed to chemical hazards during the course of work shall require HAZCOM training in accordance with AFI 90-821, upon initial assignment and thereafter when a new hazard or chemical is introduced into the work area, a new employee is assigned or existent tasks are reevaluated with possible new hazards. **(T-0)** Disposal of hazardous waste will be coordinated with the host installation environmental management office. **(T-1) Note:** Supervisors shall ensure all personnel have access to Safety Data Sheets for chemicals used in work processes. **(T-0)** Refer to CFR § 1910.1200, *Hazard Communication*, for additional guidance.

28.2.5. Compressed Gases. Refer to **Chapter 19** for specific and additional guidance on compressed gases.

28.2.6. Falling from Heights. The potential of falling is the most obvious hazard encountered while climbing. Safety gear shall be used and worn properly. **(T-0)** Refer to **Chapter 13** and **paragraph 28.7.16** for additional guidance on personal fall arrest systems.

28.2.7. Soldering Precautions. Ensure fire extinguishers are accessible in the soldering area. **(T-1)** Remove combustible materials from the work area to prevent fires. **(T-1)** Never sling excess solder from a soldering iron. Wipe it off with a damp cloth or sponge. Always place the soldering iron in the proper holder when not in use, and never leave the iron plugged in and unattended. **(T-1)**

28.2.7.1. Wear a face shield or safety goggles when soldering. Normal prescription glasses or plain safety glasses may be used in place of safety goggles for light electronic equipment soldering, such as electronic circuit boards.

28.2.7.2. Ensure the work area where soldering is performed is well ventilated in accordance with the requirements in the BE Occupational and Environmental Health risk assessment and the ACGIH's *Industrial Ventilation: A Manual or Recommended Practice for Operations and Maintenance.* **(T-0)** Ensure all power unit exhausts are vented to the building exterior. **(T-0)** Use approved respiratory devices when working in permit-required confined spaces that are not adequately ventilated. **(T-0)** Refer to AFI 48-137 and **Chapter 23** for additional guidance and information on confined spaces.

28.2.8. Confined Spaces. Employees required to enter confined spaces, such as manholes or underground vaults, shall be trained in self-rescue. **(T-0)** Safety observers or attendants shall be trained in rescue procedures for each type of confined space to be entered. **(T-0)** Refer to **Chapter 23,** applicable TOs and 29 CFR § 1910.146, *Permit-Required Confined Spaces,* for additional requirements.

28.2.9. Grounding and Bonding. Most electricians and electronics employees consider the ground to be a stake or other direct connection into the ground (earth) to which the electrical system of the facility is connected. In a two-wire electrical cord, there is a neutral or ground wire and a hot wire. The neutral or ground wire for the system shall be white. **(T-1)** The other wire is the hot wire and it may be any color other than white or green. In a three-wire system, the third wire is the ground wire and it is always green or green with one or more yellow stripes. Bonding, on the other hand, consists of interconnecting two (2) or more pieces of conductive equipment with a suitable wire or strap to equalize the resistance and, in effect, make them as one piece of equipment as far as electrical potential is concerned. For specific guidance, refer to AFMAN 32-1065.

28.2.10. Respiratory Precautions. Respiratory protection is required if prolonged breathing of chemical vapors, mists or fumes is expected or if working in confined spaces when the atmosphere oxygen deficient or hazardous. A supplied breathing air system with quick access emergency egress air supply may be needed. BE's occupational and environmental health risk assessment identifies recommended controls. Refer to ACGIH's *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance,* and AFMAN 48-146 for additional guidance.

28.2.11. Miscellaneous.

28.2.11.1. Fluid/Chemical Leakage. Employees shall be especially watchful for any sign of oil or fluid leakage from transformers or similar devices. **(T-1)** There is a possibility the liquid may contain high concentrations of polychlorinated biphenyl, which is extremely toxic. Any sign of leakage from any component shall be reported to the nearest BE and Environmental Management office. **(T-1)** Employees shall not touch or disturb the leaking fluid without the approval of the appropriate medical activity. **(T-1)**

28.2.11.2. Heaters and Torches Used in Ground and Aerial Tents. Flame-type heaters shall not be used within ground tents or on platforms within aerial tents unless the tent covers are constructed of fire-resistant materials and adequate ventilation is maintained. **(T-0)**Torches may be used on aerial splicing platforms or in buckets enclosed by tents, provided the material is constructed of fire-resistant material and the torch is turned off when not in actual use. The tent shall be adequately ventilated while torch is in use. **(T-0)**

28.2.11.3. Notifications. Provide the installation F&ES Flight and the emergency response units with maps indicating routes to locations of remote sites. **(T-1)** Where practical, establish a memorandum of understanding with the installation F&ES Flight and emergency rescue units to conduct actual tests to evaluate the route suitability and response times. Ensure all areas containing flammable materials have appropriate fire prevention signs posted and fire extinguishers available. **(T-0) Note:** Off-base facilities/sites shall coordinate and plan with the nearest local area medical facility for emergency medical services, if the host installation medical facility is too far to provide immediate emergency medical attention. **(T-1)**

28.2.11.4. Safety Observers. When installing or repairing commercial and industrial systems, communication cables and antenna systems that may expose employees to energized equipment, high voltage circuits, 600 volts or above, or low voltage power if it has a high current flow, work shall not begin until a qualified safety observer is present. **(T-0)** An individual shall not be assigned other duties while serving as safety observer. **(T-1)** Normally, the supervisor is also the safety observer.

28.2.11.4.1. When repairing or troubleshooting energized high voltage communications equipment, the safety observer does not have to be proficient in the task being observed.

28.2.11.4.2. Safety observers shall be trained in accordance with **paragraph 1.9** and be familiar with local installation procedures to obtain medical assistance. **(T-1)**

28.2.11.4.3. While the task is being performed, the safety observer shall stand where they can plainly see all personnel who are working on the equipment, have access to the main power switch and give a positive warning of potential danger to anyone approaching the equipment. **(T-0)** If unable to maintain visual contact with the main power switch, the hazardous energy control procedure shall be used. **(T-0)** Additionally, the safety observer will have ready access to safety equipment when high voltage is involved. **(T-0)**

28.3. Training. All training shall be documented on the AF Form 55, *Employee Safety and Health Record,* or AF Form 623, *Individual Training Record Folder,* or an approved computer automated system in accordance with AFI 91-202. **(T-1)** A record of climbing certification shall be maintained on AF Form 1098 or approved computer automated system. **(T-0)**

28.4. Safety Equipment and Devices.

28.4.1. Manholes, Aerial Cables and Pole Lines. Motor vehicle traffic is a hazard to personnel working in and around manholes on streets and highways. Warning devices, barriers and guarding shall be used to protect personnel working at these locations. **(T-0)** Employees working on aerial cable installation and pole line construction along streets and highways will use the same barriers, and warning and guarding devices as required for manholes. **(T-0)** Ventilating equipment shall be positioned so the air intake is located away from vehicular exhaust. **(T-0)** Refer to TO 31W3-10-12, *Outside Plant Cable Placement*, for additional guidance on guarding requirements and warning devices.

28.4.2. Safety Straps, Harnesses, and Lanyards. Nylon straps, not leather safety straps, shall be used on steel structures. **(T-0)** Safety harnesses, straps and lanyards shall be provided and supervisors shall ensure their use when work is performed at positions more than four (4) feet above the ground, on poles and on towers. **(T-0)** Safety harnesses, straps and lanyards are not required for portable ladders. Refer to Chapter **13** and **29** CFR § 1910.268(g), *Telecommunications, Personal Climbing Equipment*, for additional guidance. **Note:** If personnel can sustain a fall of more than two (2) feet while wearing climbing equipment, fall arrest procedures and equipment guidance in **Chapter 13,** UFC 3-560-01, 29 CFR § 1910.140 and 29 CFR § 1926, Subpart M, Appendix C, *Personnel Fall Arrest Systems – Non-Mandatory Guidelines for Complying with 1926.502(d)*, shall be followed. **(T-0)** Safety straps and harnesses shall also be worn when working at elevated positions on poles, towers or similar structures, which do not have adequately guarded work areas in accordance with 29 CFR §

1910.268. **(T-0)** Supervisors shall ensure all safety climbing equipment is inspected daily by a qualified individual to determine if it is in safe working condition. **(T-0)** Each person using safety harnesses, straps and lanyards shall inspect the equipment prior to each use. **(T-0)**

28.4.3. Climbing Safety Devices. Climbing safety devices shall be installed on all ladders that are an integral part of the antenna support. **(T-0)** Where climbing safety devices are not installed, installation or maintenance shall be performed only by a certified climber using prescribed fall protection. **(T-0)** Personnel climbing metal antenna support poles equipped with metal steps will use climbing safety devices. **(T-0) Note:** All Cyber Support field technicians required to climb un-stepped communication poles will use the squeeze pole fall protector (pole choker) arrest system. **(T-0)** Users of the pole chokers will comply with TO 00-25-245, *Operations Instructions - Testing and Inspection Procedures for Personnel Safety and Rescue Equipment*, and manufacturer's instructions regarding inspection, maintenance, cleaning and storage of personal fall arrest systems equipment. **(T-0)**

28.4.4. Markings. All antenna support, power, telephone and transmission line poles shall be marked 12 feet from the butt of the pole to determine the depth of the pole. **(T-0)** The 12-foot mark shall be indicated with aluminum pole tags or marker nails. **(T-0)** If these are not available, 1-inch galvanized steel roofing nails shall be driven into the pole to form the numerals "12." **(T-0)**

28.4.5. Proximity Warning Devices. These devices may be used on cranes or aerial lifts. Refer to **Chapter 16,** Chapter **12, 29** CFR § 1910.67, *Vehicle-Mounted Elevating and Rotating Work Platforms,* and 29 CFR § 1910.180, *Crawler Locomotive and Truck Cranes*, for additional guidance.

28.4.6. Electrical Safety Boards. Refer to **paragraph 8.12** for required items in an emergency equipment kit or board.

28.4.7. Hard Hats. Refer to **paragraph 14.4.5** for additional guidance.

28.4.8. Rubber Insulating Floor Matting. Refer to **paragraph 8.11.5** for insulating matting specific guidance.

28.5. Tools and Equipment. Refer to **Chapter 11** for additional information.

28.5.1. Nonconductive tools shall be used while performing work on energized communications systems equipment. **(T-0)** Taping or plastic coating is not an acceptable means of insulation. Wooden handle tools shall not be used on energized communications systems equipment. **(T-0)**

28.5.2. All tools shall be kept clean and free of grease, oil, paint or other foreign material in accordance with TO 32-1-101. **(T-0) Exception**: This does not prevent the use of a light film of oil on tools for rust protection.

28.5.3. Ladders. Refer to **Chapter 7** for additional guidance.

28.5.4. Equipment and/or Component Cleaning. Vacuuming is the preferred method of cleaning electronic equipment. If compressed air is used, employees will limit the air pressure to less than 30 psi, use effective chip guarding and wear required PPE. **(T-0)**

28.5.5. Test equipment shall be designed, constructed and installed to provide safe work procedures and to minimize personnel exposure to hazardous work situations. **(T-0)** When tests

involve live circuits, the area shall be closed. **(T-0)** Only authorized personnel who have been briefed about the potential hazards involved shall be in this area when tests are performed. **(T-0)** At least one safety observer shall be present when high voltage is involved. **(T-0)**

28.5.5.1. Set Up. Test operators and technicians shall follow the exact methods of adjustment, operation and repair of test equipment given in TOs, manufacturer's instructions and manuals or applicable diagrams. **(T-0)** Employees shall be knowledgeable of the characteristics and safe operation of the various instruments before being authorized to use them. **(T-0)** This shall be accomplished by briefings and warning signs at affected locations. **(T-0)** Before voltage is applied, cable conductors shall be isolated to the maximum extent practicable. **(T-0)**

28.5.5.2. Approved and effective warning signs and/or signals shall be used to indicate when power is on. **(T-0)** A means of emergency power shutdown shall be provided outside the test area in addition to the main power switch within the test area. **(T-0)**

28.5.5.3. Connections to test tables, bus bars, plug racks, terminal cabinets and distribution boards shall be secure. **(T-0)**

28.5.6. Other Tools and PPE. All employees involved in test operations shall be provided with approved PPE. **(T-0)** Refer to Chapter **14, 29** CFR § 1910.268(e) and 29 CFR § 1910.268(i) for additional mandatory requirements for head and eye protection, portable lights, protective devices on tools and appliances, soldering devices and lead work.

28.6. High Voltage.

28.6.1. High voltage is defined as greater than 600 volts (root-mean-square) nominal or greater. However, much lower voltage can be lethal. The design and development of all military electronic equipment shall provide fail-safe features for safety of employees during the installation, operation, maintenance or interchanging of a complete equipment assembly or component part. **(T-1)** Operators and technicians shall not attempt to adjust any electronic equipment when there is a possibility of injury from unprotected high voltage. **(T-0)** Adjustments on operating high voltage equipment, other than those specified by TO or manufacturer's instructions, shall only be authorized by the unit commander. **(T-1)** The unit commander shall consider all operational requirements, TOs, manufacturer's instructions, safety precautions and emergency procedures before authorizing work to proceed. **(T-1)** Employees using high voltage to troubleshoot and/or test cables shall be instructed in the precautions necessary for their safety and the safety of others. **(T-0)** Employees shall be warned to stay clear while voltage is applied. **(T-0)**

28.6.2. Only qualified personnel shall perform work near energized overhead power lines. **(T-0)** Approach distances for qualified workers shall be in accordance with UFC 3-560-01, Table 3-1. **(T-0)** Before starting any communications work near overhead power lines, coordinate the work with CE's electrical shop. Safety precautions in accordance with 29 CFR §§ 1910.268 and 1910.333, *Selection and Use of Work Practices*, shall be considered when working near overhead power lines. **(T-0)**

28.6.3. If an aerial lift or equipment contacts an electrical conductor, the vehicle, equipment and attachments shall be considered energized. **(T-0)** Personnel standing on the ground shall not contact any part unless using protective equipment rated for the voltage. **(T-0)**

28.6.4. Tree branches hanging on an energized conductor shall be removed only with appropriate electrically insulating equipment, and only by authorized personnel. **(T-0)**

28.6.5. Line workers' electrical safety boots shall be worn to provide additional protection against electrical hazards. **(T-0)** Rubber footwear or line workers' overshoes shall not be worn. **(T-0)**

28.6.6. Warning signs or Air Force Visual Aids shall be prominently posted in all areas housing high voltage equipment; the highest expected voltage shall also be posted. **(T-0)**

28.7. Aerial Work.

28.7.1. Only properly trained and certified personnel, or individuals in training status and under the direct observation of a qualified instructor, are authorized to climb poles and towers. Appropriate safety equipment shall be worn while performing aerial work. **(T-0)**

28.7.2. Unit commanders shall designate, in writing, all personnel required to maintain climbing proficiency. **(T-2)** Restrict climbing authorizations to structures that must be climbed to accomplish mission requirements. **(T-1)** Coordinate with installation BCE to ensure real property structures have current inspection and maintenance, and allow only structures with current inspections that identify the structure, as safe to climb, to be climbed. **(T-1)** Ensure employees who must climb structures are provided access to inspections/maintenance records. **(T-1)**

28.7.3. Installation BCE will ensure inspection and maintenance records are provided upon request by using agencies. **(T-1)** Maintain records on the inspection and maintenance of poles and towers considered real property in accordance with DAFI 32-9005, *Real Property Accountability and Reporting,* and the *Real Property Handbook.* **(T-1) Note:** The *Real Property Handbook* is maintained at each installation's CE facility.

28.7.4. Installation Safety office will review these records during annual inspections to ensure they are current. **(T-1)**

28.7.5. Initial Certification Procedures. Upon assignment to a unit, each individual whose future duties will require climbing poles and towers where they may be subject to a fall of four (4) feet or more in height shall be trained and certified, as applicable. **(T-1)** For Air Force Specialty Codes other than 3D1X7, commanders shall restrict climbing authorizations to those structures that must be climbed to accomplish mission requirements. **(T-1)**

28.7.6. Climbing Certifier Requirements. Climbing certifier must:

28.7.6.1. Complete a climbing certification training course or commercial equivalent. **(T-1)**

28.7.6.2. Be designated, in writing, by the commander to conduct climbing certification. **(T-1)**

28.7.6.3. Be current in cardiopulmonary resuscitation (CPR), and first aid training. **(T-1)**

28.7.6.4. Demonstrate ability to perform and teach complex tasks aloft. **(T-1)**

28.7.6.5. Be certified to train individuals on rescue on the following structures when present on the installation. **(T-1)**

28.7.6.5.1. Pole Top.

28.7.6.5.2. Tower.

28.7.6.6. Use a training plan to conduct rescue training and climbing certification on the following structures when present on the installation. **(T-1)**

28.7.6.6.1. Pole Top.

28.7.6.6.2. Tower.

28.7.6.7. Maintain climbing proficiency and knowledge of current OSHA requirements. **(T-1)**

28.7.6.8. Determine and arrange for the specific safety equipment to use during performance evaluations. **(T-1)**

28.7.6.9. Evaluate a written and/or oral knowledge test. **(T-1)**

28.7.7. Tower and Pole Climbing Precautions. Refer to TO 31-10-19, *Antenna Systems—Anchors and Supports,* and TO 31R-10-5, *Air Force Comm Commands (E-I Standards) – Antenna Systems, Maintenance, Repair and Testing,* for precautionary requirements on tower and pole climbing.

28.7.8. Steps and Ladders. All antenna towers and structures will have steps and ladders installed when the design permits. **(T-0)** These steps and ladders shall be equipped with cages or safety devices where possible. **(T-0) Exception**: Structures designed to provide equivalent protection of a safety cage, e.g., triangular antenna towers that are climbed internally where structural members provide approximately the same protection normally afforded by a safety cage. Refer to Chapter **7, 29** CFR § 1910.25, *Stairways,* and 29 CFR § 1910.23, *Ladders,* for additional guidance on steps and ladders.

28.7.9. Radome Installation, Maintenance and/or Removal. Employees engaged in radome work shall be experienced riggers and work under the direction of a qualified supervisor. **(T-0)** Those who work on or in the immediate vicinity of the radome shall wear hard hats and safety-toed shoes. **(T-0)** Employees shall make frequent checks with the nearest weather forecasting agency to allow time to lash down equipment for impending inclement weather. **(T-1)** Also, employees shall never try to replace panels when the wind is blowing more than 30 miles per hour and shall never remove more than one panel at a time under normal conditions. **(T-0)** When mixing resin, employees shall follow the manufacturer's instructions. **(T-0)** Employees shall use the maintenance rope to lift the maintenance ladder to the top of the radome. **(T-0)** Prior to each use, the rope shall be inspected for frayed or worn spots and replaced, if required. **(T-0)**

28.8. Ground-Controlled Approach Radars. Before ascending to the roof of the ground-controlled approach trailer or other rotating antenna location, the supervisor shall inform all nearby personnel that work is being performed on the roof and shall ensure the following is accomplished: **(T-1)**

28.8.1. The surveillance antenna control switch is turned off, locked out and a warning sign or AFVA 91-303, *DANGER – DO NOT ENERGIZE – PERSON WORKING ON ANTENNA,* is placed on the high voltage power supply switch. The roof-mounted antenna safety switch shall be turned off. **(T-1)** Refer to **Chapter 21** for additional guidance on hazardous energy control requirements.

28.8.2. TO 35-1-3 requires rooftops of mobile ground-controlled approach vans be painted to warn personnel of rotating antenna hazards. **Note:** In combat areas, the sweep area covered by antenna rotation may be indicated by a broken line of ¾ inch-wide red dashes.

28.9. Single Phase Portable and Vehicle-Mounted Generators.

28.9.1. Portable Generators. Under the following conditions, the frame of a portable generator is not required to be grounded and may serve as the grounding electrode for a system supplied by the generator when:

28.9.1.1. The generator supplies only equipment mounted on the generator and/or cord and plug-connected equipment through receptacles mounted on the generator.

28.9.1.2. The non-current-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame.

28.9.2. Vehicle-Mounted Generators. Under the following conditions, the frame of a vehicle may be permitted to serve as the grounding electrode for a system supplied by a generator located on the vehicle:

28.9.2.1. The frame of the generator is bonded to the vehicle frame.

28.9.2.2. The generator supplies only equipment located on the vehicle and/or cord- and plug-connected equipment through receptacles mounted on the vehicle or on the generator.

28.9.2.3. The non-current-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame.

28.9.3. Neutral Conductor Bonding. A neutral conductor shall be bonded to the generator frame when the generator is a component of a separately derived system. **(T-0)** The bonding of any conductor other than a neutral within the generator to its frame shall not be required.

28.9.4. Metallic Encased Tools. The tools and equipment being powered by generators shall contain three-wire cords with grounded plugs. **(T-0)**

28.9.5. Fixed Wiring Systems. Portable and vehicle-mounted generators that supply fixed wiring systems shall be grounded in accordance with NFPA 70, Article 250, *Grounding*. **(T-0)**

28.10. Repairs and Adjustments.

28.10.1. Repairs and adjustments shall be made to energized circuits only when a power-on condition is essential. **(T-1)** Refer to applicable TO for additional guidance.

28.10.2. Repairs and adjustments of components, when the equipment slides are extended from their cabinets and voltages are applied, shall be permitted only when specified by applicable TOs, manufacturer's instructions or approved isolation and troubleshooting methods. **(T-1)** Personnel not essential to the operation shall be removed from the area before power is applied. **(T-1)** When high voltages are present or transmitters of 1-kW power rating or higher are involved, unit commander will approve procedures and adjustments not specified by TO or manufacturer's instructions. **(T-1)** Additionally, use insulated gloves when directed by TOs or the manufacturer's instructions. Ensure insulated matting is used and a qualified safety observer is present. **(T-1)**

28.11. Power Distribution Panels.

28.11.1. Power Distribution Panels and Interlocks. Power distribution panels and interlocks shall be secured to prevent personnel contacting energized circuits. **(T-0)** When equipment must be removed from service for inspection or repair, the appropriate circuit breaker or interlock shall be locked open (off), if possible, and posted with a danger tag, warning sign, AFVA or other suitable identification until the equipment is again ready for use. **(T-0)** Tape shall not be used to "lock" open circuit breakers. **(T-0)** Refer to **Chapter 17** for additional guidance and information on signs and visual aids.

28.11.2. Fuses and Circuit Breakers. The inside cover of fuse(s) and circuit breaker panels (or area adjacent if not equipped with a cover) shall indicate in writing the equipment controlled by which fuse or circuit breaker. **(T-0)** Whenever possible, over-current devices shall be installed in electrical circuits of a size and type to interrupt the current flow when the current exceeds the current rating of the equipment or exceeds the capacity of the conductor, whichever is smaller. **(T-0)** Replace blown fuses by the type required by the manufacturer or manufacturer's instructions. **(T-0)** When possible, use insulated fuse pullers when removing or replacing clip type or flat-mount cartridge fuses. Wire, foil, solder and similar materials shall not be used as substitutes for fuses. **(T-0)**

28.11.3. Carbon Blocks and Heat Coils. Prior to removal of operating carbon blocks or heat coils, a measurement of line potential shall be made using a voltmeter having a minimum input impedance of 20,000 ohms per volt to ensure the foreign electromotive force which energized these protective devices is no longer present. **(T-1)** Do not remove carbon blocks and/or heat coils if the foreign electromotive force is still present. **(T-1)**

28.12. Radar and Microwave Equipment.

28.12.1. Radar and microwave equipment are sources of non-ionizing radiation. Personnel shall be instructed in the hazards of non-ionizing radiation and shall not be exposed to non-ionizing radiation levels above the permissible exposure limits outlined in AFI 48-109. **(T-0)**

28.12.2. Exercise caution when working on or adjacent to transmitter antennas. A transmitter connected to an antenna being inspected or worked on shall be locked out and de-energized in accordance with hazardous energy control procedures in **Chapter 21. (T-1)** Ensure adjacent antennas, which create hazardous levels of RF radiation at the work location, are secured. **(T-1)** Ensure employees remove all jewelry prior to performing any task on equipment. **(T-0)** Review the site standard operating procedures for radiation hazard control and site RF hazards reports and drawings. This will ensure locations where RF hazards exist are known and appropriate measures (shutdown or blanking of antennas) are taken to prevent exposure of personnel working in those areas. A danger tag, warning sign, AFVA or other suitable identification advising others of the nature of work in progress shall be posted on the console of the transmitter and in all other critical locations. **(T-1)**

28.12.3. Employees shall not look into an open waveguide that is connected to an energized source of microwave radiation. **(T-1)**

28.12.4. A non-ionizing radiation warning sign shall be posted in areas where a hazard may exist. **(T-1)** Refer to AFI 48-109 for additional guidance.

28.13. Entering Manholes, Handholes and Unvented Vaults. All requirements in **Chapter 23** shall be met before, during and after any entry operation.

28.13.1. Manholes, vaults and handholes shall be positively identified as to utility type (communication, electrical power distribution, sewer, etc.) prior to entry. **(T-0)** In the absence of positive identification, personnel shall coordinate with the installation occupational safety office to establish positive identification. **(T-1)**

28.13.2. Unidentified cables shall be positively identified as to the utility type. **(T-1)** Cables shall be evaluated using a nonintrusive device, such as a clamp-on voltmeter, to determine the absence or presence of electrical voltage and current prior to beginning any work on the cable. **(T-1)** Although discouraged, a small percentage of manholes, vaults, or handholes may be joint use. In these few instances, extreme caution shall be used and the communication cable shall be positively identified. **(T-1)** When requested, the installation BCE electrical shop shall provide an electrician to assist in determining guarding and safe procedures. **(T-1)**

28.14. Cables.

28.14.1. Aerial Cables. Maintain minimum distances (42 inches up to 87,000 volts and 48 inches over 87,000 volts) between power and communications cables on joint-use poles. **(T-0)** If minimum distances cannot be maintained, de-energize the power line before performing installation or maintenance work. Employees shall comply with the requirements in UFC 3-560- 01, Table 3-1.. **(T-0)**

28.14.2. Observe caution when installing messenger strand so the loose ends do not make contact with power lines. **(T-0)**

28.14.3. When crossing over roadways, railroads, walkway, etc., ensure proper overhead clearances are maintained. **(T-0)**

28.14.4. Before riding or placing a ladder against an aerial strand, test the strand by suspending approximately 300 pounds in the middle of the span. **(T-0)** An easy test method is to place a rope over the strand and have two (2) employees suspend their weight on it.

28.14.5. Cable cars shall not be ridden over power lines (primary or secondary). **(T-0)**

28.14.6. Check handlines for serviceability prior to use. **(T-0)** The line employee shall remove the handline from the safety harness when they reach the work position and secure it to the pole. **(T-0)**

28.14.7. Use safety straps and safety harnesses while working on elevated work platforms such as aerial splicing platforms, pole platforms, ladder platforms and terminal balconies. **(T-0)** Wear insulating rubber gloves when handling suspension strand that is being installed on joint-use poles. **(T-0)**

28.14.8. Underground and Buried Cables. Refer to TO 31W3-10-12, *AF Comm Command (E-I) Standard Installation Practices – Outside Plant Cable Placement*, for guidance and requirements.

28.14.9. Pressurized Cables. Refer to TO 31W3-10-16, *Outside Plant Cable Pressurization*, for information and guidance.

28.14.10. Trenching and Excavations. Refer to TO 3lW3-10-12, *Outside Plant Cable Placement*, US Army Corps of Engineers Manual (EM) 385-1-1, *Safety and Health*

Requirements Manual, and 29 CFR § 1926.652, *Excavations — Requirement for Protective Systems*, for information and guidance.

28.15. Special Purpose Vehicles. See AFI 24-302 for additional guidance.

28.15.1. Inspection. Prior to operation, visually inspect the vehicle and check vehicle documentation, e.g., AF Form 1800, *Operator's Inspection Guide and Trouble Report.*

28.15.2. Truck-Mounted Winches. Telephone line and maintenance trucks are equipped with front- and/or back-mounted drum-type winches. A safety observer will stand to the front and well clear of the winch when used. **(T-0)** Winches are extremely powerful tools and extreme caution shall be exercised when used. **(T-0)** The winch operator shall be thoroughly trained and familiar with both the operation of a winch gear train and power takeoff lever movement. **(T-0)**

Winch operators shall wear leather gloves when handling a winch line and never hand feed the line onto the drum. **(T-1)** Inspect the winch line before use for defects such as broken or worn strands, kinks, flat spots and worn eye loops. **(T-1)** Remove damaged or badly kinked winch lines from service. **(T-1)** Winch lines shall not be rigged to pull against the flange of the winch drum. **(T-1) Note:** Some winches are designed for pulling while others are designed for raising or lowering. Winches shall be used for their designed purpose. **(T-1)**

28.15.3. Cable Reels. The safe handling, moving, and positioning of cable reels require well-trained operators in good physical condition. Pre-planning the move and final positioning will identify any problems with the surface condition and the best methods to use. Always use a spotter when backing cable reel trailers. Caution shall be used when handling cable reels and cable reel trailer. **(T-0)** A full reel of large cable may weigh as much as 10 tons. Therefore, it is necessary to carefully control the movement of the reel. Never permit the reel to tilt. On uneven or soft ground, provide a substantial runway of heavy planks. **(T-0)** Level the reel by blocking it in a manner that prevents tilting. After positioning in the desired storage location, block the reel to prevent rolling. **(T-0)**