

**21 MARCH 1994**

**Civil Engineering**

**ELECTRICAL SAFE PRACTICES**



**COMPLIANCE WITH THIS PUBLICATION IS MANDATORY**

---

**NOTICE:** This publication is available digitally on the SAF/AAD WWW site at: <http://afpubs.hq.af.mil>. If you lack access, contact your Publishing Distribution Office (PDO).

---

OPR: HQ AFCESA/ENE  
(Mr David A. Conkling)  
Supersedes AFR 91-12, 31 January 1990.

Certified by: HQ AFCESA/CC  
(Col Donald J. Thomas, Sr.)  
Pages: 10  
Distribution: F

---

This instruction implements AFR 32-10, *Installations and Facilities*. It assigns responsibilities for base civil engineering personnel who maintain and operate electrical systems and facilities. AFMAN 32-1078, *Electrical Worker Safety*, provides additional safety requirements. Users should send comments and suggested improvements on AF Form 847, **Recommendation for Change of Publication**, through major commands (MAJCOM) and HQ AFCESA/ENE, 139 Barnes Dr, Suite 1, Tyndall AFB FL 32403-5319 to HQ USAF/CEO, 1260 Air Force Pentagon, Washington DC 20330-1260.

**SUMMARY OF REVISIONS**

This is the first publication of AFI 32-1064. It incorporates requirements and procedures from AFR 91-12. It clarifies and places stronger emphasis on base civil engineering responsibilities in safety.

**1. Application and Scope.** This instruction assigns supervisor responsibilities and provides necessary guidance to safely build, operate, and maintain electrical distribution systems and equipment. It complies with AFI 91-301, *The US Air Force Occupational and Environmental Safety, Fire Prevention, and Health Program* (formerly AFR 127-12), and incorporates National Consensus Standards. Detailed requirements for worker safety are in AFMAN 32-1078.

**2. Supervisor Responsibilities:**

**2.1. Personal Safety.** The most important part of a supervisor's job is to get the job done SAFELY. Supervisors must provide a safe and healthful work environment. Facilities, work areas, equipment, and work procedures must comply with safety, fire, and health policy. Each supervisor must be thoroughly familiar with safe working practices, particularly those in AFMAN 32-1078, and applicable standards and codes (**Attachment 1**).

**2.2. Planning and Worker Awareness.** Plan the work properly and ensure it is performed safely. Review job requirements with the workers and ensure they understand why and how to do the work, the hazards they may encounter and how to control them, and the proper procedures for working safely.

**2.3. Training Assistance.** Provide general and specific safety instructions and training to workers. Give personnel the opportunity to attend formal technical schools for training. Train employees weekly through an established shop safety education program. Make sure each employee has access to this instruction and AFMAN 32-1078 and demonstrates satisfactory knowledge before performing any task.

**2.4. Safety Meetings.** Make safety briefings interesting and successful by using a variety of aids such as safety posters, mock-ups (using the actual equipment where appropriate), pictures, and films. Be enthusiastic. Cover the following topics:

- Lockout/tagout.
- Selected safety rules (two or three).
- Methods and hazards of jobs in progress.
- Unsafe practices and common causes of mishaps.
- Recent accidents.
- Potential personal injuries.
- Personal protective equipment.
- Electrical tools.
- Materials handling.
- Good housekeeping.
- Adequate illumination.
- Working on or near machinery.
- Ladders.
- Work in elevated positions.
- Lifting and hoisting equipment, including aerial lifts.
- Grounding systems.
- Work in underground facilities (confined spaces).
- Overhead lines.
- First aid.
- Rescue and resuscitation.

**2.5. Specific Job Related Safety Training:**

2.5.1. Give special attention to hazardous conditions workers may encounter on any new task.

2.5.2. Instruct employees who must handle poisons, caustics, and other harmful substances in their safe handling and potential hazards. Include required personal hygiene and protective measures. See paragraph 3. on polychlorinated biphenyls.

2.5.3. Instruct employees who work on job sites where harmful plants or animals are present regarding potential hazards, how to avoid injury, and relevant first aid.

2.5.4. Instruct employees who must enter confined or enclosed spaces on hazards and necessary precautions. Specific instructions and procedures to enter and work in hazardous or potentially hazardous confined spaces must comply with the requirements in AFOSH Standard 127-25, *Confined Spaces*. Technical orders or other procedures that incorporate the requirements established in the standard are valid and may be used.

2.5.5. If there are questions or the job involves special hazards, ask the employee to describe the work assignment and methods.

**2.6. Assigning Tasks.** Assign employees to jobs which they are capable of doing safely. Permit only qualified personnel to operate equipment and machinery. Ensure two qualified employees work together when high voltage circuits or energized circuits are present.

**2.7. Job Site Inspection.** Frequently inspect job sites, materials, and equipment and ensure unsafe items are tagged, rendered inoperative, or removed from the work site. Ensure safe working conditions and practices. Take action to correct any observed or reported violation of safety rules in this instruction. Pay particular attention to safe clearance procedures and practices when working on energized lines and equipment. Present safety briefings to workers at the job site. See paragraph 4. and paragraph 5. below.

**2.8. Work Injuries.** Report injuries, even minor ones, as stated in AFI 91-202, *The US Air Force Mishap Prevention Program* (formerly AFR 127-2), to the employee's immediate supervisor. Ensure an injured employee receives prompt medical attention. Apply cardiopulmonary resuscitation (CPR) immediately in case of electrical shock and continue until the patient is breathing normally.

**2.9. Mishap Reports.** Investigate every mishap involving an injury, property damage, or "near misses." Determine the cause and implement corrective action to prevent recurrence. Notify the wing or installation safety staff of all mishaps that involve injuries or property damage. Investigate and report certain mishaps through safety channels according to AFI 91-204, *Investigating and Reporting Mishaps* (formerly AFR 127-4). Either the supervisor or base safety personnel will perform the investigation.

**2.10. Standards and Codes.** Train employees to comply with AFOSH standards and the following codes: National Electrical Code (NEC), National Electrical Safety Code (NESC or ANSI C2), and host nation codes (see **Attachment 1**).

**2.11. Protective Equipment.** Equip workers properly and train them to use and maintain tools and personal protective equipment properly. Pay particular attention to rubber insulating protective equipment (rubber gloves, sleeves, line hoses, hoods, and covers) and hotline tools. Make sure equipment receives periodic electrical tests and careful inspection before use. Periodically inspect equipment in the field and maintain required maintenance and testing records (AFOSH STD 12-31).

**2.12. Scheduling Routine Maintenance.** Schedule routine maintenance when disruption of power will cause the least inconvenience to all users. Arrange electrical circuits and equipment of the prime power source to important facilities to allow efficient performance of routine maintenance tasks with minimum outages.

**2.13. First Aid Training.** Ensure all electrical personnel (military and civilian) receive training in CPR, bleeding, shock management, and emergency care of a person having open wounds or burns.

Train individuals as soon as possible after assignment to the work unit. Until properly trained, no one should work a shift which may involve exposure to working voltages unless there are at least two other persons present who have been trained in CPR.

2.13.1. Host base medical personnel usually train unit CPR instructors. If the host base cannot provide medical personnel, they can arrange for certification of unit personnel through the American Red Cross or American Heart Association.

2.13.2. Reexamine all personnel for certification annually, regardless of the length of time for which the certification is valid.

**2.14. Rescue Training.** Train individuals designated responsible by the supervisor for rescuing workers from confined spaces according to OSHA and AFOSH requirements. This includes initial and annual refresher training.

**2.15. Noise Hazards.** Ensure all potentially hazardous noise sources are identified to Bioenvironmental Engineering Services for evaluation. Ensure all personnel that may be exposed to the noise hazards are made aware of them and use the controls required by AFOSH STD 44-1, *Hazardous Noise Program* (formerly AFR 161-35). See AFOSH STD 161-19, *Hazardous Noise Program*, and AFOSH STD 161-20, *Hearing Conservation Program*.

**2.16. System Maintenance.** Maintain electrical systems properly so they will continue to operate in a safe and effective manner (AFI 32-1063, *Electrical Power Systems* [formerly AFR 91-4]). Do not authorize or permit alterations or modifications to equipment or protective device settings without adequate engineering guidance and study.

**2.17. Technical Data.** Make sure current maintenance and operations procedures, diagrams, schematics, and manuals are available and properly used. Develop them if manufacturers' data is not available; obtain engineering guidance if necessary.

**2.18. Supervisory Control and Data Acquisition (SCADA) Systems.** All operators of SCADA systems which remotely control electrical distribution systems must have full knowledge of the base distribution system and thorough understanding of switching procedures. Operators must keep each display screen (schematic or map) within the SCADA system up-to-date and all switching points on the remote terminal unit accurately identified. Develop local procedures for remote operation of circuit breakers and switches to ensure safety of personnel and equipment.

**2.19. Safe Clearance.** Make sure all workers are thoroughly familiar and comply with safe clearance procedures before working on equipment. See paragraph 4. Do not permit work unless workers follow these procedures.

**2.20. Work on Energized Equipment.** Permit work on energized lines and equipment only if authorized by the Chief of the Operations Flight. See ANSI standards for approved work methods and paragraph 5.

### **3. Polychlorinated Biphenyls (PCB):**

**3.1. Purpose and Limitations.** PCB is a class of nonflammable liquid insulation formerly used as a transformer liquid dielectric. PCB is a suspected carcinogen and no longer manufactured. Several manufacturers distributed PCB under various trade names such as Askarel, Inerteen, Pyranol, Chlor-extol, and others.

**3.2. Personal Contact Precautions.** Workers should avoid contact with PCBs. If PCB contacts the skin, remove it with waterless hand cleaner, wipe with towels, and dispose of towels with other contaminated material. If eye contact occurs, flush eye thoroughly with water.

**3.3. Cleaning Spills.** Clean up PCB spills immediately. Prevent PCB from reaching storm drains, sewers, drainage ditches, or any other place where water is flowing. Handle a PCB spill and report it according to base and Environmental Protection Agency (EPA) requirements. Report a spill through the Base Environmental Coordinator.

**3.4. Controlling Equipment Containing PCB.** Mark, handle, store, dispose of, and account for equipment containing PCB according to the latest EPA standards. Contact the Base Environmental Coordinator for additional information and the latest EPA rulings.

**4. Safe Clearance Requirement.** Require safe clearance procedures for personnel opening and closing switches while working on transmission or distribution lines and equipment. Safe clearance procedures are necessary to clear lines and equipment for work in the DEENERGIZED condition to protect life and property. Safe clearance will include locking out switches, breakers, or other controlling devices when necessary; using mishap prevention tags; and grounding. Tags may provide additional warning, or stand alone if lockout is not possible because of equipment design. No individual must work on lines or equipment under unsafe conditions.

#### **4.1. Safe Clearance Responsibilities:**

4.1.1. The safe clearance manager designated by the Base Civil Engineering Operations Flight Chief will issue a safe clearance as required. The safe clearance manager arranges for interruption of service and must have full knowledge of the base distribution system. This person must also notify the utility company supplying power to the installation before any operation which may affect the utility company's system. The safe clearance manager will issue safe clearances to the supervisor responsible for exterior electrical systems. Usually, he will issue only one safe clearance; however, if some distance separates the various crews or the task areas when two or more crews are working, he may issue as many safe clearances as necessary. In such cases, the exterior electric supervisor must act as coordinator of all the issued safe clearances. The exterior electrical supervisor releases the safe clearance to the safe clearance manager after the work is complete. The supervisor ensures all personnel and temporary grounds are clear, and the line or equipment is ready for service. However, in the absence of the supervisor, issue the safe clearance only to authorized personnel on a list maintained by the infrastructure support element supervisor. The safe clearance manager accepts and approves the release. If the safe clearance manager issues more than one safe clearance, then the manager ensures all clearances are released and accepted before any change is made in the blocking and tagging to put the line or equipment back in service.

4.1.2. Develop local procedures for proper switching, blocking, tagging, and lockout when switching by remote control, such as SCADA system. Depending on the type of SCADA system, each software manufacturer will have different protocols to identify and issue tag orders for equipment or switchgear being worked. Each worker and system operator must fully understand local procedures. Physically verify all SCADA-issued commands for opening and lockout before beginning work. When working on equipment with local control capability, the technician should take control from the SCADA operator and notify the operator when the equipment is returned to normal operation. The operator must issue blocking orders and attach messages stating the reason for the condition and estimated restoration time.

**4.1.3. Forms Used.** Safe clearance procedure requires AF Form 979, **Danger Tag** or AF Form 982, **Do Not Start Tag**; AF Form 980, **Caution Tag**; AF Form 269, **Electrical Facilities Safe Clearance** (local reproduction authorized). Dispose of safe clearance records according to AFMAN 37-139, *Records Disposition--Standards* (formerly AFR 4-20, volume 2, Table 91-3); and danger tags according to Table 127-1.

**4.2. Switching and Blocking Procedures.** The on-site supervisor ensures workers accomplish switching, blocking, and tagging operations in the sequence specified on AF Form 269. When work is completed, perform the operations in the reverse order. For instance, if a detail of switching, blocking, and tagging reads, "Open Switch No. 501 and Attach Danger Tag," the opposite operation is "Remove Danger Tag and Close Switch No. 501." Annotate the form with the date and time. Do not operate switches bearing AF Form 979 or AF Form 982 under any circumstances without specific authorization from the Operations Flight Chief. Notify the SCADA systems operator before operating circuit opening devices remotely operated or monitored. The "local-remote" switch must be blocked in the position which disables remote operation. Notify the operator when work is complete and remote operation is safe.

**4.3. Tagging Procedures.** Tagging is placing an appropriate tag directly on the circuit opening device. Apply tags and lock out the energy control device to ensure safety and prevent altering of device positions by unauthorized personnel. Place danger tags in a conspicuous place upon opening a switch, disconnects, cutouts, primary jumpers, or breakers before beginning work on a line or equipment.

**4.4. Underground Distribution Systems.** Block the switch mechanically and lock and tag the handle on underground distribution systems when it is not practical to provide a visible line break. Always use AF Forms 979, 980, and 982 under a safe clearance (AF Form 269), except when working on secondary lines or equipment. Do not use AF Form 269 when applying AF Forms 979, 980, and 982 on secondary lines or equipment.

**4.5. Grounding Lines and Equipment.** Check all deenergized transmission and distribution lines and equipment, test for voltage, and ground before touching for work. Work all lines not grounded as energized.

## **5. Energized Circuits:**

**5.1. General.** Deenergize electrical circuits and equipment, when possible, before working on them. Work on energized circuits and equipment only when authorized by the Chief of the Operations Flight as necessary to support a critical mission, prevent injury to persons or protect property. Authorization is not required for work on low voltage control, power, and lighting circuits while energized for the purposes of testing, calibrating, troubleshooting, performing minor repairs and replacing fuses and circuit breakers. Workers must not work alone. When working on circuits over 300 volts, a safety observer must be present.

### **5.2. Live Maintenance by Gloving or Hot Sticking:**

#### **5.2.1. General Requirements:**

5.2.1.1. Accomplish live line maintenance only when authorized by the Chief of the Operations Flight to support critical mission requirements, prevent injury to persons, or protect property. All personnel must recognize the lines as energized, deserving maximum respect, and make optimum use of insulating equipment and application of the basic principle of isolation.

The supervisor must thoroughly plan each live line maintenance job. The supervisor will ensure proper training of workers, and suitable proper tools and equipment are available to do the job safely.

**5.2.2. On-Site Briefing.** Before starting a job, the on-site supervisor must hold a "tailgate conference" with workers and discuss all aspects of the job. The on-site supervisor must make sure each person clearly understands the procedures and knows what to do and how to do it. Give particular attention to potential hazards.

**5.2.3. Supervision.** While the job is in progress, the on-site supervisor must closely supervise the workers, checking them constantly to make sure they are in safe working positions and handling tools safely.

**6. Form Prescribed.** Safe clearance procedures requires the use of the following form:

- AF 269, **Electrical Facilities Safe Clearance.**

JAMES E. McCARTHY, Maj General, USAF  
The Civil Engineer

## Attachment 1

### GLOSSARY OF REFERENCES AND TERMS

#### *References*

AFI 91-202, *The US Air Force Mishap Prevention Program*

AFI 91-204, *Investigating and Reporting Mishaps*

AFI 91-301, *The Air Force Occupational and Environmental Safety, Fire Prevention, and Health Program*

AFMAN 32-1078, *Electrical Worker Safety*

AFOSH Standard 127-9, *Scaffolds and Working Platforms*

AFOSH Standard 127-10, Chapter 10, *Interior and Exterior Electrical Maintenance*, Chapter 11, *Electrical Power Production*

AFOSH Standard 127-25, *Confined Spaces*

AFOSH Standard 127-31, *Personal Protective Clothing and Equipment*

AFOSH Standard 127-32, *Emergency Shower and Eyewash Units*

AFOSH Standard 127-45, *Hazardous Energy Control and Mishap Prevention Signs and Tags*

AFOSH Standard 127-50, *Ground Communication Electronics Systems*

AFOSH Standard 127-51, *Communications Cable and Antenna Systems*

AFOSH Standard 127-66, *General Industrial Operations*

AFOSH Standard 161-8, *Controlling Exposures to Hazardous Materials*

AFOSH Standard 161-19, *Hazardous Noise Program*

AFOSH Standard 161-20, *Hearing Conservation Program*

ANSI C2, *National Electrical Safety Code*

ANSI/ASTM D120, *Rubber Insulating Gloves*

ANSI/ASTM D178, *Rubber Insulating Switchboard Matting*

ANSI/ASTM D1048, *Rubber Insulating Blankets*

ANSI/ASTM D1049, *Rubber Insulating Insulator Covers*

ANSI/ASTM D1050, *Rubber Insulating Line Hose*

ANSI/ASTM D1051, *Rubber Insulating Sleeves*

ANSI/ASTM F478, *Inservice Care of Insulating Line Hose and Covers*

ANSI/ASTM F479, *Inservice Care of Insulating Gloves and Sleeves*

#### *Terms*

**ANSI**—American National Standards Institute.

**Approved**—Sanctioned, endorsed, accredited, certified, or accepted as satisfactory by a duly constituted and nationally recognized authority or agency.

**Authorized Person**—A person approved or assigned by a supervisor to perform a specific duty or duties or to be at a specific location or locations at the job site.

**Blocking**—Placing a switch in the open or closed position and mechanically ensuring the position of the switch cannot be accidentally changed.

**Cable**—A conductor with insulation or a stranded conductor with or without insulation and other coverings (single conductor cable or a combination of conductors) insulated from one another (multiple conductor cable). *Note: A cable sheath may consist of multiple layers of which one or more are conductive.*

**Cardiopulmonary Resuscitation (CPR)**—An emergency medical procedure which includes opening and maintaining an airway, providing ventilation through rescue breathing, and providing artificial circulation through the use of external cardiac compression.

**Certified or Certification**—The accomplishment of curriculum as specified in this publication.

**Circuit**—For purposes of this instruction only, a conductor or system of conductors through which an electric current is intended to flow.

**Circuit Breaker**—A device to open and close a circuit and to open the circuit automatically at a predetermined overload of current, without injury to itself, when properly applied within its rating.

**Conductor**—A material (usually a wire, cable, or bus bar) for carrying an electric current. *Note: This term is used only with reference to current-carrying parts which are sometimes alive (energized).*

**Equipment**—A general term which includes fittings, devices, appliances, fixtures, and apparatus, and like items used as part of, or in connection with, an electrical power transmission and distribution system, or communication systems.

- *Equipment - Climbing.* Includes body belts, safety and climber straps, climbers and ladders.
- *Equipment - Electrical Inspecting and Testing.* Electrical and mechanical devices such as voltmeters, ammeters, ohmmeters, phase meters, and similar devices.
- *Mobile and Portable - Large Equipment.* Relatively large equipment items easily transported for maintenance, which must include line trucks, aerial lift trucks, motor-generator sets, pole hole diggers, and similar apparatus.
- *Equipment - Protective.* Includes rubber gloves, line hose, matting, blankets, insulator hoods, and sleeves, in addition to barricades and warning devices.

**Live**—(Energized) Electrically connected to a source of potential difference or electrically charged to have a potential significantly different from the earth in the vicinity. The term "live" is sometimes used in place of the term "current carrying" where the intent is clear to avoid repetition of the longer term.

**Live Line (Hotline) Work**—Maintenance of energized high voltage electrical conductors or equipment using approved hotline tools and rubber protective goods. Does not include routine operations such as opening and closing hook switches and fuse cutouts or installation of hotline clamps; does not include working in manholes on dead circuits.

**Mishap**—An unplanned or unsought event or series of events that results in death, injury, or occupational illness or damage to or loss of equipment or property.

**NOTE:**—The NEC states low voltage is 600v and below.

**Qualified**—A person with a recognized degree, certificate, or professional standing or who by knowledge, training, and experience has successfully demonstrated the ability to solve problems relating to the subject matter, the work, or the project.

**Supervisor**—Refers to the supervisor of "employees or workers" as used in this instruction. Generally includes the supervisor responsible for exterior electrical systems, the zone supervisor or foreman, and the infrastructure support element supervisor. Titles are necessary to assign specific responsibilities to a specific individual.

**Switch**—A device for opening and closing or changing the connection of a circuit. In this instruction, the term is generic for all oil circuit breakers, air switches, network protectors, disconnects (either fusible or plain), hot clamps, and other devices which open an electrical circuit.

**Tag**—A system or method of identifying circuits, systems, or equipment being worked on.

**Tagging**—Placing a safety tag directly on a circuit opening device or equipment for additional safety to ensure it is not used or its position altered.

**Tags**—Temporary signs (usually attached to a piece of equipment or part of a structure) to warn of existing or immediate danger.

**Voltage**—The effective RMS potential difference between any two conductors or between a conductor and ground. Voltages are usually listed as nominal values. The nominal voltage of a system or circuit is the value assigned to a system or circuit of a given voltage class to provide a convenient nomenclature. The operating voltage of the system may vary above or below this value.

- *Secondary Voltage.* Lines and equipment operating at and below 600 volts (nominal phase-to-phase).
- *Distribution Voltage.* Lines and equipment operating above 600 volts (nominal phase-to-phase) up to and including 36kV (nominal phase-to-phase). Note the NESC refers to high voltage as above 750 volts.
- *Transmission Voltage.* Lines and equipment operating above 36 kV (nominal phase-to-phase).