DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON, DC

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8 September 2020

MEMORANDUM FOR DISTRIBUTION C__
MAJCOMs/FOAs/DRUs

FROM: AF/SE
1400 Air Force Pentagon, Suite 4E252
Washington, DC 20330-1400

SUBJECT: Air Force Guidance Memorandum to AFMAN 91-203, *Air Force Occupational Safety, Fire and Health Standards*

By Order of the Secretary of the Air Force, this AF Guidance Memorandum immediately implements changes to AFMAN 91-203, *Air Force Occupational Safety, Fire and Health Standards.* Compliance with this Memorandum is mandatory. To the extent its directions are inconsistent with other Air Force publications, the information herein prevails, in accordance with AFI 33-360, *Publications and Forms Management.*

In advance of a rewrite of AFMAN 91-203, the Attachment to this Memorandum is updated to provide guidance changes that are effective immediately. An asterisk (*) indicates newly revised material.

The Memorandum becomes void after one-year has elapsed from the date of this Memorandum, or upon incorporation of an Interim Change or rewrite of AFMAN 91-203, whichever is earlier.

JOHN T. RAUCH, Maj Gen, USAF
Chief of Safety

Attachment:
Guidance Changes

Attachment
Guidance Changes

The below changes to AFMAN 91-203, dated 11 December 2018, are effective immediately.

1.8. First Aid and Cardiopulmonary Resuscitation (CPR) Training. Initial first aid/CPR training shall be accomplished prior to assigning an individual duties where first aid/CPR are requirements of the position. **(T-1)** All employees requiring CPR training will receive refresher training before current CPR certification expires. **(T-1)** Unit CPR instructors may be trained by the local Medical Group or trained directly by the American Red Cross or American Heart Association. Unit CPR instructors will, in turn, train unit personnel. **(T-1)** If CPR training is not provided by the host medical facility, any instructor receiving training directly from the American Red Cross or American Heart Association will be required to maintain the requirements and pay the costs related to maintaining that certification. **(T-1)** Training will also include Public Access Defibrillator training in accordance with AFI 44-177, *Public Access Defibrillator Program.* **(T-1) Note 1:** Self-aid and buddy care may be used to fulfill first aid training requirements; however, it does not cover CPR. Employees performing duties with risk of severe cuts, burns or electrocution, or performing duties in remote locations away from emergency responders will have a plan for immediate medical response pending definitive transfer and care. **(T-0) Note 2:** Remote location is defined as emergency care that is more than three to four minutes from the workplace.

1.10. Process Safety Management (PSM) of Highly Hazardous Chemicals.

1.10.1. The Air Force implements 29 CFR § 1910.119, *Process Safety Management of Highly Hazardous Chemicals,* requirements to prevent or minimize consequences of catastrophic releases of toxic, reactive, flammable or explosive chemicals. The criteria in 29 CFR § 1910.119 shall be used in its entirety for program implementation and application unless otherwise specified. **(T-0).** PSM may also apply to explosives and pyrotechnics. Refer to 29 CFR § 1910.119, AFI 91-202 and Defense Explosives Safety Regulation (DESR) 6055.09_AFMAN 91-201, *Explosives Safety Standards,* for additional guidance.

1.10.3. Responsibilities.

1.10.3.1. The installation Occupational Safety (SEG) office shall:

1.10.3.1.1. Serve as the focal point for coordinating and implementing PSM procedures as called for to include leading the PSM team if one is required. **(T-1)**

1.10.3.1.2. With the assistance of the Hazardous Material Pharmacy (HMP), conduct and document an assessment of the installation's chemical quantities on-hand that are listed in 29 CFR § 1910.119, Appendix A, *List of Highly Hazardous Chemicals, Toxics and Reactives.* **(T-0)**

1.10.3.1.2.1. If the chemicals on the installation do not exceed the threshold quantities listed in 29 CFR § 1910.119, Appendix A, the installation SEG will document the assessment and note that, in accordance with 29 CFR § 1910.119 Appendix A, threshold quantities, a PSM Program is not required. **(T-1)** In this case, a reassessment will be accomplished and documented by the installation SEG, in coordination with the affected unit, at a minimum of every three years from the initial assessment or sooner when new chemicals or increased quantities of chemicals listed in 29 CFR § 1910.119, Appendix A, are introduced to the installation. **(T-1)**

1.10.3.1.2.2. If the chemicals on the installation exceed the threshold quantities listed in 29 CFR § 1910.119, Appendix A, the commander and a formal PSM program will be instituted with a PSM team lead by the installation safety office. **(T-0)**

1.10.3.1.2.3. The installation safety office will ensure copies of OSHA-required PSM documentation are maintained in the installation safety office for OSHA's review for the life of the process. **(T-0)**

1.10.3.1.2.4. The installation safety office, in coordination with the affected unit, will assess installation operations and advise NAF/SE and MAJCOM/SE of the number and type of operations that fall under the PSM program. **(T-1)**

1.10.3.2. The Installation PSM Program Team, when required, shall:

1.10.3.2.1. Include representatives from the installation Occupational Safety office, Bioenvironmental Engineering (BE), HMP Program OPR (also called the installation Hazardous Material Management Process team lead), Civil Engineering (CE), Environmental Management office, Fire Emergency Services (FES) Flight, Readiness Flights and all highly hazardous chemical users as defined in 29 CFR § 1910.119. **(T-1)**

1.10.3.2.2. Develop and coordinate the installation plan for employee participation. **(T-0)**

1.10.3.2.3. Meet as necessary to conduct and review process hazard analyses (PHA). **(T-1)**
Note: The PSM Program Team is not necessarily the same team that performs the PHA in 29 CFR § 1910.119(e). These PHAs may be performed by internal staff members, through a contract, or a combination of both.

2.5.2.3. Modular office furniture electrical systems are normally designed only to provide power to office equipment, e.g., personal computers, monitors, printers, etc. Refer to 29 CFR § 1910, Subpart S, *Electrical,* for additional guidance. Use of appliances for personal convenience, such as refrigerators, coffee makers, microwave ovens, will be requested through the facility manager prior to use to ensure the electrical system can safely accommodate the additional load. **(T-2)** Facility managers shall contact their installation CE when assistance is needed. **(T-2)**

2.5.7. Facility floors, especially raised floors, shall be kept smooth, clean and free of obstructions and slippery materials.

2.5.8. Raised floor spaces shall be divided in the same manner as the equipment spaces above the area they serve.

2.5.9. Raised floor spaces shall contain a standard or ultra-sensitive smoke detection system in the same manner as the equipment spaces above the area they serve.

2.5.10. Raised floor systems shall be constructed of noncombustible materials.

2.5.11. Floors shall not be cleaned with flammable or combustible liquids. Follow the manufacturer's and SDS guidelines when using cleaning agents for floors and facilities.

2.5.12. To prevent buildup of trash and foreign objects, sub-floors under raised floors shall be cleaned periodically, but not less than once every 60 days. Sub-floors shall be inspected once each operational day to ensure no flooding or leaking is present, unless the sub-floor area is provided with an automatic water leakage detection system. **Note:** Any change in facility or room use requires reassessment of the cleaning schedule.

2.5.13. Utility trenches shall be kept clean of foreign objects and inspected at least every 60 days. If cleaning history shows a longer period between cleanings is feasible, the FES Flight may allow extending the time between cleanings. **Note:** Any change in facility or room use requires reassessment of the cleaning schedule.

2.11. Manual Material Handling. Supervision will accomplish a hazard assessment to identify risks to employees or property and methods to mitigate these hazards, prior to moving equipment or furniture. **(T-1)** Some possible exposures to mishaps include, but are not limited to:

2.11.1. Movable or detachable parts, such as doors or drawers which must be secured properly prior to moving. **(T-1)**

2.11.2. Remove items inside doors or drawers to lighten load and prevent shifting or falling hazards.

2.11.3. Secure cords, communication cables or other gear attached to the item to prevent tripping or snagging hazards.

2.11.4. For large or difficult to handle items, secure the load to the hand-truck or dolly with a cargo strap or other fastening device.

2.11.5. Paths of travel must be evaluated for conditions such as slopes, carpeting or other irregularities to ensure safe movement of items. **(T-1)**

2.11.6. Ensure pathways are cleared and the object being moved will fit through doorways or other required openings. **(T-1)**

2.11.7. Use more than one person if moving the load up or down slopes or stairs. **Note:** Team lifting will be used when items are considered to be too heavy for one person or when items are lifted from an awkward position or location. **(T-1)**

2.11.8. Choose the proper size and style dolly for the job.

2.11.9. If the use of an elevator is required, the size and weight of the item and manufacturer's loading and weight limit requirements must be considered.

2.11.10. Evaluate the need for PPE.

2.11.11. Follow the guidelines in paragraph **2.9.3** for additional guidance on proper lifting.

3.3.4. Locations with nuclear munitions will request notification of lightning within 10 miles of their location in accordance with DoDM 3150.02, *DoD Nuclear Weapon System Safety Program,* from their servicing weather unit. Local procedures for these advisories are documented in DESR 6055.09_AFMAN 91-201.

4.4.3. Machinery/Equipment. Supervisors shall maintain manufacturer's manuals for all machinery or equipment under their control or develop local operating instructions, to include job safety, maintenance, lubrication and inspection, and identify operator and maintenance technician responsibilities. **(T-1)** Supervisors may use manufacturer's instructions to develop operating instructions or lesson plans to train operators on requirements of specific machinery. Refer to 29 CFR § 1910.212, *General Requirements for All Machines,* and 29 CFR § 1910.263, *Bakery Equipment,* for additional guidance on machinery. Equipment connected by flexible cords, i.e., extension cords, shall be disconnected when not in use for extended periods of time or at the end of the work shift. **(T-1)**

6.2.1.6. Emergency Lighting. Emergency lighting shall be provided in accordance with National Fire Protection Association 101, *Life Safety Code.* **(T-0)**

6.2.1.7. Data processing rooms located below floors equipped with water sprinkler systems are susceptible to water damage if the sprinkler systems are actuated. Managers shall provide a means of protecting data processing equipment in the event of a water leak or sprinkler activation (time permitting). **(T-0)** This may be accomplished by strategically locating pre-cut pieces of plastic sheeting within data processing rooms. In the event of a water leak or spill, equipment shall be shut down before it is covered with the plastic sheeting. **(T-0)** This will reduce the possibility of the equipment overheating and catching on fire. The plastic sheeting shall be removed before restarting equipment. **(T-0)**

6.2.1.8. A survey of each data processing facility by the installation CE shall be requested to determine if a water hazard exists. **(T-1)** The building custodian shall keep the completed survey on file and brief incoming personnel during initial safety orientation. **(T-1)**

6.2.4.4. Fire Extinguisher Purchase and Maintenance. Facility managers and using organizations shall budget for purchase and maintenance of fire extinguishers. **(T-3) Note:** Not applicable to flightline fire extinguishers.

6.2.4.5. All fire extinguishers shall meet the requirements of National Fire Protection Association 10, *Standard for Portable Fire Extinguisher.* **(T-1) Note:** This includes flightline fire extinguishers.

6.2.4.6. Worker Responsibilities. All employees are responsible for fire extinguishers in their work areas. Supervisors shall ensure fire extinguishers are readily accessible with unobstructed access and are used only for the intended purpose. **(T-0)** FES Flights shall be notified of any fire extinguisher discharge, accidental or intentional. **(T-3)**

6.2.4.6.1. Deleted.

6.2.4.6.2. Deleted.

6.2.4.6.3. Deleted.

6.2.4.7. Supervisor Responsibilities. Supervisors are responsible for fire extinguishers in areas under their control. Supervisors shall:

6.2.4.7.1. Perform visual inspections of fire extinguishers in accordance with paragraph **6.2.4.8.** **(T-1)**

6.2.4.7.2. Take defective extinguishers to an authorized servicing location, as determined locally and coordinated with the installation FES Flight, for services. **(T-0)** Fire extinguishers removed from service shall be immediately replaced. **(T-1)**

6.2.4.7.3. Mount fire extinguishers in or on vehicles or equipment in approved brackets, or otherwise secure them, to prevent damage as directed by TO or other directive. **(T-0) Note:** Vehicle fire extinguishers shall only be purchased with the approval of Vehicle Management to ensure the vehicle technical orders and AFIs require the vehicle to carry fire extinguishers. **(T-1)**

6.2.4.7.4. Deleted.

6.2.4.7.5. Deleted.

6.2.4.7.6. Deleted.

6.2.4.7.7. Deleted.

6.2.4.7.8. Deleted.

6.2.4.8. Visual Inspection. Managers and supervisors at all levels shall ensure a visual inspection is performed and documented monthly for all fire extinguishers under their control. **(T-0)**

Extinguishers with discrepancies shall be removed from service until repaired. **(T-0)** This inspection includes:

6.2.4.8.1. Extinguisher located in a designated place. **(T-0)**

6.2.4.8.2. No obstruction to access or visibility. **(T-0)**

6.2.4.8.3. Operating instructions on name plate legible and facing outward. **(T-0)**

6.2.4.8.4. Safety seals and/or tamper indicators not broken or missing. **(T-0)**

6.2.4.8.5. No obvious physical damage, corrosion, leakage or clogged nozzle. **(T-0)**

6.2.4.8.6. Pressure gauge reading or indicator in the operable range or position. **(T-0)**

6.2.4.8.7. For wheeled units, the condition of the tires, wheels, carriage, hose and nozzle checked. **(T-0)**

6.2.4.8.8. Fullness determined by weighing or "hefting." **(T-0)**

7.4.2.5.5. Deleted.

8.5.6. Remote Disconnect Control circuits will comply with requirements found in NFPA 70. **(T-0)**

8.11.5.2. Supervisors shall consult with installation occupational safety office to determine if insulating matting is required in their areas of responsibility. **(T-3)** This includes areas where potential shock hazards exist and additional protection is needed, floor resistance is lowered due to dampness and where employees are exposed to voltages of 50 volts or more. Refer to NFPA 70E, Article 130, *Work Involving Electrical Hazards,* for additional guidance.

9.1. Scope. This chapter addresses regulations and standards, acquisition, location and installation, maintenance, use and testing of emergency shower and eyewash units. Also included are performance specifications for both permanently-installed and self-contained units. Types of equipment covered are emergency showers, eyewash units, eye and face units, combination units, hand-held drench hoses and eyewash bottles.

9.2. Regulations and Standards.

9.2.1. OSHA Regulation.

9.2.1.1. General Requirements. In accordance with 29 CFR § 1910.151(c) and 29 CFR § 1926.50(g), *Medical Services and First Aid,* where the eyes or body of any employee may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of eyes and body shall be provided in the work area for immediate emergency use. **(T-0)**

9.2.1.2. Specific Requirements.

9.2.1.2.1. Storage and Handling of Anhydrous Ammonia. Refer to 29 CFR § 1910.111, *Storage and Handling of Anhydrous Ammonia.*

9.2.1.2.2. Telecommunications. Refer to 29 CFR § 1910.268, *Telecommunications.*

9.2.1.2.3. Batteries and Battery Charging. Refer to 29 CFR § 1926.441(a)(6).

9.2.2. UFC 3-420.01, *Plumbing Systems.*

9.2.2.1. Deleted.

9.2.2.2. Deleted.

9.2.2.3. Deleted.

9.2.3. American National Standards Institute/International Safety Equipment Association (ANSI/ISEA) Z358.1-2004, *Emergency Eyewash and Shower Equipment.*

9.3. Equipment - Acquisition.

9.3.1. Emergency shower and eyewash equipment may be locally and centrally procured. The installation occupational safety office shall ensure the procuring document includes documentation from the manufacturer that the equipment meets or exceeds ANSI/ISEA Z358.1-2004 specifications. **(T-1)**

9.3.2. Installation Occupational Safety and BE offices shall evaluate each request for emergency showers and/or eyewashes to determine the need for the installation and proper location of units. **(T-1)**

9.3.2.1. Respective owner shall document and maintain rationale for decisions. **(T-1)**

9.3.2.2. The affected unit will identify the type of material used, its properties, how the material is dispensed, probability of injury, extent of potential injury and PPE available and used shall be considered in determining the need for the units. **(T-0)**

9.3.3. Self-contained Units. Units shall be constructed of noncorrosive materials and provide a minimum of 15 minutes continuous flow. **(T-1)** Stored fluid shall be protected against contaminants and temperature extremes. **(T-1)** Units may be filled with potable water or a solution approved by either the manufacturer or the installation medical services. Instructions and expiration dates shall be permanently affixed to the unit. **(T-1)**

9.3.4. Eyewash Bottles. Shall provide an immediate flushing to the eyes. Eyewash bottles are not a replacement for other types of emergency equipment. These bottles may be filled with potable water or an eye-flushing solution, either approved by the manufacturer or by the

installation medical services. Unit supervision shall develop procedures to prevent these units from being exposed to extreme temperatures. **(T-1)** Instructions and expiration dates shall be permanently affixed to the unit, if applicable.

9.4. Location and Installation.

9.4.1. Location.

9.4.1.1. Eyewash and emergency showers shall be located as near to the hazard as possible with maximum of 10 seconds or 100 feet unobstructed travel from the source of exposure to the unit. **(T-0)**

9.4.1.2. Unobstructed means no objects, equipment, furniture or doors lie in the travel path.

9.4.1.3. Path will be well lit. **(T-1)**

9.4.1.4. The emergency shower and eyewash station will be clearly marked with appropriate signage. **(T-1)**

9.4.1.5. Recommend emergency shower and eyewash station be located near an emergency exit to allow easy access by emergency responders.

9.4.2. Installation.

9.4.2.1. Permanent plumbed in emergency showers and eyewash stations shall meet UFC 3-420-01. **(T-1)**

9.4.2.2. Installation must meet manufacturer's requirements. **(T-1)**

9.4.2.3. Water pipes servicing the emergency shower and eyewash station shall be protected from freezing or hearting. **(T-1)**

9.4.2.4. Valves servicing the equipment shall be labeled to prevent inadvertent shut off. **(T-1)**

9.4.2.5. Water lines must be able to provide enough pressure to meet manufacturer's requirements for that equipment. **(T-1)**

9.4.2.6. Water supply used will be free of contaminants and shall not be delivered at extreme temperatures. Temperature shall be maintained between 60° and 100°F. **(T-1)** This prevents injury to the eyes and ensures personnel will be able to continue to use the equipment and not stop due to temperature discomfort.

9.4.2.7. Emergency shower and eyewash stations shall remain activated without the use of the operator's hands on activated. **(T-1)** Activation of the equipment shall take one second or less. **(T-1)** Once activated, it shall remain on until intentionally shut off. **(T-1)**

9.4.3. Deleted.

9.4.4. Deleted.

9.4.5. Deleted.

9.4.6. Deleted.

9.5. Maintenance and Testing.

9.5.1. Permanently-installed shower and eyewash units shall be activated by the supervisor weekly to verify operation and to reduce accumulation of bacteria/sediment for time period directed by the manufacturer. **(T-1)** Maintain manufacturer instructions with the unit. **(T-1)**

9.5.2. The supervisor or employee shall inspect unit(s) monthly in accordance with manufacturer's instructions and document the inspection when completed. **(T-1)** Coordinate the inspection with weekly activation and thoroughly check for damage, scale accumulation or other defects as required by the manufacturer. Supervisors shall maintain documentation to show date of inspection and name of individual performing the test. **(T-0)** This documentation may be kept in a log, computerized or affixed to the equipment by tag or label. **Exception:** Units installed at missile sites, not permanently manned, shall be tested and documented by the team chief during the most frequently performed periodic inspection established for that system. **(T-1)**

9.5.3. Self-contained units shall be tested and inspected in accordance with the manufacturer's instructions and documented. **(T-0)**

9.5.4. Eyewash bottles shall be tested, refilled, maintained and disposed of in accordance with the manufacturer's instructions. **(T-0)**

9.5.5. Installation Occupational Safety office shall inspect all units during the annual facility/workplace inspection for proper placement, installation and documentation of supervisory testing and operation. **(T-1)**

9.5.6. Installation Occupational Safety office shall evaluate all installed units that no longer meet the criteria of the manufacturer's instruction for replacement or upgrade. **(T-1)**

9.6. Training. Workers shall be trained initially and annually thereafter on the location and proper use of the emergency shower and eyewash station. **(T-1)** Training shall include:

9.6.1. Locations of each emergency shower and eyewash station in the work center. **(T-1)**

9.6.2. Ensuring the paths to the emergency shower and eyewash station remains clear and the equipment is properly maintained. **(T-1)**

9.6.3. Taking proper actions to assist personnel who are exposed and need to use the emergency shower and eyewash station, to include calling for medical assistance. **(T-1)**

9.6.4. Instructing workers on the proper way to use the station to wash the exposed area(s), i.e., how to get the water into their eyes in the most effective manner. **(T-1)**

11.3.1.4.3. Machine operators will not wear gloves during operations when manufacturer's instructions specify that the wear of gloves will increase the chance of injury. **(T-1)**

11.4.6. Exhaust Ventilation. Installation BE must evaluate machines that develop fine dust and fumes to safeguard workers. **(T-0)** Refer to AFMAN 48-146, *Occupational and Environmental Health Program Management,* and 29 CFR § 1910.94, *Ventilation*, for additional guidance.

12.3.5.1. Whenever possible, electric or battery powered equipment shall be used indoors. **(T-1)** Internal combustion engines shall not be operated inside buildings unless an exhaust system or other ventilation approved by BE is installed and used. **(T-1)** Administrative areas, e.g., offices, must be protected from exhaust buildup either by distance or positive air flow pressure in relation to the warehouse activities. When internal combustion engine equipment is used inside warehouses, BE personnel shall determine ventilation requirements to preclude exposure of workers to carbon monoxide gas. **(T-1)** Refer to DESR 6055.09_AFMAN 91-201 for operating in explosives and weapons areas.

12.6.3.1. Acquisition. Overhead hoists shall meet design specifications, characteristics and rules of American Society of Mechanical Engineers B30.7, *Winches*, B30.10, *Safety Standard for Cableways, Cranes, Derricks, Hoists, Hook*s, *Jacks and Slings,* and B30.16, *Overhead Underhung and Stationary Hoists*. **(T-0)** When applicable, a system safety program shall be established. **(T-1) Note:** Nuclear-certified hoists must also meet requirements in AFMAN 91-118, *Safety Design and Evaluation Criteria for Nuclear Weapon Systems.* **(T-1)**

12.7.2.3.1. Frequent Inspections. The operator or designated person shall perform a visual inspection of the sling prior to using the sling and during sling use, as warranted. **(T-0)** If damage, defects or abuse is detected, the sling shall be removed from service until periodic testing is done. **(T-0)** This inspection will be documented on AFTO Form 244. **(T-1)** Refer to paragraph **12.1.1** concerning use of paper forms and automated systems.

12.7.3.1.2. Hooks, rings, oblong or pear-shaped links, welded or mechanical coupling links or other attachments shall have a rated capacity at least equal to that of the alloy steel chain with which they are used. **(T-0)** The sling shall not be used in excess of the rated capacity of the weakest component. **(T-0)**

12.7.3.2.5.5. Cracked, deformed or worn end attachments. **(T-0)**

12.7.3.2.5.7. Corrosion of rope or end attachments. **(T-0)**

12.7.3.3.6. Metal mesh slings not impregnated with elastomers may be used from minus 20ºF to 550ºF without decreasing the working load limit. Metal mesh slings impregnated with polyvinyl chloride or neoprene may be used only from 0ºF to 200ºF. For operations outside these temperature ranges or for metal mesh slings impregnated with other materials, the sling manufacturer's recommendations shall be followed. **(T-0)**

13.1.1. General Industry. Fall protection shall be provided whenever employees can fall four (4) feet or more. **(T-0)** This four (4) foot rule applies to all walking and working surfaces and includes open-sided floors and platforms, wall openings and window wall openings at a stairway landing, floor, platform or balcony with a drop of four (4) feet or more. Refer to 29 CFR § 1910 Subpart D – *Walking-Working Surfaces,* for additional requirements, and paragraph **13.4** for types of fall protection.

13.1.2. Construction Operations. Fall protection shall be provided when employees can fall six (6) feet or more during construction operations. **(T-0)** This six (6) foot rule applies to all walking and working surfaces, including roofs, open-sided floors and platforms, wall openings and window wall openings at a stairway landing, floor, platform or balcony with a drop of six (6) feet or more. Refer to 29 CFR § 1926 Subpart M – *Fall Protection* (29 CFR § 1926.500), for additional requirements.

13.1.7. Fire and Emergency Services. Fall protection shall be provided for FES personnel when exposed to falls greater than four (4) feet during routine operations as stipulated by General Industry standards (29 CFR § 1910 Subpart D). **(T-0)**

13.2.2.3. Fall Protection Plans. Fall protection plans are only allowed for residential roofs, leading edge work and precast concrete erection work. A written fall protection plan must be prepared by a qualified person and meet the requirements of 29 CFR § 1926.502(k). **(T-0)** This written plan shall be coordinated with the installation Occupational Safety office before the plan and its procedural controls are used. **(T-1)** Training for the fall protection plan must meet the requirements of 29 CFR § 1926.503(a) and (c). **(T-0) Note:** A corrective action plan will be accomplished describing planned upgrades (equipment, cost and timetable, prioritized by the shop) and appropriate Risk Assessment Codes, to partially or totally eliminate need for procedural controls. **(T-1)**

13.2.2.3.1. Deleted.

13.2.2.3.2. Deleted.

13.2.2.3.2.1. Deleted.

13.2.2.3.2.2. Deleted.

13.2.2.3.2.3. Deleted.

13.2.2.3.2.4. Deleted.

13.4.6.3. Horizontal lifelines (Skylines), commonly used in aircraft hangars, wash racks, corrosion control or other aircraft maintenance areas, shall meet the requirements found in 29 § CFR 1910.140 and 29 CFR § 1926.502**. (T-0)** Documentation that show the installed horizontal lifelines meet these requirements will be maintained in the workcenter. **(T-1)**

13.4.6.5. Lanyards. Lanyards of synthetic materials shall have free ends lightly seared to prevent unraveling. **(T-0)** Knots weaken a lanyard and shall not be used in lanyard end terminations. **(T-0)** Lanyards and personal energy absorbers subjected to impact loading from a falling person or weight test shall be removed from service and replaced. **(T-0)** Refer to paragraphs **13.5.2.8** and **13.6.8.4** for additional guidance. **Warning:** Wire rope or rope covered wire lanyards, some plastics (such as nylon) and wet lanyards are conductive and shall not be used near electrical hazards.

13.4.6.6. Energy (Shock) Absorber Components. Each personal fall arrest system may include an energy absorber, which shall be designed so activation is obvious, e.g., ripped stitches, telltale strips visible, etc. **(T-0)** Energy absorbers with any signs of activation shall be removed from service. **(T-0)**

13.4.6.7. Anchorage. Anchorages will meet requirements in 29 CFR 1910.140 and 29 CFR § 1926.502, *Fall Protection Systems Criteria and Practices.* **(T-0)** Workcenter will maintain documentation demonstrating that the anchorages meet these criteria. **(T-1)**

13.4.6.8.1. Snaphooks and carabiners shall be self-closing, self-locking, designed to take 2 consecutive and deliberate actions (double locking) to open and load rated for at least 5,000 pounds. **(T-0)**

13.4.6.9. Fall Arrest Components. Fall arresters, as in self-retracting lifelines, shall be automatic in their locking (fall stopping) function. **(T-0)** Employees shall follow manufacturer's instructions to test the locking mechanism after connection to their harness/lanyard. **(T-0)** Self-retracting lifeline systems will be positioned over the employee as the employee moves. **(T-0)** Pulling on the lifeline cable to provide more slack without moving the overhead carrier (trolley) will result in a pendulum swing should the employee fall.

13.5.1.2. Employees shall inspect their personal fall arrest systems prior to the first use of the day or shift for mildew, wear, damage and other deterioration. **(T-0)**

13.5.1.3. Supervisors shall ensure all PFAS components receive a thorough inspection at least quarterly. **(T-1)** This inspection shall be documented and maintained for at least one year. **(T-1)** **Exception:** Components of a PFAS that have been professionally installed and certified will be inspected in accordance with manufacturer's instructions, at the interval recommended by the manufacturer, and by a person qualified to perform the inspection. Inspection shall be documented and maintained. **(T-1)**

13.6.1. Fall prevention and protection must be considered for maintenance work or storing of equipment at heights. **(T-0)** At the planning and design phase of a project, fall hazards shall be considered and eliminated whenever possible. **(T-0)** When elimination or prevention of fall hazards is not feasible, the design must include certified and labeled anchorages in accordance with 29 CFR § 1910.28, 29 CFR § 1910.140 and American National Standards Institute Z359.1. **(T-0)** Where fall protection is required near material handling equipment, care must be taken to prevent potential conflicts. **(T-0)**

13.6.5. Supervisor, as defined in AFI 91-202, paragraph 1.6.55, shall:

13.6.5.1. Ensure each worker/qualified person/competent person using a fall protection/fall arrest system is trained and evaluated on proper use, application and inspection of fall protection/fall arrest systems. **(T-1)**

13.6.5.2. Be able to provide recommendations for qualified and competent personnel in the organization. **(T-1)**

13.6.5.3. Be designated in writing by the unit commander. **(T-1)**

13.6.6.3. Ensure initial training evaluations are provided to shop personnel on fall protection and fall arrest systems prior to initial use. **(T-0)** Recurring training evaluations are also required. Refer to paragraph **13.3** for additional guidance.

13.6.6.5. Prepare and accomplish self-inspection checklist annually in accordance with TO 00-25-245. **(T-1)** Checklist shall include all relevant information on fall protection and fall arrest systems, e.g., proper care, maintaining and inspection of fall protection and fall arrest systems equipment, training program, etc. **(T-1)** The self-inspection shall be documented and maintained until the next self-inspection is performed. **(T-1) Exception:** Components of a PFAS that have been professionally installed and certified and is inspected in accordance with manufacturer's instruction, at the interval recommended by the manufacturer, and by a person qualified to perform the inspection will not require self-inspection. **(T-1)**

13.6.7. A qualified person, as defined in ANSI/ASSE Z359.0, *Definitions and Nomenclature Used for Fall Protection and Fall Arrest,* shall:

13.6.7.4. Be designated in writing by the commander. **(T-1)**

13.6.7.5. Keep the documentation of the agreement for the services needed to comply with fall protection requirements, if the services of a qualified person come from outside of the organization. **(T-1)**

13.6.8. A competent person, as defined by ANSI/ASSE Z359.0, shall:

13.6.8.5. Be designated in writing by the unit commander. **(T-1)**

13.7.1.1. Type of rescue system, e.g., self-rescue, assisted self-rescue, mechanically aided, FES Flight, outside agency.

13.7.2. Supervisors shall ensure employees using a personal fall arrest system are trained to respond to a fall using a suitable rescue plan and system that allows for self-rescue when possible and organized rescue when incapacitated. **(T-0)** Availability of rescue personnel, ladders or other rescue equipment shall be determined prior to using a fall arrest system. **(T-0) Warning:** Hanging in a harness for an extended period of time can be fatal. 29 CFR § 1910.140(c)(21) and American National Standards Institute Z359.2, *Minimum Requirements for a Comprehensive*

Managed Fall Protection Program, prescribe prompt rescue, which has been interpreted by OSHA as rescuing the worker prior to serious injury. Rescue timelines can vary based on many issues, however, as stated in American National Standards Institute Z359.2, the overall goal should be less than six (6) minutes to rescue a worker.

13.7.4. Employees suspended in a full body harness often lose consciousness after a fall. This is caused by restrictions in blood flow to the extremities caused by the harness. The rescue plan must ensure a rescue can be affected very quickly to prevent permanent injury or death. **(T-0)**

14.1. Scope. This chapter covers the use, selection, care and maintenance for protective equipment for eyes, face, head and extremities, protective clothing, respiratory devices and protective shields/barriers. For issues involving Radio Frequency or laser radiation, refer to AFI 48-109, AFI 48-139 and AFMAN 48-148, *Ionizing Radiation Protection.* **Note:** A cross-reference of host nation and US standards is not available. On a case-by-case basis, when procuring PPE outside of the Air Force supply system, each Wing/installation should conduct a product risk assessment to determine if the product meets or exceeds the US standards. If the product does not meet or exceed the US standards, then purchase a product within US standards, if possible.

14.3.1. Training shall be provided to each affected employee who is required to use PPE when accomplishing any work activity. **(T-0)** Supervisors shall train each employee in accordance with 29 CFR § 1910.132(f), Training, and applicable manufacturer's instructions. **(T-0)** Respiratory training shall be in accordance with 29 CFR § 1910.134, *Respiratory Protection,* and AFI 48-137. **(T-0).** Hearing protection shall be in accordance with AFI 48-127.

14.3.1.1. Deleted.

14.3.1.2. Deleted.

14.3.1.3. Deleted.

14.3.1.4. Deleted.

14.3.1.5. Deleted.

14.3.2. Retraining. As required by 29 CFR § 1910.132(f)(3), supervisors shall ensure an affected employee is retrained when:

14.3.2.1. Employee has a change in their job assignments. **(T-0)**

14.3.2.2. A change in the work processes present a new hazard. **(T-0)**

14.3.2.3. There is a change type of PPE used. **(T-0)**

14.3.2.4. Other conditions as specified in 29 CFR § 1910.147(f)(3). **(T-0)**

14.3.3. Supervisor shall document training in accordance with paragraph **1.7** and AFI 91-202, *The US Air Force Mishap Prevention Program.* **(T-1)** Respiratory training shall be documented in accordance with AFI 48-137. **(T-1)**

14.3.4. Deleted.

14.4.5. Head Protection. Personnel working in areas where there is a potential for injury from falling or fling objects, bumping head against a fixed object or electrical shock or burns shall be provided and use protective helmets. **(T-0)** Typical examples of these areas are construction sites and warehouses. Protective helmets must comply with American National Standards Institute/International Safety Equipment Association (ANSI/ISEA) Z89.1, *Industrial Head Protection,* and 29 CFR § 1910.135, *Head Protection.* **(T-0) Note:** Protective helmets that contain the ANSI/ISEA Z89.1 marking meet the requirements of ANSI/ISEA Z89.1.

14.4.9. Hand and Arm Protection. When an employee's hands or arms are exposed to hazards, such as skin absorption of harmful substances, severe cuts, lacerations, abrasions, punctures, chemical burns or harmful temperature extremes, appropriate hand or arm protection shall be provided and used. **(T-0)** Sleeves, padded arm protectors, hand pads and other items shall be worn to protect the hands and arms when hot or sharp materials are handled. **(T-0)** There is a wide assortment of gloves, hand pads, sleeves and wristlets for protection against various hazardous situations. Before purchasing any chemical protective equipment, contact BE, who will evaluate the hazard and provide the necessary specifications such as material type, thickness and coverage area, then ensure the manufacturer's recommended use for the glove matches the particular application and anticipated hazards involved. **(T-1)** Supervisors shall select appropriate hand protection based on the characteristics required for the task to be performed, dexterity required, conditions present, duration of use, frequency, physical stresses, limitations of protective clothing and degree of exposure to identified hazards. **(T-0)**

14.4.11.2. Safety shoes shall be sturdy and have an impact-resistant toe. **(T-0)** Only shoes meeting or exceeding the requirements found in ANSI Z41 impact standard, as incorporated by reference in 29 CFR § 1910.6, *Incorporation by Reference,* are approved for the Air Force. Refer to 29 CFR § 1910.136, *Foot Protection,* for additional information. Metal insoles in shoes protect against puncture wounds. Additional protection, such as metatarsal guards, may be necessary for some job tasks. Nonskid shoes shall be worn where floors may be wet or slippery. **(T-0)** Electrical hazard shoes are not designed to be a replacement for electrically-rated matting in high voltage situations. These shoes are designed to be used when working on low voltage circuits and as a secondary means of protection. **Note:** When exposed to cold temperatures and foot crushing hazards, if cold weather footwear which also provides crushing protection is not available, personnel shall be issued footwear which protects against the possibility of frostbite. **(T-0)**

14.4.12. Chemical Protective Clothing. The purpose of chemical protective clothing and equipment is to shield or isolate individuals from chemical, physical and biological hazards encountered during hazardous materials operations. Many chemicals pose invisible hazards and offer no warning properties. It is important for employees to realize that no single protective clothing item can protect against all hazards. Other protective methods, such as elimination,

substitution, engineering or administrative controls, shall be used to limit chemical contact before considering use of PPE. **(T-0)**

14.4.12.2.2. Requirements. The proper type of chemical protective clothing or equipment depends on job requirements, and includes requirements from TOs, Safety Data Sheets (SDSs) and manufacturer's recommendations. Check with BE before purchasing chemical protective clothing or equipment.

14.4.12.2.2.1. Deleted.

14.4.12.2.2.2. Deleted.

14.4.12.3. Chemical Protective Clothing Limitations. Many chemicals can have adverse effects on protective clothing and gloves. Permeation, a process by which a chemical can pass through PPE, and Degradation, a reduction in the physical properties of PPE, are two examples. Chemicals allowed to remain on protective clothing or equipment can diffuse through the material, even if it is in storage. Chemical protective clothing that is reused must be cleaned before storage. **(T-0)** In some cases, it may be more cost effective to select chemical protective clothing with a relatively short breakthrough time (see definitions, **Attachment 1**), and decontaminate and discard it properly after one use.

14.4.12.3.1. Duration of Exposure. Maximum duration of exposure to a chemical shall be considered when selecting chemical protective clothing. **(T-0)** Contact BE to determine the appropriate PPE.

14.4.15.2. Personnel exposed to a traffic environment or flightline operations during hours of darkness, periods of reduced visibility or as part of construction, shall be provided and use reflective vests and accessories or shall use organizational clothing with sewn-on reflective tape. **(T-3).** Refer to ANSI/ISEA 107, *American National Standard for High-Visibility Safety Apparel,* for additional guidance regarding selection of reflective clothing. Security Forces performing flightline operations are exempt from this requirement per AFI 91-207, *The US Air Force Traffic Safety Program.* **Note:** Personnel whose job requires them to perform some function in the traffic/flightline environment shall be provided reflective equipment to enhance their visibility, except as previously stated for Security Forces. **(T-1)**

14.5. Proper Care and Maintenance. Workers shall maintain all PPE in accordance with with manufacturer's instructions to include being kept clean and in good repair. **(T-0)** Previously used PPE shall be disinfected before reissue to another worker. **(T-0)** Contaminated PPE that cannot be decontaminated shall be disposed of in a manner that protects employees from exposure to hazards. **(T-0)** Contact BE to determine the appropriate disposal measures. Functional managers shall ensure disposal of contaminated PPE is consistent with applicable environmental regulations. **(T-1)** Reusable PPE that can be decontaminated can be stored in resealable or drawstring type bags. Refer to the PPE manufacturer's instructions, UFC 3-560-01, AFMAN 32- 1065, *Grounding and Electrical Systems,* 29 CFR § 1910.137, Table I, and 29 CFR § 1910.141, *Sanitation,* for more information on cleaning specific equipment.

18.1.1. Hydrocarbon fuels consist of aviation fuels, diesel fuels, gasoline, aviation gasoline and natural gas composites used by the Air Force. Hydrocarbon fuels are a fat soluble, which can irritate skin. Fuels such as gasoline, kerosene, diesel and fuel oils have similar characteristics and warrant the same degree of safety as aviation fuels.

18.1.2. TO 42B-1-1, *Quality Control of Fuels,* provides specifications for fuels. Refer to TO 42B-1-1-14, *Fuels for USAF Aircraft,* for a complete description of aircraft fuel classifications, characteristics and use.

18.1.3. Fuel Spill Classifications. Fuel spill classification and emergency procedures are described in TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding.* Cleaning procedures shall be established in accordance with the installation environmental management office guidance. **(T-0)**

18.2. Hazards. Fuel can ignite unexpectedly and cause fires or explosions, which may result in property damage, injury and/or loss of life. Ignition sources include open flames such as matches and cigarette lighters, cutting and welding sparks, static electricity, electrical arcing and lightning. Support equipment being operated in any fuels area shall meet the requirements of AFMAN 24-306, *Operation of Air Force Government Motor Vehicles,* and TO 36-1-191, *Technical and Managerial Reference for Motor Vehicle Maintenance.* **(T-3)**

18.2.3.1. Static Electricity. Static electricity can occur when fuel is stable (not flowing) or flowing. Static electricity can be generated by the slightest movement in a stable environment, e.g., in a fuel tank or cell, container, etc. Fuel flowing through hoses or pipe systems can generate an electrostatic charge over 20,000 volts, sufficient to cause an arc or spark when touched. A conductivity additive in commonly used aviation turbine fuels minimizes static buildup during fuel flow. **Warning:** The additive does not eliminate static electricity in fuel flowing through hoses or pipes, but rather facilitates releasing the built up static charge. This is why proper grounding and bonding of fuel systems, components and equipment is necessary to mitigate the ignition risk posed by static discharge.

18.2.4.1. Filter separator vessels generate static electricity when fuel flows through filters. Workers should wait at least 30 seconds after flow stops so the static charge can dissipate.

18.2.4.2. Loading Racks and Fillstands. Line strainers with a pore size less than 300 micron with 50 mesh per inch opening generate static charges. Screens with a pore size less than 300 micron with 50 mesh per inch can create static charges. Movement of fuel through piping or hose also generates static charges. Proper grounding and bonding are required to control static buildup and hazards.

21.3.5.9. Deleted.

23.2.7.5. Provide a copy of the list of all confined spaces, permit-required and non-permit, to the installation Confined Space Program Team. **(T-1)** The list shall include, at a minimum, the number of spaces (quantity), type (with every entry point uniquely identified and listed) and

exact location (e.g., grid coordinates, Global Positioning Satellite coordinates, if available, highlighted maps, if necessary). **(T-1)**

23.3.11. Deleted.

24.2.3.1. Installation unit maintenance commanders and supervisors may identify other job tasks that require CPR/SABC training based on hazards associated with tasks performed. Unit CPR instructors shall meet training requirements described in paragraph **1.8.** **(T-1)** All personnel requiring
CPR/SABC training shall remain current. **(T-0)**

24.3.1. Flammable Fuel Vapor Areas. Supervisors shall ensure all personnel are aware of potentially flammable fuel vapor areas and the restriction against ignition sources in these areas. **(T-0)** Fuel vapors are heavier than air, settle to ground level and will enter below-ground areas. These areas include, but are not limited to, fuel pits below ground level, areas within 10 feet of aircraft fuel vent systems and fuel spills, hydrant pump houses and fuels laboratories. Spark arresters are not required on general or special purpose vehicles driving on the flightline and around aircraft. However, these vehicles are not designed, certified or authorized to operate in flammable fuel vapor areas. Employees in flammable fuel vapor areas shall receive specialized training emphasizing hazards associated with these operations. **(T-0)** Refer to DESR 6055.09_AFMAN 91-201 for requirements for spark arresters on general or special purpose vehicles within or near structures containing exposed explosives. Not rated/approved equipment shall be turned off or removed from the area during refueling operations and fuel cell/tank work, unless permitted by TO 1-1-3, *Inspection and Repair of Aircraft Integral Tanks and Fuel Cells*. **(T-1)** Only explosion-proof, intrinsically safe radios/equipment or equipment incapable of having sufficient energy to be an ignition source (approved by competent authority, e.g., HQ AFSEC, HQ AFMC, HQ AFCEC) shall be used in and around flammable fuel vapor areas. **(T-0)** Refer to NFPA 70, Article 501, Class I Locations, for additional information.

24.4.4. Jet Intakes. Mechanics entering jet intake sections shall wear appropriate PPE. **(T-0)** A pocket-less, zipper-less, button-less bunny-suit labeled, "Intakes Only," and cloth over-booties or stocking feet (Boots may be worn if not restricted for use by TO/MAJCOM and are authorized by MXG). Boots, if worn, must be inspected and FOD removed from boots prior to installing cloth over-booties. **(T-2)** To minimize heat stress during high heat/humidity conditions, e.g., air temperatures above 85° F, employees in engine intakes may wear half-bunny suits and garments designed for use over trousers. When worn with a pocket-less T-shirt, these items provide the same level of FOD protection as a full bunny suit. Units using half-bunny suits shall have procedures in place to control use. **(T-1)**

24.4.5.1.3. Face shield. **(T-0) Note:** Face shield is secondary eye protection and must be worn in conjunction with primary eye protection (goggles). **(T-0)**

24.4.5.1.4. Gloves (loose fitting), leather, welder's gauntlet cuff, medium gloves, cloth, work, cotton knit, medium as an insert; or Gloves (loose fitting), leather with glove inserts, wool or equivalent. **(T-0) Note:** The wool glove insert and cotton knit cloth work gloves used as inserts

can be used interchangeably with either welder's gauntlet cuff leather gloves or leather gloves specified above.

24.4.5.1.5. Apron. **(T-0)**

24.4.5.1.6. Coveralls, cotton white (mandatory). **(T-0)**

24.4.5.1.7. Cuff-less trousers. **(T-0)**

24.4.5.1.8. Long sleeve shirt. **(T-0)**

24.4.5.1.9. Jacket (optional).

24.4.5.1.10. Leather boots, which fit closely around the top, with rubber soles and heels. **(T-0)**

24.4.5.1.11. Deleted.

24.4.5.2.3. Face shield. **(T-0)**

24.4.5.2.4. Gloves (loose fitting), leather, welder's gauntlet cuff, medium with gloves, cloth, work, cotton knit, medium as an insert; or Gloves (loose fitting), leather with glove inserts, wool. **(T-0) Note:** The wool glove insert and cotton knit cloth work gloves used as inserts can be used interchangeably with either welder's gauntlet cuff leather gloves or leather gloves specified above.

24.4.5.2.5. Apron. **(T-0)**

24.4.5.2.10. Protective footwear, which fit closely around the top, with rubber soles and heels. **(T-0) Note:** A leather boot approximately eight (8) inches in height with close fitting top and rubber soles and heel is recommended, since LOX spills normally subject one's foot area to a freeze burn exposure hazard. This type footwear when equipped with a hard protective toe area is generally classified as a safety shoe or boot.

24.5.1. Specific parking locations shall be designated for each aircraft in accordance with AFMAN 32-1084, *Standard Facility Requirements*. **(T-1).** Generally, distances between parked aircraft, wingtip to wingtip, shall allow immediate access of emergency vehicles and permit free movement of equipment and materials. **(T-1).** Refer to AFMAN 32-1084 for specific aircraft wingtip distances. Refer to DESR 6055.09_AFMAN 91-201 and TO 11A-1-33, *Handling and Maintenance of Explosives Loaded Aircraft,* for parking explosives loaded aircraft.

24.13.3. Speed Limits. No vehicle (including motorcycles, mopeds, bicycles or tricycles) shall be operated at a speed in excess of that deemed reasonable and prudent for existing traffic, road and weathers. **(T-2)** Emergency vehicles will not automatically assume the right of way. **(T-2)** Installation commanders and aircraft maintenance commanders are responsible for ensuring personnel authorized to drive on the flightline are informed of flightline speed limits. **Note:**

Vehicles responding to Red Balls (emergency flightline scenarios), exercises and precautionary landings are not authorized to exceed posted flightline speed limits.

24.13.3.1. Deleted.

24.13.3.1.1. Deleted.

24.13.3.1.2. Deleted.

24.13.3.1.3. Deleted.

24.13.3.1.4. Deleted.

24.13.3.1.5. Deleted.

24.13.3.1.6. Deleted.

24.13.6. Entering or Leaving Flightline Driving Areas. All vehicles, except emergency and alert vehicles responding to an alert or emergency, shall stop prior to entering the flightline and accomplish an FOD check. **(T-1)** (**Note 1:** Refer to AFI 13-213, Chapter 4, for additional information information.) FOD Check signs shall be positioned at every entrance to ramp areas and flightline. **(T-1)** (**Note 2:** This may be waived by the installation Commander.) Traffic lanes on aircraft parking ramps are normally to the right of the aircraft. Unless prevented by local procedures, traffic flow on aircraft parking ramps shall be parallel to the noses of parked aircraft with the driver‘s side toward the aircraft. **(T-1)** Vehicles shall not be driven diagonally across the parking ramp, but at 90-degree angles to the driving lanes. **(T-1)**

24.13.12. *Follow Me* Vehicles. *Follow Me* vehicles for guiding aircraft shall be equipped with signs, easily visible at night, reading "*Stop"* and "*Follow Me*." **(T-1)** They shall have two-way radio communication on control tower frequencies. **(T-1)** When approaching the parking spot, the *Follow Me* vehicle operator should illuminate the "*Stop"* signal, move the vehicle from the intended path of aircraft travel, and position it laterally — clear of the aircraft wingtip. The marshaler, who may be the vehicle operator, will guide the aircraft to the parking spot using approved marshaling signals. **(T-1)** *Follow Me* vehicles may exceed the 15 mph flightline speed limit when necessary to accommodate the safe taxiing speed of aircraft. Tugs shall not be used as *Follow Me* vehicles. **(T-1)**

24.13.13.1. Maneuvering Forklifts and Hi-Lift Trucks. A spotter shall assist operators in determining safe clearances when maneuvering close to aircraft. **(T-1)** Bumper blocks or vehicle chocks placed on ramps shall be used to prevent backing into aircraft. **(T-1)** Spotters shall also assist operators when necessary to back the vehicle. **(T-1)** The driver and spotter shall be able to communicate at all times. **(T-1)** The spotter shall use luminous wands or flashlights to relay signals to the hi-lift operator during the night unless supplemental lighting is used. **(T-1)** Spotters shall be used any time the cargo bed is raised or lowered. **(T-1)** Forklift carriage operation (i.e., raise/lower, tilt, side shift, etc.) is prohibited while forklift is in motion. Forklifts shall never be driven under an aircraft except when required by the aircraft involved. **(T-1)** When traveling

long distances and/or when carrying bulky loads, the forklift shall be driven in reverse as the operator's field of vision is less obstructed. **(T-1)** Forks of parked forklifts shall be lowered flat on the ground to prevent injury to personnel working or walking in the area. **(T-1)** Parked and unattended forklifts shall have operating levers placed in neutral, ignition switched off and handbrake set. **(T-1)**

24.15.9.6. Explosives. Storing, handling and using explosives shall be in accordance with specific TOs and DESR 6055.09_AFMAN 91-201. **(T-0)**

24.16.5.2.1. Personal fall arrest systems require an anchorage connection point, connecting hardware components, body and fixed or shock absorbing lanyard, depending on system design. Anchorage connecting point(s) for each employee will have minimal support strength of 5,000 pounds (22.2 kilo-newton [kN]). **(T-0)** Vertical and horizontal lifelines shall have a minimal breading strength of 5,000 pounds (22.2 kN). **(T-0)** Horizontal lifelines shall be designed, installed and used under the supervision of a qualified person, as part of a complete personal fall arrest system, which maintains a safety factor of at least two. **(T-0)** Lanyards, D-rings, locking snap-hooks and all components of a fall arrest system will also be capable of sustaining a minimum tensile load of 5,000 pounds (22.2 kN). **(T-0)** Refer to 29 CFR § 1926.502, *Fall Protection Systems Criteria and Practices,* 29 CFR § 1910.66, Appendix C, *Personal Fall Arrest System,* and 29 CFR § 1926.104, *Safety Belts, Lifelines, and Lanyards,* for additional personal fall arrest system guidance. To prevent employee injury or death, personal fall arrest systems shall not be used without a rescue plan. Rescue timelines can vary based on many issues, however, as stated in American National Standards Institute Z359.2, the overall goal should be less than six (6) minutes to rescue a worker. Refer to paragraph **13.7.2** for additional guidance. **Caution:** Shock absorbing lanyards will not be used in conjunction with self-retracting lifelines, fall limiters, retractable web lanyards or decelerator packs (inertial reel type lifelines) devices. Multi-use or combinations of use can result in two falls and could hinder and/or prevent self-rescue or external rescue. **Warning:** Hanging in a harness for an extended period of time can be fatal. Supervisors shall ensure employees using a personal fall arrest system can be properly rescued or can rescue themselves should a fall occur. **(T-0)** Availability of rescue personnel, ladders or other rescue equipment shall be determined prior to using a fall arrest system. **(T-0)**

25.2.1.12. Ensure industrial shops and sites have a basic first aid kit, or suitable substitute, approved by the installation medical services, available to care for employees injuries until professional help arrives or they can obtain full medical care. **(T-1)** Refer to **Chapter 8,** *Electrical Safety,* for additional guidance.

25.3.6. Asbestos fibers can cause lung diseases such as asbestosis and cancer of the lung. If asbestos is used or already in place, safe handling procedures shall be in accordance with 29 CFR § 1910.1001, *Asbestos*. **(T-0)** Employees shall not be exposed to unsafe levels of airborne asbestos. **(T-0)** Consult BE prior to all planned asbestos projects. Immediately notify BE if asbestos is suspected or confirmed during a project. Employees shall not resume work until receiving proper guidance from BE. **(T-1)** Refer to AFMAN 48-146 and AFI 32- 1001, *Civil Engineer Operations,* for additional guidance.

25.12.2. Mobile Cranes. A minimum of one person assigned to each 4FPET and 4FPAS Unit Type Code (UTC) will be qualified and certified within the respective Career Field Education and Training Plan. **(T-1)** Contact AFCEC for more information on operator certification, qualification and currency training requirements. Refer to 29 CFR § 1926.1427, *Operator Training, Certification, and Evaluation,* and 1926 CFR § Subpart CC – Appendix C, *Operator Certification—Written Examination—Technical Knowledge Criteria,* for minimum training requirements.

25.12.3. Dump Trucks. Dump truck operators shall be trained in accordance with Air Force Qualification Training Package (QTP) 3E2X1-8 Earth Moving and Excavation Equipment. **(T-1)** This course covers operational checks/maintenance, operations and tailgate removal and installation. Members are required to complete the AFQTP and associated web-based training: Dump Truck Operator QTP and Dump Truck Tailgate Removal and Installation QTP. Additionally, there is a Dump Truck Training package for non-3E2s located at the Air Force e-Publications website.

26.5.1.1. Personnel handling or transferring LN_2 or LOX shall follow PPE requirements in **Chapter 14,** *Personal Protective Equipment (PPE).* **(T-0)** Non-absorbent long sleeves shall extend to the gloves. **(T-0)** Cuff-less trousers shall be worn outside leather boots or over high-top leather shoes to shed spilled liquid. **(T-0)** BE-approved foot protection shall have no mesh sides or air holes and will be tightly laced to prevent spilled cryogen seeping inside. **(T-0)** Only tightly woven materials shall be worn during LN_2 or LOX operations. **(T-0)** A face shield, eye protection (safety goggles or safety glasses with side shields) and apron (leather or other BE-approved) shall be worn. **(T-1)**

26.7. Electrical Safety. LN_2 and LOX production plants and tank support equipment may require electrical service up to 480 volts alternating current. Use extreme care when working around any electrical connections, panels, motors or other energized components. Moving fluids, drive belts, removal of clothing and almost any form of friction can generate a static charge. Ground LN_2 and LOX plant components and storage tanks at all times. Personnel must be arc flash and CPR trained prior to performing duties on electrical systems. **(T-0)**

26.8.2. Dirty tools and equipment are sources of hydrocarbon contamination. All tools and equipment used with oxygen components and systems shall be kept meticulously clean and properly stored. **(T-1)**

26.9.1. Due to the catastrophic consequences of mixing LN_2 and LOX in storage tanks and carts, workers shall exercise care in verifying the correct product is transferred to the correct storage tank or cart. **(T-1)** Refer to TOs 42B6-1-1, *Quality Control Aviators Breathing Oxygen and Aviators Gaseous Breathing Oxygen*, and 42B7-3-1-1, *Quality Control of Nitrogen*, for detailed procedures. Only fittings designed specifically for LOX or LN_2 equipment will be used; workers will never fabricate or use ones that are compatible with both LOX or LN_2 equipment. **(T-1)**

26.11.4.3. BE's occupational and environmental health risk assessment of the cryogenic liquid work processes identify hazards and recommend controls. Typical PPE for work with cryogenic liquids includes safety goggles, insulated gloves, apron, face shield and leather boots. Gloves

should be loose enough to easily toss off in the event spilled cryogens enter the gloves. Supervisors shall contact BE for proper PPE. **(T-1)**

26.11.4.3.2. Wear foot protection in accordance with paragraph **26.5.1.1** or other BE-approved foot protection.

26.11.6.7. Cryogenic dewars shall not be stored in hallways, unventilated closets, environmental rooms or stairwells. **(T-0)**

26.11.7.2. Keep all combustible materials away from flammable liquids and oxygen.
26.11.7.3. Ensure "No Smoking" signs are posted, and no sources of ignition are present.

29.3.5.14. Ionizing Radiation Warning Signs, Placards and Forms. Refer to AFMAN 48-148, *Ionizing Radiation Protection,* AFMAN 40-201, *Radioactive Materials (RAM) Management,* and 10 CFR 20, *Standards for Protection Against Radiation.* Electrical equipment labeling and placarding shall comply with UFC 3-560-01, *Operation and Maintenance: Electrical Safety.* **(T-0)**

30.3.14. 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, *Grounding and Electrical Systems.*

30.6.11. 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.

30.9.5.1. Complete a climbing certification training course or commercial equivalent. **(T-1)** Tower certifier training, J3AZR3D157 0C0B, can be found at website: **https://app10-eis.aetc.af.mil/etca/SitePages/ETCA_BCI_CourseDetail_AETC2.aspx?BCIListID=2483**.

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

30.9.5.5.1. Pole Top.

30.9.5.5.2. Tower.

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

30.9.5.6.1. Pole Top.

30.9.5.6.2. Tower.

32.2.8. Respiratory protection is required if prolonged breathing of chemical vapors, mists or fumes is expected or if working in confined spaces when the atmosphere is 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 American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance,* and AFMAN 48-146 for additional guidance.

32.6.1.1.1. The vehicle maintenance work area shall have a suitable exhaust ventilation system either under the floor with readily available adapter hoses or an overhead system arranged so connecting hoses can be raised when not in use. **(T-0)** In shop areas with under floor systems, adapters shall be used on equipment having vertical exhaust stacks to conduct the exhaust to the floor connections. **(T-1)** Carbon monoxide (CO) concentration shall be monitored by BE and levels kept under occupational and environmental exposure limits listed in AFMAN 48-146. **(T-1)** The facility owner/operator shall ensure a proper calibration schedule for the airborne gas analyzer. **(T-1)**

32.6.3. In accordance with AFMAN 48-146, BE's risk assessment identifies controls.

32.6.5. Periodic Testing. In accordance with AFMAN 48-146, BE shall perform periodic evaluations. **(T-1)** BE shall provide evaluation results to the vehicle maintenance supervisor. **(T-1)** If a shop has a manometer or similar piece of equipment that measures the ventilation system's air flow, then only the monitoring data needs to be reviewed annually by BE and the shop supervisor.

32.7.1.2. Oil and Hydraulic Fluid Spills. The organization responsible for the spill shall contain/clean the pill using the applicable method, such as compound, oil and water absorbent. **(T-1)** Contact the installation Environmental Management office for additional guidance.

32.9.1.5. Cleaning rooms shall be equipped with an adequate mechanical ventilation system and blowers and exhaust systems shall conform to National Fire Protection Association 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids.* **(T-0)** Refer to ACGIH's *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance,* and AFMAN 48-146 for additional guidance.

32.15.7.2. Static Grounding. Aircraft refuelers shall have a static ground system in serviceable condition. **(T-1)** Refueling equipment in a refueler maintenance facility or undergoing maintenance shall be connected to a serviceable ground at all times, except when the vehicle is in motion. **(T-1)** Refueling maintenance support equipment shall be grounded. **(T-1)** Storage bins

shall be grounded if located inside the maintenance bay. **(T-1)** Ramp ground rods shall have resistance values of 10,000 ohms or less. **(T-1)** These static grounds do not require retesting unless damaged or if the system has a deficiency. Any static ground which measures greater than 10,000 ohms shall be removed or replaced. **(T-1)** Static ground test data shall be maintained by the installation CE. **(T-1)** Fuel nozzle static grounding shall be in accordance with TO 00-25-172. Only approved 75 amp ground clips shall be used in accordance with TO 00-25-172. **(T-1)** Alligator clips shall not be used to ground or bond aircraft and support equipment. Only specified ground wire shall be used in the shop or on refueling equipment. **(T-1)** Ground cables shall be inspected weekly for broken strands. **(T-1)** Repaired or newly constructed grounding cable assemblies shall be checked for continuity. **(T-1)** User shall check bonding devices on all aircraft refueling units and associated equipment to ensure proper bonding prior to use. **(T- 1)**
34.2.3. Chemical Hazards. PMEL operations use and may expose personnel to hazardous chemicals. OSHA defines a hazardous chemical as any chemical which is a physical or health hazard. This definition clearly applies to most of the chemicals typically used in PMEL operations. Refer to AFMAN 48-146 for additional guidance and information on the management of hazards associated with chemical exposure.

34.5.1. Laboratory Floors. The floor covering of calibration/repair areas shall be as specified in UFC 4-218-01F, *Air Force Criteria for Precision Measurement Equipment Laboratory Design and Construction.* **(T-0)** Floor coverings that are damaged or do not meet specified requirements shall be repaired or replaced. **(T-0)** Insulated mats (Black – 24 inches wide / Blue – 36 inches wide / Green – 36 inches wide), or suitable substitutes, are required when personnel are exposed to and working on energized high voltage circuits.

34.5.6. Facility Ground. The facility ground shall be marked at its connection to the ground buss bar. **(T-1)** The facility custodian shall visually inspect the electrical and grounding systems on a monthly basis for security and damage. **(T-1)** After repairs, they shall be tested for continuity and polarity by a qualified electrician. **(T-1)** Refer to AFMAN 32-1065 for additional guidance.

BY ORDER OF THE SECRETARY OF THE AIR FORCE

AIR FORCE MANUAL 91-203

11 DECEMBER 2018

Safety

AIR FORCE OCCUPATIONAL SAFETY, FIRE, AND HEALTH STANDARDS

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

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This manual implements Air Force Policy Directive (AFPD) 91-2, *Safety Programs,* and parts of Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR), and includes additional requirements not addressed by the OSHA standard. Refer to Air Force Instruction (AFI) 91-202, *The US Air Force Mishap Prevention Program,* for guidance on submitting requests for variance to requirements of this standard. Report conflicts in guidance between this standard, federal standards or other Air Force directives through MAJCOM, DRU or FOA occupational safety offices to Headquarters Air Force Safety Center, Occupational Safety Division, Standards and Policy Branch (HQ AFSEC/SEGS), 9700 G Avenue SE, Kirtland AFB NM 87117-5670. This manual requires the collection and/or maintenance of information protected by the Privacy Act of 1974 authorized by 10 United States Code (U.S.C.) 8013, *Secretary of the Air Force,* Department of Defense (DoD) 4500.36-R, *Management, Acquisition, and Use of Motor Vehicles,* AFPD 24-3, *Management, Operations and Use of Transportation Vehicles,* and AFI 24-301, *Transportation, Vehicle Operations.* The applicable SORNs F024 AF IL C, *Motor Vehicle Operator's Records,* and F031 AF SP L, *Traffic Accident and Violation Reports,* are available at **http://dpclo.defense.gov/Privacy/SORNs.aspx**. 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;* route AF Forms 847 from the field through the appropriate functional chain of command. The authorities to waive wing/unit-level requirements in this publication are identified with a Tier number (T-0, T-1, T-2, T-3) following the compliance statement. See AFI 33-360, *Publications and Forms Management*, Table 1.1, for a description of the authorities associated with the Tier numbers. Submit requests for waivers through the chain of

command to the appropriate Tier/Waiver approval authority, or alternately, to HQ AFSEC/SEG for variances/exemptions to non-tiered compliance items. This publication may be supplemented at any level, but all direct supplements must be routed to the OPR of this publication for coordination prior to certification and approval. Records Disposition: Ensure all records created as a result of processes prescribed in this publication are maintained IAW AFMAN 33-363, *Management of Records*, and disposed of in accordance with (IAW) Air Force Records Disposition Schedule in the Air Force Records Information Management Systems. This standard defines the Air Force's minimum safety, fire protection and occupational health standards. Requirements in this publication are mandatory, unless otherwise indicated. It applies to all Regular Air Force (RegAF), Air Force Reserve Command (AFRC) and Air National Guard (ANG) military and civilian personnel. Not included are safety, fire prevention and occupational health requirements addressed in specific equipment technical orders (TOs). Portions of this standard may apply to contractors for the protection of AF people and property. **Note:** MAJCOMs may have more stringent or restrictive requirements than those contained in this standard or other Air Force Occupational Safety and Health (AFOSH) publications/standards. Therefore, all requests for interpretations or clarifications concerning these publications must be forwarded through the servicing MAJCOM/DRU/FOA safety, health and/or civil engineering organization, as applicable. **Note:** With respect to references in this AFI to installation medical treatment facilities, pursuant to 10 USC 1073c, the Defense Health Agency, a combat support agency, will be responsible for their administration and management; the details of these responsibilities are still being worked and finalized.

SUMMARY OF CHANGES

This document is substantially revised and must be completely reviewed. Major changes include changing this publication to an Air Force Manual, reducing the size of the standard by referring the reader to Occupational Safety and Health Administration (OSHA) safety standards and other consensus standards that were previously repeated. Chapters with similar information were combined to reduce redundancy and streamline requirements; a substantial amount of figures and tables were removed, and where appropriate, referenced to the original source; and language for administrative devices, that includes locks and tags not used for hazardous energy control have been moved to Chapter 29, *Mishap Prevention Signs and Tags.*

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Chapter 1

INTRODUCTION

1.1. Objective.

1.1.1. Occupational Safety and Health Administration (OSHA) safety guidance published in the Department of Labor (DoL) 29 series Code of Federal Regulations (CFR) provides employees a safe and healthful workplace. OSHA dictates what must be accomplished in the workplace, but in some cases, not necessarily how it will be accomplished, or by whom. Refer to AFSEC Occupational Safety SharePoint site for Introduction to OSHA Standards training information located at **https://cs2.eis.af.mil/sites/10178/Pages/SEGHomeV2.aspx.**

1.1.2. Commanders are responsible for the safety of their facilities and personnel, including the correction of all hazards and deficiencies in their workplaces. This standard compliments AFI 91-202, *The US Air Force Mishap Prevention Program*, and assigns responsibilities to individuals or functions to help Commanders manage their safety and health program, ensuring they comply with OSHA and Air Force guidance. This standard provides uniform guidance, which safety staffs and commanders may supplement when additional or more stringent safety, fire prevention and health criteria are required.

1.2. Variances and Exemptions. The effected work center shall process a request for variance or exemption when it is impossible to meet AFOSH guidance due to operational needs, mission impact or technical reasons. **(T-1)** When requesting a variance or exemption, the work center leadership must identify and implement interim control measures to reduce the degree of risk associated with the hazard in order to protect personnel, equipment and/or property. **(T-1)** The process for requesting a variance or exemption is provided in AFI 91-202.

1.3. How to Use This Document.

1.3.1. This standard incorporates appropriate parts of the 29 CFRs 1910 and 1926 standards that relate to Air Force operations. References to other Air Force publications and national consensus standards are provided as appropriate. Air Force activities must comply with OSHA requirements at all times, unless the military-unique exemption applies IAW DoDI 6055.01, *DoD Safety and Occupational Health Program*, and AFI 91-202. **(T-1)**

1.3.2. This standard is intended for use by fire, safety and health professionals, commanders, functional managers, supervisors and employees. The information in this standard is for the protection of employees, Air Force property and equipment, and to ensure compliance with Federal law. **Note 1:** This standard does not apply to state employees. **Note 2:** This standard may contain criteria not fully compatible with host-nation safety criteria. In case of conflict, safety offices shall facilitate coordinated concerns through their hierarchy for resolution.

1.4. Applying Standards. Air Force personnel must comply with all applicable safety guidance during Air Force operations. **(T-1)** If, or when, there is conflicting guidance, use the guidance that provides the most protection for the employee until conflict resolution is attained.

1.4.1. Compliance.

1.4.1.1. This Air Force standard contains both horizontal and vertical fire, safety and health standards/requirements within the various chapters. Generally, horizontal standards/requirements apply across all industries/activities; whereas, vertical

standards/requirements apply to a specific industry/activity, e.g., construction or telecommunications. There are occupational safety and health mandates contained within one chapter of this standard which could be interpreted as vertical; however, because safety rules are established based upon hazards and not just tasks, the mandate may, in fact, be applied horizontally across several occupations. **Example:** Confined space requirements in **Chapter 23** – primarily a General Industry application, but may apply to applicable portions of aircraft maintenance tasks. For this reason, broad guidance cannot be codified to address all situations. If there is doubt, contact your local safety office for guidance. Resolve locally, when possible, using risk management techniques focused on the hazard and hazard mitigation.

1.4.1.2. When AFOSH guidance or other established safety criteria does not cover a situation, use non-Air Force standards to include, but not limited to, national consensus standards, professional safety and health standards, and other Federal agency standards.

1.4.2. Occupational Safety and Health Administration (OSHA) Requirements. Air Force safety officials cannot grant exemptions to OSHA standards, only the Department of Labor has the authority to grant exemptions to OSHA standards. Refer to AFI 91-202 for additional guidance.

1.4.3. National Consensus Standards. National consensus standards referenced in this document have been adopted, in whole or in part, for Air Force use and list the standard, part/document number, part/document title and date of standard, as applicable, e.g., American Society of Mechanical Engineers B30.9, *Slings*, and National Fire Protection Association 70, *National Electrical Code.* Personnel needing access to American National Standards Institute and/or other national consensus standards can contact the installation Occupational Safety office for guidance and assistance.

1.4.4. Joint Base Safety Standard Compliance. Air Force personnel at Joint Bases will follow safety requirements outlined in the approved support agreement(s) developed IAW DoDI 4000.19, Support Agreements. **(T-1)** Conflicts in safety program requirements will first be coordinated through senior leadership at the local level for resolution. **(T-1)** If resolution at the local level cannot be obtained, the unit will refer conflicts to AFSEC/SEG through the appropriate MAJCOM/FOA/DRU safety office for cross-service resolution. **(T-1)**

1.5. Job Hazard Analysis (JHA). JHAs are conducted on all work processes, where appropriate, to identify potential fire, safety or health hazards, determine appropriate personal protective equipment (PPE) and include preventative measures in procedures to mitigate the hazards. Refer to AFI 91-202 for additional guidance.

1.6. Military-Unique and Nonmilitary-Unique Policy. The Air Force directive guidance is to comply with AFOSH, OSHA, DoD and other non-DoD regulatory safety and health standards and guidance as provided under federal law and IAW DoD policy with respect to military-unique and nonmilitary-unique workplaces, operations, equipment and systems. Refer to AFI 91-202 for additional guidance.

1.7. Documentation. This standard specifies use of Air Force Technical Order (AFTO) Form 95, *Significant Historical Data*, AFTO Form 244, *Industrial/Support Equipment Record*, or other appropriate inspection, maintenance and general purpose forms for documenting maintenance and inspection actions. With expanding use of automated systems for tracking these activities,

requiring specific paper forms may impede use of more efficient automated processes. Therefore, use of automated systems for documenting inspections, maintenance and other activities is acceptable in place of specified AFTO Forms 95 and 244 or other appropriate inspection, maintenance and general purpose forms if they contain the same information called for by the designated form. Electronic signatures or other unique personal identifiers (not initials) are acceptable. While this standard offers an optional alternative to paper forms, MAJCOMs, NAFs, local procedures, Technical Orders (TOs) and other Air Force guidance may continue to require use of these forms. Check the prescribing directive(s) before discontinuing use of any forms.

1.8. First Aid and Cardiopulmonary Resuscitation (CPR) Training. Initial first aid and CPR training shall be accomplished prior to assigning an individual duties where first aid and CPR are requirements of the position. **(T-1)** All employees requiring CPR training will receive refresher training before current CPR certification expires. **(T-1)** Whether by the local Medical Group, the American Red Cross or other appropriate organization, CPR training shall be provided for unit instructors, who, in turn, will train unit personnel. **(T-1)** If CPR training is not provided by the host medical facility, instructor training shall be obtained from an approved source, e.g., American Red Cross, American Heart Association, military network, etc. **(T-1)** Training will also include Public Access Defibrillator training IAW AFI 44-177, *Public Access Defibrillator Program.* **(T-1) Note 1:** Self-aid and buddy care may be used to fulfill first aid training requirements; however, it does not cover CPR. Employees performing duties with risk of severe cuts, burns or electrocution, or perform duties in remote locations away from emergency responders will have a plan for immediate medical response pending definitive transfer and care. **(T-0) Note 2:** Remote location is defined as emergency care that is more than three to four minutes from the workplace.

1.9. Bloodborne Pathogen Training. Any person with routine duties where tasks and procedures involve reasonably anticipated exposure to blood or other potentially infectious materials (e.g., individual responsible for rendering medical assistance as part of their duties) must be trained and enrolled in the Bloodborne Pathogen Program IAW 29 CFR 1910.1030, *Bloodborne Pathogen,* and AFI 44-108, *Infection Prevention and Control Program.* **(T-0)** A person may be required to receive separate first responder training outside of bloodborne pathogen, e.g., First Aid, CPR, self-aid buddy care (SABC). For workplaces with employees that meet this job description, supervisors shall establish a written exposure control plan and conduct training IAW 29 CFR 1910.1030. **(T-0)**

1.10. Process Safety Management of Highly Hazardous Chemicals.

1.10.1. The Air Force implements 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals,* requirements to prevent or minimize consequences of catastrophic releases of toxic, reactive, flammable or explosive chemicals. The criteria in 29 CFR 1910.119 shall be used in its entirety for program implementation and application unless otherwise specified. **(T-0)** Process safety management also applies to explosives and pyrotechnics, which are defined in AFMAN 91-201, *Explosives Safety Standards.*

1.10.2. 29 CFR 1910.119, Appendix A, *List of Highly Hazardous Chemicals, Toxics and Reactives,* contains a list of chemicals used in the Air Force, whether the chemical is in a mixture or a byproduct of a chemical process and/or reaction.

1.11. Responsibilities.

1.11.1. Air Staff. All Air Staff elements shall ensure policies and procedures are consistent with the guidance of this manual.

1.11.2. Headquarters, Air Force Safety Center (AFSEC) shall:

1.11.2.1. Formulate and execute policy. Clarify roles, responsibilities and guidance applicable to all areas of safety.

1.11.2.2. Act as approval authority for safety variances associated with T-1 and above wing-level requirements in this manual.

1.11.3. Major Commands (MAJCOMs), DRUs and FOAs shall provide program oversight and supplement safety and health guidance, as necessary, ensure safety training is available to subordinate units. **(T-1)**

1.11.4. Commanders and Functional Managers shall:

1.11.4.1. Ensure and promote applicable occupational safety and health (OSH) guidance for workplace and operations is available to all personnel. **(T-1)**

1.11.4.2. Ensure and promote compliance with occupational safety, fire prevention and health program requirements in their areas of responsibility. **(T-1)**

1.11.4.3. Provide a safe and healthful workplace by conducting monthly spot-inspections for hazards or deficiencies. **(T-1)**

1.11.4.4. Provide employees training in job safety, fire prevention and health, as required by:

1.11.4.4.1. OSHA directives. **(T-0)**

1.11.4.4.2. AFOSH directives. **(T-1)**

1.11.4.4.3. Air Force Policy Directives (AFPD). **(T-1)**

1.11.4.4.4. Air Force Instructions (AFI), Air Force Manuals (AFMAN) and any other associated directives. **(T-1)**

1.11.5. Supervisor's Responsibilities. Supervisor responsibilities can be found in AFI 91-202. Supervisors will require workers to notify them in advance if they have a medical condition or are taking medications that could interfere with their safe performance of assigned duties. **(T-1)** Supervisors shall ensure employees are trained, using manufacturer's manual/instructions or lesson plans, prior to the operation of any type of equipment or accomplishing assigned tasks. **(T-1)** Supervisors will provide such instruction at time of initial assignment and refresher training, as required. **(T-1)** If instruction is not available, supervisors shall accomplish a JHA. **(T-1)**

1.11.6. Air Force Personnel (military and civilian) shall:

1.11.6.1. Comply with OSH guidance. **(T-0)**

1.11.6.2. Promptly report unsafe working conditions/activities including any safety, fire and health hazards and deficiencies to the supervisor. **(T-1)**

1.11.6.3. Promptly report injuries and illnesses to the supervisor, i.e., occupational illness and on-duty injury to DoD military and civilian personnel, and off-duty injury to DoD military personnel. **(T-1)**

1.11.6.4. Comply with PPE requirements, including its use, inspection and care; ensure required guards, interlocks and enclosures are properly used. **(T-1)**

Chapter 2

GENERAL WORK PROCEDURES

2.1. General Information. This chapter provides general work procedures for a safe and healthful workplace, to include the wearing of jewelry, workplace safety, ergonomics and housekeeping. IAW AFI 91-202, the job safety training outline will evaluate and identify PPE requirements. **(T-1)** All facilities shall comply with DoD standards, UFC 3-600-01, *Fire Protection Engineering for Facilities,* Air Force guidance and National Fire Protection Association 101, *Life Safety Code.* **(T-0)**

2.2. Hazards. Physical hazards are the most common workplace hazards. Hazards can include working from heights; slips, trips and falls; falling objects; spills; faulty equipment; and noise hazards. Other examples of workplace hazards includes:

2.2.1. Radiation. Ionizing and non-ionizing are the two basic types of radiation. 29 CFR 1910.196, *Ionizing Radiation,* and AFI 48-148, *Ionizing Radiation Protection,* list requirements for working in an area with ionizing radiation. Non-ionizing radiation includes most radio frequency energy sources, light sources and lasers. Protection levels and requirements are outlined in AFI 48-139, *Laser and Optical Radiation Protection Program,* and AFI 48-109, *Electromagnetic Field Radiation (EMFR) Occupational and Environmental Health Program.*

2.2.2. Noise. Noise can cause hearing loss and/or prevent hearing of warning signals. Noise issues are common to industrial and outside work areas such as flightlines and transportation/logistics maintenance areas, but noise in an office area or from an outside source can present problems. BE (or joint base equivalent) conducts occupational environmental hazard risk assessments, then recommends appropriate engineering controls, administrative actions or PPE. Refer to AFI 48-127, *Occupational Noise and Hearing Conservation Program,* and 29 CFR 1910.95, *Hearing Conversation Program,* for additional guidance.

2.2.3. Thermal Exposure. Refer to AFI 48-151, *Thermal Injury Prevention Program,* for guidance and information on thermal injuries and their prevention/treatment.

2.2.4. Inhalation. Refer to 29 CFR 1910.134, *Respiratory Protection,* and AFI 48-137, *Respiratory Protection Program,* for guidance and information.

2.2.5. Chemical. Chemical hazards may exist in everyday products such as cleaning supplies, pesticides and paints. It may also include vapors and fumes from welding and brazing, solvents, and flammable or combustible liquids. Refer to 29 CFR 1910.1200, *Hazard Communication,* AFI 90-821, *Hazard Communication (HAZCOM) Program,* and **Chapter 22,** *Flammables and Combustibles,* of this standard.

2.3. Jewelry. Jewelry, such as rings, watches, bracelets and necklaces, that presents a potential for catching, snagging, pulling or tearing shall be evaluated, controlled and restricted from wear if it presents a hazard to the employee or operation. **(T-1)**

2.3.1. Finger Rings. Rings (any material type) shall not be worn by personnel engaged in work in industrial areas, performing maintenance on aircraft, vehicles, equipment or machinery. **(T-0)** Personnel will comply with established safety precautions to prevent personal injury. **(T-0)** Rings shall not be worn performing the following activities (this list is not all-inclusive):

2.3.1.1. Climbing, ascending or descending activities where personnel could fall or jump from elevated surfaces. **(T-0)** This includes personnel working on elevated surfaces, e.g., ladders, scaffolds, platforms, roofs, or high reach vehicles, e.g., refuelers, wreckers, sweepers, dump trucks and stake bed trucks.

2.3.1.2. Materials handling operations, e.g., warehousing, parts handling, operating equipment, packing and crating, and attaching/detaching equipment to tow vehicles. **(T-0)**

2.3.1.3. Any type of work where personnel are exposed to moving machinery, rotating or revolving parts, or activities that could result in their hands being caught by a moving part and injured. **(T-0)**

2.3.1.4. Performing work or inspection on or near energized electrical parts. **(T-0)** Articles such as jewelry, earrings, rings, hair fasteners, bracelets, key chains or metallic ID (dog) tags with metal chains shall also be removed and metal framed eyeglasses shall be secured by a band or cord to prevent them from falling into energized electrical circuits or machinery. **(T-0) Note:** This prohibition includes conductive jewelry such as necklaces, bracelets, watches, etc. These items will permit inadvertent electrical current transfer to the worker.

2.3.1.5. Performing maintenance or inspections on aircraft or ground support equipment, including civil engineering-type or transportation-type maintenance. **(T-0)**

2.3.1.6. Performing work on or around high temperature equipment. **(T-0)**

2.3.2. Eyewear. Metal eyeglasses shall be secured by a band or cord to prevent them from falling into energized electrical circuits or moving industrial machinery. **(T-1) Note:** It‘s best practice to wear nonmetallic eyeglasses and neck lanyards (e.g., ID cardholders) with a breakaway safety band, lanyard or cord to prevent them from falling into energized electrical circuits or moving industrial machinery.

2.3.3. Medic-Alert. Personnel that require identification for medical issues are permitted to don non-dangling/non-hazardous medical alert items, e.g., clasps, medical cards in hard hats, identification badge holders, etc., to warn co-workers of potential medical issues. Supervisors shall ensure such items do not create hazards during worker’s assigned tasks. **(T-0)**

2.3.4. These restrictions do not apply to administrative and support personnel assigned office duties or visiting these areas, but not performing industrial work.

2.4. Housekeeping.

2.4.1. Floors and Walking Surfaces. Keep areas where personnel walk and work free of potential tripping and slipping hazards such as tools, electrical cords, air lines and packaging materials. Clean up spills as soon as possible and post warnings until cleanup is complete. This includes sidewalks, parking lots etc. Facility managers shall ensure potholes are filled and uneven surfaces corrected. **(T-0)**

2.4.1.1. Facility managers will ensure removal of snow and ice from all facilities walkways, sidewalks, handicap ramps and work areas expediently where they may create a hazard or interfere with the work. **(T-0)** If ice cannot be readily removed, sand or other approved materials shall be applied. **(T-1)** Snow and icicles above walkways shall be removed by the unit or a work request shall be submitted for areas that cannot be reached. **(T-1)**

2.4.1.2. Place telephone and electrical cords where they do not pose tripping hazards. If placement in foot-traffic areas is unavoidable, cords and cables shall be properly protected by molded housings, bridges or other covers approved for such use to prevent tripping. **(T-0)**

2.4.1.3. Briefcases, wastebaskets, etc., shall be placed under desks, against a wall or otherwise out of the way. **(T-1)**

2.4.1.4. Repair or replace stair and floor defects, such as loose tiles, broken steps, torn carpeting, loosed or curled mats, worn, frayed or damaged anti-slip material on stairs or inadequate lighting.

2.4.1.5. Do not position a step stool or ladder in front of a door if the door can swing and contact the stool, ladder or individual using it. Station a guard at the door if a step stool or ladder must be placed in a doorway. **(T-1)**

2.4.2. Combustible Materials and Waste. Refer to AFI 32-7042, *Waste Management*, for approved hazardous waste disposal procedures and guidance. Safety Data Sheets required for each hazardous chemical, IAW AFI 90-821, can assist with the proper identification of waste prior to being removed for disposal, especially for wastes generated as a result of unused and/or expired hazardous chemicals. Use or storage of flammable or combustible liquids shall be kept to a minimum and not exceed the maximum allowable quantities specified in **Chapter 22**. **(T-1)**

2.4.3. Packing Supplies and Recycled Materials. Non-soiled excelsior (fine wood shavings), straw, shredded paper, recyclable cardboard, recyclable paper and other packing/recyclable materials shall be stored in an isolated fire-resistant area and/or container. **(T-0)** Small supplies of packing materials, which are kept in shops for immediate use, shall be stored in metal or noncombustible covered containers. **(T-1)** Remove protruding nails, brads and staples from crates, cases, packing boxes, casks, boards and lumber to prevent injury to personnel.

2.4.4. Electric Buffing Machines. Supervisors shall ensure electric buffing machines are equipped with under-voltage/overvoltage sensing and cutoff controls.

2.4.5. Stacking Materials. Refer to AFJMAN 23-210, *Joint Service Manual (JSM) For Storage and Materials Handling*, for guidance on stacking materials. When materials are stacked to a height less than 15 feet, maintain an 18-inch clearance below ceiling sprinkler deflectors. If the stack is over 15 feet in height, increase the clearance to 36 inches (when only joists, rafters, beams and roof trusses exist, without a ceiling constructed below, a 36 inches clearance will also be required. **(T-1)** Position all stacks of materials to ensure an 18-inch clearance around light or heating fixtures, or follow manufacturer‘s instructions, regardless of height.

2.4.6. Lighting Fixtures. Tubular light fixtures (fluorescent/light-emitting diode) without self-locking tubes shall have shields, clamps or other devices installed to keep the tubes from falling out of the fixture. **(T-1)**

2.4.7. Garbage cans within a food handling environment shall be washed and sanitized monthly with hot soapy water. **(T-1)** All other garbage cans shall be cleaned as needed. **(T-1)** Exterior garbage cans shall be securely covered when not actually being filled or emptied. **(T-1)**

2.4.8. General Safe Practices. All areas, shops, yards, buildings and mobile equipment facilities/areas shall be maintained in a clean and orderly condition. **(T-0)** Supervisors and employees are responsible for good housekeeping in or around the work area they are supervising or working.

2.4.8.1. Material shall not be placed where it creates a hazard for employees or visitors, by falling, being a trip hazard or causing the collapse of structures. **(T-0)**

2.4.8.2. Aisles and passageways shall be kept clear of tripping hazards. **(T-0)**

2.4.8.3. Nails shall be removed from loose lumber or the points turned down. **(T-0)**

2.4.8.4. Tools and supplies shall be properly stored. **(T-0)**

2.4.8.5. Disconnect switches, distribution panels and alarm supply boxes shall not be blocked by any obstruction that would prevent ready access. **(T-0)**

2.4.8.6. Wire reels shall be stacked with strips of wood between reels. **(T-0)**

2.4.8.7. Noncombustible materials shall be neatly kept in designated cabinets with their contents plainly marked. **(T-1)**

2.4.8.8. Compressed Air. If using compressed air for cleaning equipment, keep the air pressure as low as practical, but limit air pressure to less than 30 psi. Follow TO, manufacturer's data or local procedures as applicable. Ensure the nozzle discharge tip is a diffuser type. Compressed air shall not be used to blow chips or other debris from an employee's body or clothing. Screens, barriers or protective cones attached to air nozzles shall be used to prevent flying chips and particles from striking the eyes and skin of the operator. **(T-0)**

2.4.8.9. Machinery and equipment shall be kept clean of excess grease, oil and excessive dust. **(T-1)** Pressure gauges and visual displays shall be kept clean, visible and serviceable at all times. **(T-1)** Drip pans and wheeled or stationary containers shall be cleaned and emptied at the end of each shift. **(T-2)**

2.4.8.10. All work surfaces and floors shall be kept free of any visible accumulation of dust or any other foreign particles, as practicable. **(T-0)**

2.5. Office Safety.

2.5.1. General Office Equipment.

2.5.1.1. Chairs.

2.5.1.1.1. Inspect chairs regularly for broken casters or other defects. New or replacement caster chairs shall have at least five (5) legs. **(T-1) Note:** Five (5) or more legged caster chairs are more stable and ergonomically sound than four (4) legged caster chairs.

2.5.1.1.2. Do not stand on a chair to change a light bulb, retrieve overhead items or when hanging pictures/decorations, etc. Use stepstools or ladders to access anything above shoulder level.

2.5.1.1.3. Do not tilt back, lean sideways or reach behind to lift objects while seated in a chair.

2.5.1.2. File Cabinets.

2.5.1.2.1. Store heavy material in bottom drawers and load cabinets from the bottom up.

2.5.1.2.2. Close drawers when not in use.

2.5.1.2.3. Do not climb on open file drawers.

2.5.1.3. Office Shelving/Bookcases. Store heaviest objects/books on lower-level shelves.

2.5.2. Electrical Equipment.

2.5.2.1. Appliance, electrical equipment and other office machines shall comply with 29 CFR 1910.334, *Use of Equipment.* **(T-0)**

2.5.2.2. Keep access to fuse or circuit breaker boxes or electrical controls clear and unobstructed with panel doors closed to prevent electrical flashover if a malfunction occurs. Refer to National Fire Protection Association 70, *National Electrical Code,* and **Chapter 8,** *Electrical Safety,* for additional guidance on fuse and circuit breakers in the office area.

2.5.2.3. Appliances such as refrigerators and coffee makers shall not be plugged into modular office furniture unless the furniture electrical system is rated and certified by Civil Engineering for general appliance use. **(T-0) Note:** Modular office furniture electrical systems are normally designed only to provide power to office equipment, e.g., personal computers, monitors, printers, etc. Refer to 29 CFR 1910, Subpart S, *Electrical,* for additional guidance.

2.5.2.4. Only qualified electricians, using approved materials shall install or perform electrical work IAW National Fire Protection Association 70. **(T-0)** Refer to **Chapter 8** for additional information.

2.5.3. Items that could present hazards, such as knives or razors, shall not be left unprotected in desk drawers, storage cabinets, on top of counters or desktops. **(T-1)**

2.5.4. Lighting. Consult the local Civil Engineering facility design section when specific guidance on lighting is required. Fluorescent light bulbs contain toxic materials and shall be managed IAW local hazardous waste disposal criteria. **(T-0)** Supervisors shall ensure any stroboscopic effect with moving machinery is eliminated when using fluorescent lighting fixtures. **(T-1)** Work area lighting shall be installed to eliminate glare and harsh shadows. **(T-1)** Supplementary or additional lighting shall be provided where general lighting is not sufficient. **(T-1)**

2.5.5. Heating, ventilation and air conditioning systems shall be maintained and inspected IAW American National Standards Institute/American Society of Heating, Refrigerating and Air Conditioning Engineers 62.1, *Ventilation for Acceptable Indoor Air Quality*. **(T-1)** Filters shall be changed as needed. **(T-1)** Do not cover air vents or obstruct air flow from registers. **(T-1)** Do not place furniture, equipment or materials where they interfere with air movement or thermostats. **(T-1)**

2.5.6. Elevators.

2.5.6.1. Elevators shall be inspected annually by a certified inspector. **(T-0)** Elevator inspection certification shall be posted in the cab of the elevator in view of all passengers or retained by the building manager and a permanent sign posted in the cab that identifies the location of the elevator certification. **(T-0)**

2.5.6.2. Elevators shall stop level with the floor when the doors open to prevent a tripping hazard. **(T-0)** Report elevator malfunctions immediately to the unit facility manager. Employees shall not try to stop elevators by placing a hand or foot in closing doors. **(T-0)** Employees shall not use elevators during emergency evacuation. **(T-0)**

2.5.6.3. Refer to American Society of Mechanical Engineers A17.1, *Safety Code for Elevators and Escalators,* and American Society of Mechanical Engineers A17.2, *Guide for Inspection of Elevators, Escalators and Moving-Walkways,* for additional guidance on elevators.

2.6. Ergonomics. Ergonomics attempt to fit the job to the person, rather than forcing the person to fit the job. Adapting the job to the employee helps reduce stress and eliminates many potential injuries and disorders from overuse of muscles, poor posture and repetitive motion. Ergonomic hazards occur when the body may not be positioned correctly for a work task or working conditions put a strain on the body. They may include sore muscles, improperly adjusted workstations and/or chairs, poor posture, frequent lifting, vibration, repetitive motion or awkward movement. Contact the installation BE for questions relating to ergonomics or to have an ergonomic assessment completed. Refer to OSHA website: **https://www.osha.gov/SLTC/ergonomics/controlhazards.html** and the U.S. Army Public Health Center website: **https://phc.amedd.army.mil/topics/workplacehealth/ergo/Pages/default.aspx** for additional guidance.

2.7. Roll-up Doors. Roll-up doors shall be maintained in good operating condition with door tracks free of debris and obstructions to allow smooth operation. **(T-1)** Operators shall conduct a visual inspection of door path and track-way and correct any discrepancies before operating door. **(T-1)** Individuals shall remain clear of door path while door is in motion. **(T-1)** Auxiliary service roll-up doors, to include tow vehicle exit doors, shall meet the following requirements:

2.7.1. Be able to open a minimum of 8 feet or 70 percent of maximum opening height. **(T-1)**

2.7.2. Powered roll-up doors equipped with one touch open or close buttons shall have a crush sensor on the bottom of the door installed and operational. **(T-1) Note:** Powered roll-up doors equipped with dead man switches do not require crush sensors.

2.7.3. Controls for the door shall be located so there is an unobstructed view during door operation. **(T-1)**

2.7.4. Open and close motion shall be no faster than nine (9) inches per second. **(T-1)**

2.7.5. Prior to entering or exiting the hangar with a vehicle through these doors, vehicle drivers will sound their horn to alert personnel. **(T-0)**

2.7.6. Motion alarm will sound on the closing cycle of powered roll-up doors, unless equipped with a dead-man switch. **(T-1) Note:** This requirement does not affect powered roll-up doors installed prior to January 2016. However, this requirement must be met when the doors are modified or replaced. **(T-1)**

2.8. Powered Doors In Facilities Not Used as Hangars. Refer to paragraph **24.14.8**

2.9. Receiving/Loading Docks. Frequently used loading docks shall be located away from principal streets and intersections. **(T-0)** Vehicles parked at docks shall not block general vehicular traffic unless control devices, such as cones, barricades or warning signs are used to redirect traffic. Loading docks shall adhere to fall protection requirements in paragraph **7.1.5.4** **(T-1)**

2.9.1. Dock surfaces shall be smooth and even. **(T-0)** Where necessary, aisleways shall be marked. **(T-0)** Edges of docks shall be marked with four-inch wide yellow lines when there is a chance of employees falling. **(T-0)** Markings of physical hazards shall be IAW 29 CFR 1910.144, *Safety Color Code for Marking Physical Hazards*. **(T-0)** Where the potential for serious injury exists, removable railings shall be used. **(T-1)**

2.9.2. The dock shall be at least two (2) feet wider than the widest vehicle or more common material being transported. **(T-0)** Additional clearance shall be provided to permit safe turns. **(T-0)**

2.9.3. Employees shall be instructed in proper handling techniques for the equipment and materials received. **(T-0)** Supervisors shall periodically evaluate and advise employees on proper lifting techniques. **(T-1)** The installation Occupational Safety office shall be consulted in the planning stages of new facility design to minimize material handling hazards. **(T-1)**

2.10. Walk-in Refrigerators and Freezers. A bypass or other type device shall be installed on the door of a walk-in refrigerator or freezer to permit escape from inside if an employee is locked inside. **(T-0)** An internally activated alarm bell shall be provided and tested weekly and documented. **(T-1)** If the bell is inoperable, it shall be replaced immediately. **(T-1)** When a door can be locked from the outside, e.g., with a hasp and padlock, a permanent sign stating, “Determine No One Is Inside Before Locking Door,” shall be mounted on the door’s exterior. **(T-1)** The letters shall be at least three (3) inches high. **(T-1)**

Chapter 3

WEATHER SAFETY

3.1. Responsibilities.

3.1.1. The supporting Air Force weather organization is responsible for making initial notification of adverse or mission-limiting weather conditions to predetermined support agencies. **Note:** Adverse or mission-limiting weather conditions include strong and damaging surface winds, heavy rain, thunderstorms, hail, snow and freezing precipitation.

3.1.2. Each Air Force installation shall develop local procedures to ensure key personnel and agencies involved in weather-related high risk activities and operations are notified according to the installation weather support documents. **(T-1)** Normally, these agencies are those having aircraft, petroleum/oil/lubricant facilities, open air work and recreational activities, explosive loading, aircraft maintenance and utilities work. Key personnel, in turn, shall advise all on-duty supervisors and workers to take proper precautions. **(T-1)**

3.1.3. Each installation shall employ a lightning safety program with a two-tier notification system to minimize personnel exposure to lightning hazards. **(T-0)**

3.2. Two-tier Notification System.

3.2.1. A Lightning Watch is in effect 30 minutes prior to thunderstorms being within a 5 nautical mile radius of any predetermined location or activity as forecast by the supporting Air Force weather organization. A Lightning Watch will not be cancelled by weather personnel if the potential for thunderstorms remain within 5 nautical miles of the installation or activity within 30 minutes. **(T-1) Note:** During a Lightning Watch, operations or activities may continue. However, all personnel must be prepared to implement Lightning Warning procedures without delay. **(T-1)** Be alert for any lightning activity, to include audible thunder, and advise supervisory personnel of any observations. If lightning does not occur within a 5 nautical miles radius at the valid (forecast) time of the Lightning Watch, the supporting weather organization shall reassess the Lightning Watch and amend or cancel the watch as required IAW AFMAN 15-129V1, *Air and Space Weather Operations - Characterization.* **(T-1)**

3.2.2. A Lightning Warning is in effect when lightning occurs within a five (5) nautical miles radius of the predetermined locations and activities. Personnel in affected locations or engaged in affected activities shall cease all outside activity and seek shelter. **(T-1)** Recommended locations that provide safe shelter and locations to avoid are listed in paragraph **3.3** Lightning Warnings shall be cancelled by the unit that provided the warning IAW AFMAN 15-129V1. **(T-1)**

3.3. General Lightning Safety for all AF Activities and Operations. Note: This includes AF-led joint bases.

3.3.1. When lightning is detected or observed within the immediate vicinity of any activity or operation, do not go outdoors or remain out unless it is absolutely necessary. Seek shelter in:

3.3.1.1. Dwellings or other buildings that are protected against lightning.

3.3.1.2. Protected underground shelters.

3.3.1.3. Large metal framed buildings.

3.3.1.4. Enclosed automobiles, buses, aircraft and other vehicles with metal tops and bodies.

3.3.1.5. Streets that may be shielded by nearby buildings.

3.3.2. Certain locations are extremely hazardous during thunderstorms and the following locations shall be avoided:

3.3.2.1. Hilltops and ridges. **(T-1)**

3.3.2.2. Areas on top of buildings. **(T-1)**

3.3.2.3. Open fields, athletic fields, golf courses. **(T-1)**

3.3.2.4. Parking lots, tennis/outdoor multi-purpose athletic courts. **(T-1)**

3.3.2.5. Swimming pools, lakes and seashores. **(T-1)**

3.3.2.6. Near wire fences, power and telephone poles, clotheslines, overhead wires, towers and railroad tracks. **(T-1)**

3.3.2.7. Under isolated trees. **(T-1)**

3.3.2.8. Near electrical appliances, telephones, plumbing fixtures and metal or electrically conductive objects. **(T-1)**

3.3.2.9. Aircraft dry bays, tanks and wheel wells. **(T-1)**

3.3.3. All aircraft fuel service maintenance activities, including liquid oxygen (LOX) servicing, shall cease whenever a Lightning Warning is in effect. **(T-0)** Military service stations that have the newer automatic fuel dispensing system (FMU 2550) will not have to be placed in the manual mode during a Lightning Warning. The older fuel dispensing system (FMU 2000) shall continue to be placed in the manual mode during a Lightning Warning. **(T-0)** **Exception:** Commercial and DoD pipeline receipts, issues from installation Base Exchange service station, vehicle movements (including refuelers) and pipeline transfers (including bulk storage).

3.3.4. Locations with nuclear munitions will request notification of lightning within 10 miles of their location IAW DoDM 3150.02, *DoD Nuclear Weapon System Safety Program,* from their servicing weather unit. **(T-0)** Local procedures for these advisories are documented in AFMAN 91-201, *Explosive Safety Standards.* **(T-0)**

Chapter 4

SERVICES OPERATIONS

4.1. Purpose. This chapter covers the safety requirements for services operations, e.g., laundry, lodging and food services. Refer to AFI 34-series publications for services operations requirements such as fitness centers, sport fields, rental equipment, bowling centers, auto hobby shops, etc.

4.2. Laundry. Laundry operations in the Air Force applies to installation facilities including billeting laundries and laundry facilities in shops/workplaces. Medical Treatment Facilities laundries shall meet the requirements of National Fire Protection Association 99, *Health Care Facilities Code,* and Joint Commission Accreditation Manuals. **(T-0)**

4.2.1. Supervisors shall conduct monthly inspections of laundries and dry cleaning facilities for hazards or deficiencies using a checklist containing requirements of this chapter and manufacturer's instructions, as required. **(T-2)** Copies of these inspections shall be maintained on file for a rolling year. **(T-2)**

4.2.2. Facility Requirements.

4.2.2.1. Laundries and dry cleaning plants shall have separate areas designated for receiving and issue. **(T-0)**

4.2.2.2. First aid kits shall be provided if the facility is more than three (3) to four (4) minutes from a medical facility. **(T-0) Note:** Remote location is defined as emergency care that is more than three to four minutes from the workplace.

4.2.3. The installation Fire Emergency Services (FES) Flight shall be immediately notified of any flammable solvent spills. **(T-0)** Contact BE and/or Environmental Management office for guidance on spill procedures.

4.2.4. Machinery producing potentially hazardous noise/vibration levels shall be identified and control measures initiated IAW BE's occupational and environmental health risk assessment guidance. **(T-0)**

4.2.5. Hazardous and flammable materials used in laundry and dry cleaning processes shall be stored IAW **Chapter 22,** *Flammables and Combustibles.* **(T-0)**

4.2.6. Floors in dry-cleaning rooms shall be of fire-resistant construction with a noncombustible and solvent-resistant surface. **(T-0)**

4.3. Lodging.

4.3.1. Some lodging supply operations require forklift trucks. Refer to AFMAN 24-306, *Operation of Air Force Government Motor Vehicles,* and **Chapter 12,** *Material Handling Equipment,* for additional guidance.

4.3.2. Kitchen Cleaning.

4.3.2.1. As needed, grease shall be cleaned from burners and ranges to prevent fires. **(T-0)**

4.3.2.2. Unplug heat producing appliances such as irons and coffee makers prior to cleaning or when not in use. **(T-0)** Refer to **Chapter 6,** *Fire Prevention and Protection,* for additional guidance.

4.3.2.3. Microwave ovens shall be cleaned daily. **(T-0)** Microwave ovens with broken doors or latches shall be removed from service so personnel will not be exposed to microwave energy. **(T-0)**

4.4. Food Service Operations.

4.4.1. Walk-in Refrigerators and Freezers. Refer to paragraph **2.10** for additional guidance.

4.4.2. Food Preparation Area.

4.4.2.1. Supervisors shall routinely evaluate employees on the proper and safe operation of all equipment and associated PPE. **(T-1)** Unsafe behaviors shall be corrected on the spot. **(T-1)**

4.4.2.2. Movable parts on equipment shall be properly guarded. **(T-0)** Refer to **Chapter 11,** *Hand Tools, Portable Power Tools and Machinery,* for additional guidance.

4.4.2.3. Knives and cutting attachments shall be safeguarded when not in use. **(T-0)**

4.4.2.4. Hoods and Ducting. Hood filters over grease vapor producing activities, e.g., deep fat fryers and grills, shall be washed at least daily. **(T-1)** Hood filters in other areas shall be washed at least weekly. **(T-1)** Ducting shall be cleaned as necessary but at least once every six (6) months. **(T-1)** Cleaning of filters and ducts shall be documented IAW local procedures. **(T-1)** Cooking shall not be permitted under hoods without properly installed filters or when the fire extinguishing system is not operating. **(T-1)** Exhaust hoods shall be vented outside the facility. **(T-1)** Refer to National Fire Protection Association 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations,* for additional guidance. **Exception:** Cleaning of hood and exhaust ducts used for food service equipment may be extended to every two years if a dining facility prepares less than 10 meals per month.

4.4.3. Machinery/Equipment. Supervisors shall maintain manufacturer's manuals for all machinery or equipment under their control or develop local operating instructions, to include job safety, maintenance, lubrication and inspection, and identify operator and maintenance technician responsibilities. **(T-1)** Supervisors may use manufacturer's instructions to develop operating instructions or lesson plans to train operators on requirements of specific machinery. Refer to 29 CFR 1910.212, *General Requirements for All Machines,* and 29 CFR 1910.212, *Bakery Equipment,* for additional guidance on machinery. Equipment connected by flexible cords shall be disconnected when not in use for extended periods of time or at the end of the work shift. **(T-1)**

4.4.4. Fire Prevention. Refer to **Chapter 6** and National Fire Protection Association 96 for guidance and information on food service facilities.

Chapter 5

NONDESTRUCTIVE INSPECTION (NDI) AND OIL ANALYSIS

5.1. Scope.

5.1.1. Nondestructive Inspection (NDI). The purpose of nondestructive inspection is to employ inspection methods such as magnetic particle, eddy current, liquid fluorescent penetrant, ultrasonic and radiographic to detect cracks or flaws, measure geometric characteristics or determine material structure or composition of equipment. Refer to TO 33B-1-1, *Nondestructive Inspection Methods, Basic Theory,* for additional guidance.

5.1.2. Oil Analysis Program. The purpose of the oil analysis program is to measure and evaluate metal property results by interpreting oil analysis samples. Most samples are from engine oil on special or routine aeronautical flights, but may also include special and routine non-aeronautical equipment from other fluid lubricated mechanical systems, such as equipment from other Services. Refer to TO 33-1-37-1, *Joint Oil Analysis Program Manual,* for additional guidance.

5.2. Safety Precautions.

5.2.1. Ultraviolet Radiation. Unfiltered ultraviolet radiation can be harmful to the eyes and skin. Black light bulbs shall not be operated without proper lenses and/or filters. **(T-0)** Black lights can severely burn hands, arms, face or other exposed body areas and ignite fuel vapors. Black lights shall not be operated when flammable vapors are present. **(T-0)**

5.2.2. Ionizing Radiation and X-ray Equipment. Refer to OSHA 1910.1096, *Ionizing Radiation,* AFMAN 48-125, *Personnel Ionizing Radiation Dosimetry,* AFI 48-148, *Ionizing Radiation Protection,* and 21 CFR, Parts 1020.30 through 1020.33 for additional guidance.

5.2.3. Electrical Safety. NDI equipment to be used in hazardous areas shall meet National Fire Protection Association 70, *National Electrical Code*, requirements. **(T-0)**

5.2.4. Compressed Gases. Compressed gases commonly used in NDI and/or oil analysis program laboratories are nitrous oxide, acetylene and sulfur hexafluoride. Care and attention must be given to handling, storage, marking and disposition of all compressed gas cylinders. **(T-1)**

5.2.5. Housekeeping. Good housekeeping is essential to safe operations in the NDI and oil analysis program laboratories. Soiled rags, paper towels, craft paper and other trash contaminated with oil or grease shall be placed in self-closing metal containers plainly marked to indicate contents. **(T-1)** Refer to paragraph **2.4** for additional guidance on housekeeping.

5.2.6. Ventilation Systems. Only basic guidelines for NDI and/or oil analysis program laboratory ventilation are provided in this standard.

5.2.6.1. Surface area exhaust ventilation evaluations shall be conducted at least annually. **(T-0)**

5.2.6.2. Ventilation evaluation frequency is determined by BE in the occupational and environmental health risk assessment. As a minimum, areas that may require an evaluation for adequate ventilation include cleaning areas, penetrant tanks, remover tanks, penetrant inspection viewing booths, stationary magnetic particle units, film processing rooms and

the oil analysis program work area. **Note:** For more details on permissible exposure limits, flow rate requirements and design criteria, refer to UFC 4-024-01, *Security Engineering: Procedures for Designing Airborne Chemical, Biological, and Radiological Protection for Buildings,* American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance,* and AFI 48-145, *Occupational and Environmental Health Program.* Ventilation for oil analysis program spectrometers shall also comply with technical order and manufacturer's requirements. **(T-1)** Refer to BE's occupational and environmental health risk assessment for additional guidance.

5.3. Supervisor Responsibilities. Supervisors will:

5.3.1. Ensure personnel are properly trained on NDI and oil analysis procedures prior to being authorized to accomplish nondestructive inspection and oil analysis work. **(T-1)**

5.3.2. Ensure waste oil and cleaning rags do not accumulate in the oil analysis program lab. **(T-1)** Waste oil, not to exceed five (5) gallons, may be stored in the lab in an approved self-closing metal waste container. Waste cleaning rags and towels shall be removed from the lab at the end of each shift. **(T-1)**

5.4. Nondestructive Inspection Equipment and Fire Protection Systems. Contact the installation FES Flight prior to operating equipment which utilizes black lights, X-rays, ultraviolet and/or infrared rays. Some fire suppression systems are actuated by ultraviolet or infrared detectors and must be disabled, or other management actions taken, prior to using this NDI equipment to preclude actuation of the fire suppression systems. **(T-1)**

Chapter 6

FIRE PREVENTION AND PROTECTION

6.1. Fire Extinguishers.

6.1.1. **Hazards.** The maintenance and operation of portable fire extinguishers and fire suppression systems may involve exposure to toxic fire extinguishing agents and by-products of combustion. Fires produce toxic by-products of combustion, consume oxygen and produce high temperatures which create areas immediately dangerous to life and health (IDLH). It is important personnel receive training in the proper use of available portable fire extinguishers and fire education safety on preventing fires, protecting themselves and intervening early when fire occurs. Refer to 29 CFR 1910.157(a) for additional guidance. **Note:** If workcenter has a serviceable installed fire suppression system, fire extinguishers can be removed and the training requirement can also be eliminated. Coordination and approval of installation fire services is required.

6.1.2. Inspections, Testing and Maintenance. Fire detection, suppression and alarm systems, including fire hydrants, are subject to failure unless inspection, test and maintenance programs are conducted IAW UFC 3-601-02, *Operations and Maintenance: Inspection, Testing, and Maintenance of Fire Protection Systems*. When a fire protection system is out of service follow procedures IAW AFI 32-10141, *Planning and Programming Fire Safety Deficiency Correction Projects.* **(T-3)**

6.2. General Requirements.

6.2.1. Facility Managers/Supervisors shall:

6.2.1.1. Establish and maintain a fire prevention training program via the Job Safety Training Outline to ensure employees are trained and understand their fire prevention and protection responsibilities in their work areas IAW 29 CFR 1910.157, *Portable Fire Extinguishers.* This requirement may be fulfilled through the job safety training and documentation process IAW AFI 91-202. **(T-3) Note:** If workcenter has a serviceable installed fire suppression system, fire extinguishers can be removed and the training requirement can also be eliminated. Coordination and approval of installation fire services is required.

6.2.1.2. If further guidance is required, consult the installation FES Flight. **Note:** Building evacuation procedures in Services facilities may be practiced without actual participation of patrons, with the prior approval of the installation FES Flight Chief.

6.2.1.3. Make sure the facility is in a fire-safe condition at the close of business.

6.2.1.4. Conduct and document daily closing inspections. **(T-3)**

6.2.1.5. Coordinate approval with the installation FES Flight concerning all social events when temporary decorations or unusual arrangements are anticipated.

6.2.2. Commercial Food Service Facilities. Commercial food service facilities shall be maintained as required to prevent the loss of US Air Force resources. **(T-1)** The installation FES Flight shall inspect grease and heat removal hoods, ducts and exhausts at all food service facilities. **(T-1)** The FES inspection time and the contractor cleaning frequency shall be

approved by the installation Fire Chief. **(T-1)** The unit commander will appoint in writing a Quality Assurance Evaluator for cleaning, maintenance and testing conducted under a service contract. **(T-3)** The Quality Assurance Evaluator function is usually accomplished by the facility manager. **(T-3)**

6.2.3. Health Care Facilities. Facility managers and/or safety officers of health care occupancies shall have in effect a written fire plan that addresses appropriate staff response to a fire emergency and appropriate education and training for all elements of the fire plan. **(T-2)** The plan will address facility-wide needs in response to fire, area-specific needs for all areas, training for all staff, employees and volunteers, and appropriate training for other non-staff personnel required to participate in the fire plan. **(T-2)** This fire plan shall be approved by the installation Fire Chief or designee. **(T-3)**

6.2.4. Portable Fire Extinguishers.

6.2.4.1. Fire Emergency Services Flight. The installation FES Flight manages the installation fire extinguisher program and is the authority for all matters involving fire extinguishers. The FES Flight shall provide facility managers information on facility fire extinguisher requirements outlined in National Fire Protection Association standards. **(T-1)**

6.2.4.2. Extinguishers are not provided for military family housing. Should MAJCOMs, DRUs or FOAs direct installation of extinguishers in military family housing, procedures shall be developed to ensure occupants are trained in their use and extinguishers are maintained. **(T-3)**

6.2.4.3. Fire Extinguisher Location. The installation FES Flight shall approve the location of all fire extinguishers.. **(T-3)**

6.2.4.4. Fire Extinguisher Purchase and Maintenance. Facility managers and using organizations shall budget for purchase and maintenance of fire extinguishers. **(T-3)** All fire extinguishers shall meet the requirements of National Fire Protection Association 10, *Standard for Portable Fire Extinguisher*. **Note:** This includes flightline fire extinguishers. **(T-1)**

6.2.4.5. Worker Responsibilities. All employees are responsible for fire extinguishers in their work areas. They shall ensure fire extinguishers are readily accessible with unobstructed access and are used only for the intended purpose. **(T-0)** FES Flights shall be notified of any fire extinguisher discharge, accidental or intentional. **(T-3)**

6.2.4.6. Supervisor Responsibilities. Supervisors are responsible for fire extinguishers in areas under their control. They shall:

6.2.4.6.1. Perform visual inspections of fire extinguishers IAW paragraph **6.2.4.7** **(T-0)**

6.2.4.6.2. Take defective extinguishers to an authorized servicing location, as determined locally and coordinated with the installation FES Flight, for services. **(T-0)** Fire extinguishers removed from service shall be immediately replaced. **(T-3)**

6.2.4.6.3. Mount fire extinguishers in or on vehicles or equipment in approved/listed brackets, or otherwise secure them, to prevent damage as directed by TO or other directive. **(T-0)** **Note:** Vehicle fire extinguishers shall only be purchased with the

approval of Vehicle Management to ensure the vehicle technical orders and AFIs require the vehicle to carry fire extinguishers. **(T-1)**

6.2.4.7. Visual Inspection. Managers and supervisors at all levels shall ensure a visual inspection is performed and documented monthly for all fire extinguishers under their control. **(T-0)** Extinguishers with discrepancies shall be removed from service until repaired. **(T-0)** This inspection includes: **(T-0)**

6.2.4.7.1. Extinguisher located in a designated place.

6.2.4.7.2. No obstruction to access or visibility.

6.2.4.7.3. Operating instructions on name plate legible and facing outward.

6.2.4.7.4. Safety seals and/or tamper indicators not broken or missing.

6.2.4.7.5. No obvious physical damage, corrosion, leakage or clogged nozzle.

6.2.4.7.6. Pressure gauge reading or indicator in the operable range or position.

6.2.4.7.7. For wheeled units, the condition of the tires, wheels, carriage, hose and nozzle checked.

6.2.4.7.8. Fullness determined by weighing or "hefting."

6.2.5. Space Heaters.

6.2.5.1. Use Underwriters Laboratories-listed or host nation equivalent space heaters equipped with automatic shutoff devices that will shut off the heater if it tips over. Space heaters shall also have an overheat protection device, an automatic thermostat control and must be disconnected when not in use. **(T-3)**

6.2.5.2. Plug space heaters directly into a wall receptacle. Do not plug space heaters into multiple outlet strips. Do not use an extension cord with an electric space heater. **(T-3)**

6.2.5.3. Maintain a 36 inch minimum distance or IAW manufacturer's recommendations between any space heater and combustibles. **Note:** The more restrictive of the guidance will apply. **(T-3)**

6.2.5.4. Do not leave these devices unattended when in use and unplug them at the end of the day or shift. **(T-3)**

6.2.5.5. The use of space heaters in any hazardous location as defined by NFPA 70, National Electric Code, is prohibited. **(T-1)**

6.2.6. Coffee Makers.

6.2.6.1. Keep coffee makers and the area around them free of paper products and other loose combustibles. **(T-1)**

6.2.6.2. Follow manufacturer's operating instructions and consult with facility manager prior to placement of coffee makers.

6.2.6.3. Unplug coffee makers at the end of the day. **Note:** Coffee makers/machines with integral timers and single serve coffee makers do not need to be unplugged, e.g., Bunn-type coffee brewers and Keurig.

6.2.7. Heating Systems.

6.2.7.1. Heating devices, such as furnaces or heaters, must be kept clear of combustible and flammable material. **(T-3)**

6.2.7.2. All heating, boiler, air conditioning, air handling and mechanical rooms shall be secured. **(T-0)** Only the installation FES Flight, Civil Engineering (CE) or authorized personnel shall have access to these areas. **(T-3)**

6.2.8. Decorations.

6.2.8.1. Electric string lights and wiring must be Underwriters Laboratories (or equivalent) approved. **(T-3)**

6.2.8.2. Unplug all electrical decorations when work area is unoccupied. **(T-3)**

6.2.8.3. Decorations shall be noncombustible or fire retardant. Use of an open flame is prohibited. **(T-3)**

6.2.9. Fire Alarm Systems. Supervisors shall ensure all personnel are familiar with the fire alarm systems, know how to report an emergency and how to activate the fire alarm system. **(T-0)** At no time shall a fire detection, suppression or alarm system or device be painted, blocked or obstructed in any manner. **(T-3)**

6.2.10. Emergency Evacuation Procedures.

6.2.10.1. Supervisors shall establish an emergency action plan. **(T-0) Note:** Employees shall know primary and secondary escape routes for every area of the building. **(T-1)**

6.2.10.2. Consult the installation FES Flight to determine requirements for practicing fire evacuation drills. Facility Managers ensure new personnel are trained in evacuation procedures. **(T-3)**

6.2.10.3. Personnel shall immediately evacuate the building whenever the fire alarm activates, unless otherwise provided for in an approved building fire evacuation plan or when non-evacuation testing or maintenance is being conducted on the fire alarm system. **(T-3)** Installation commanders may approve in writing, with coordination from the installation Occupational Safety office and FES Flight, any combat ready positions authorized to remain in their work center during fire alarm activation. Upon direction of the senior fire official, all personnel shall immediately evacuate to include those combat mission ready positions. **(T-3) Note:** Command post and/or job control personnel are not considered combat mission ready.

6.2.10.4. Do not use elevators during evacuation; use the stairs. **(T-1)**

6.2.10.5. Establish a predetermined area for personnel to gather after evacuation so personnel can be accounted for. **(T-3)**

6.2.10.6. Appoint Emergency Action Procedures representatives to account for personnel at the predetermined meeting area. **(T-3)** This will help emergency response personnel determine who may still be in the building. At least two representatives per section shall be appointed; in case the primary leader is not in the building at the time of the emergency or is unable to evacuate the building, the alternate can fill in. **(T-3)** Sections with many personnel (20 or more) in their allocated space may require additional representatives. **(T-3)**

6.2.10.7. Assign workers to assist people in wheelchairs or anyone else who would have difficulty descending stairs on their own. Also, ensure people with hearing or sight problems know they are to evacuate. Assign someone to help them evacuate and report to the designated meeting area, if necessary.

Chapter 7

WALKING – WORKING SURFACES

7.1. General Requirements. Obstacles in walk areas, liquid spills, sawdust accumulations and the use of slippery surface cleaners can cause slipping hazards and shall be cleaned up immediately to prevent slips, falls and injuries. **(T-0)** Refer to 29 CFR 1910, Subpart B – *Walking-Working Surfaces,* for definition and additional guidance.

7.1.1. All walking-working surfaces shall be maintained in a clean and dry condition as much as possible. **(T-0)** Drip or oil pans shall be used whenever the possibility of spilling or dripping exists. **(T-0)** Where wet processes are used, drainage shall be maintained and false floors, platforms, mats, or other dry standing places should be provided where practicable. **(T-0)** If floor drains are present, floors shall be sloped to allow liquids to naturally flow to the drains. **(T-0)** Drains shall be kept clear to prevent clogging, especially when hazardous or contaminated materials are present. **(T-0)** In locations where wet processes do not normally occur, and drains are not available, wet areas shall be clearly marked (e.g. wet floor signage) and immediately cleaned up and dried before permitting other personnel to enter the area. **(T-0)** Protective footwear for wet slippery surfaces shall be provided where appropriate. **(T-1)**

7.1.2. Condition. Floors, aisles, and passageways shall be kept clear and in good repair, with no obstructions, free of defects that can endanger employees or interfere with handling of materials, or hinder people leaving during emergencies. **(T-0)** Refer to 29 CFR 1910.22., *General Requirements-Walking Working Surfaces*, for additional information.

7.1.3. Illumination. Control of light is important to prevent glare and harsh shadows. Soft shadows are usually acceptable, but harsh shadows should be avoided since they may obscure hazards or interfere with visibility. Supplementary lighting or additional lighting shall be provided where general lighting is not sufficient. **(T-1)** Facility managers shall ensure lighting is sufficient for walking surfaces in their work/facility area and that obstacles are visible. **(T-0)**

7.1.3.1. Consult the installation CE facility design section whenever specific guidance on lighting is required. Some work may require increased illumination. Submit a work request when a lighting survey is required. If the safety of personnel is a factor, the work request shall be coordinated with the installation Occupational Safety office, who may assign a Risk Assessment Code, if warranted. **(T-1)**

7.1.3.2. All fluorescent light bulbs contain toxic materials and shall be managed IAW local disposal criteria for hazardous waste. **(T-0)** Consult with the installation Environmental Management Office on disposal guidance for hazardous waste materials. When fluorescent lighting fixtures are used, supervisors shall ensure that any stroboscopic effect with moving machinery is avoided. **(T-1)**

7.1.4. Guards for Floor and Wall Openings. Every floor opening, such as a hatchway, chute, pit, trap door, manhole and ladderway, shall be guarded. **(T-0) Note:** Manholes shall comply with 29 CFR 1910.24, *Step Bolts and Manhole Steps*. **(T-0)** The type of guard used depends on the location, reason for the opening and frequency of use. Refer to 29 CFR 1910.28, *Duty to Have Fall Protection and Falling Object Protection,* for additional guidance. One of the following guards shall be installed:

7.1.4.1. Standard Railings and Toeboards.

7.1.4.1.1. Railings and toeboards shall be permanently attached leaving only one exposed side, which shall have a removable railing. **(T-0)** When the exposed side is not in use, the railing shall be left in place. **(T-0)** Refer to 29 CFR 1910.28 for specific detail on construction and installation.

7.1.4.1.2. Toeboards are required wherever falling objects may present a hazard. Toeboards can be constructed of any 4-inch high rigid material, either solid or with openings not greater than 1 inch. They shall be securely fastened in place with not more than one-fourth inch clearance from the floor except at the entrance of the opening. **(T-0)** Refer to 29 CFR 1910.28 for additional information.

7.1.4.2. Floor Opening Cover. A cover shall be used for less frequently used openings where traffic across the opening prevents the use of fixed railings, such as openings located in aisle spaces. **(T-0)** In addition, covers or guards shall be used to protect people from the hazards of open pits, tanks, vats, ditches, etc. **(T-0)** Refer to 29 CFR 1910.29, Fall *Protection Systems and Falling Object Protection-Criteria and Practices,* for additional requirements.

7.1.5. Guards.

7.1.5.1. Every stairway and ladderway opening shall be guarded by standard railings and toeboards on all open sides, except at the entrance of the opening. **(T-0)** If there is danger of a person walking straight into the opening, a swinging gate or offset passage shall be used. **(T-0)**

7.1.5.2. Every covered opening in a surface, such as a skylight floor opening, shall be guarded by a skylight screen or standard railing with toeboards on all exposed sides. **(T-0)** Skylight screen grillwork or slatwork shall be capable of withstanding a load of at least 200 pounds applied at any area of the screen. **(T-0)** Refer to 29 CFR1910.28 for additional information.

7.1.5.3. All open-sided floors, platforms and runways four (4) feet or more above the ground or floor shall be guarded by a standard railing on all open sides, except at ramp entrance to a ramp, stairway or fixed ladder. **(T-0)** Collapsible or removable railings may be installed on a runway, but shall only be removed when a special task (such as oiling, shafting or filling tank cars) is being performed and other protective measures, approved by the installation Occupational Safety office, are used. **(T-0)** Railings shall be reinstalled when the task is complete. **(T-0)**

7.1.5.4. Every permanent or temporary wall opening (to include windows) less than 39 inches above the floor (where there is a four [4] foot or more drop) shall be protected from falling by use of: guardrail system, safety net system, travel restraint systems or personal fall arrest systems. **(T-0)** If a guardrail system is used, the guard may be removable, but shall be installed when the opening is not in use. **(T-0)** A toeboard shall be installed when falling materials may present a hazard. **(T-0)** Refer to 29 CFR 1910.28 for additional information.

7.1.5.5. Guard railings shall consist of securely mounted top rails, intermediate rails and posts. **(T-0)** The vertical height shall be 42 inches, plus or minus 3 inches, from the upper

surface of the top rail to the floor, platform, runway or ramp level. **(T-0) Exception:** Guard railings in place prior to 26 October 2016 shall consist of a top rail, intermediate rail and posts, or equivalent, and shall have a minimum vertical height of 36 to 44 inches from the upper surface of the top rail to the floor, platform, runway or ramp level. **(T-0)** Heights greater than 45 inches are permissible, provided the guard rail system meets all criteria of 29 CFR 1910.29(b).

7.1.6. Coefficient of Friction of Walking and Working Surfaces. The finished surface shall have a coefficient of friction of at least 0.5 for level surfaces and 0.8 for sloped surfaces, as measured using American National Standards Institute/American Society of Safety Engineers A1264.2., *Standard for Provision of Slip Resistance on Walking/Working Surface,* or other adopted nationally recognized standards. **(T-1)** Consult the installation CE when coefficient of friction guidance for a specific work surface is required or needs to be determined. **(T-1)** This requirement applies to all types of floors and other walking/working surfaces, including vinyl, tile, wood, carpet, steel, concrete, etc., and any coatings or surface treatment used on them.

7.1.7. Coatings includes painted and unpainted walking and working surfaces and shall exhibit anti-skid properties to reduce the risk of employee slips and falls. **(T-0)** The purchaser shall verify anti-skid properties with coating manufacturer or supplier before purchasing. **(T-0)**

7.1.8. Interior Walking and Working Surfaces.

7.1.8.1. Layout. All interior walking and working surfaces that are part of the means of egress shall comply with UFC 3-600-01, *Fire Protection Engineering for Facilities,* and National Fire Protection Association 101, *Life Safety Code.* **(T-0)**

7.1.8.1.1. Equipment and machinery shall be arranged to permit an even flow of materials. **(T-1)** Sufficient space shall be provided to handle the material with the least possible interference from or to employees or other work being performed. **(T-1)** Machines shall be placed so it will not be necessary for an operator to stand in a passageway, aisle or exit access. **(T-0)** Additionally, machine positioning shall allow for easy maintenance, cleaning and removal of scrap. **(T-1)** After the initial positioning of equipment and machines is decided, clear zones (workspaces) of sufficient dimensions to accommodate typical work shall be established. If material exceeds established clear zones, rope and stanchions may be used to temporarily extend the workspace. The supervisor may consult with the installation Occupational Safety office as needed to determine the need to mark clear zones based upon hazard potential. **(T-1)** Yellow or yellow-and-black hash-marked lines, two (2) to three (3) inches wide, shall be used when marking is necessary. **(T-1)**

7.1.8.1.2. Passageways, aisles and exit accesses shall be provided to permit free movement of employees and material, and shall be independent of clear zones and storage spaces and shall be clearly recognizable. **(T-0)** Markings shall be used unless impractical. Floor markings shall provide a contrast to the floor color, such as yellow lines two (2) to three (3) inches wide on a gray floor. **(T-0)**

7.1.8.1.3. Where powered materials handling equipment (lift truck, etc.) is used, facility layout shall provide enough clearance in aisles, loading docks and through doorways to permit safe turns. **(T-0)** Obstructions that could create hazards shall not be permitted in aisles. **(T-0)** Aisles shall be at least two (2) feet wider than the widest

vehicle used or most common material being transported. **(T-0)** Refer to 29 CFR 1910.176., *Handling Materials—General,* for additional information.

7.1.8.1.4. Aisles shall be at least 36 inches wide to permit free movement of workers, equipment and supplies. **(T-0)** A minimum of 18 inches shall be provided for passageways formed by or between movable obstructions. **(T-0)** Refer to National Fire Protection Association 101 and UFC 3-600-01 for additional information.

7.1.8.1.5. Sufficient access and working space shall be provided and maintained around all electrical equipment. **(T-0)** Refer to 29 CFR 1910.303, *General,* for additional information.

7.1.8.2. Condition.

7.1.8.2.1. Floors shall not be cleaned with flammable liquids. **(T-0)** IAW AFI 32-7086, *Hazardous Materials Management,* floor cleaning chemicals not currently loaded in the standardized Air Force Hazardous Material (HAZMAT) tracking system must be approved by the installation Hazardous Materials Management Program Team prior to use. **(T-2)** Adequate ventilation shall be provided and/or respiratory protection may be required. **(T-0)** Combustible or explosive dust shall be eliminated at the source. **(T-0)** If this is not possible, it shall be minimized during sweeping by spreading a noncombustible sweeping compound over the floor. **(T-0)**

7.1.8.2.2. After floors have been properly cleaned, nonskid finishing compounds may be used. In some locations, such as electroplating shops, finishing compounds shall not be applied if there is a possibility of a reaction with shop chemicals. **(T-0)**

7.1.8.2.3. When floors are being cleaned or finishing compounds applied, signs shall be posted to warn employees of a slipping hazard and shall remain in place until floors have dried. **(T-0)** The size and placement of these signs shall be at the discretion of the supervisor, but shall be visible to those entering the hazardous area. **(T-0)** Refer to paragraph **29.3** for additional information on safety, fire prevention and health signs.

7.1.8.2.4. Loading Capacity. Supervisors shall ensure equipment weight and distribution comply with maximum floor loading capacity for all above grade storage areas (including areas above basements). **(T-0)** The weights of equipment, such as hoists suspended under a floor, shall also be considered when determining floor loading capacity. **(T-0)** The supervisor shall have signs that identify the floor load capacity determined by the installation CE permanently installed in plain view of all employees. **(T-0)** CE shall approve the installation of all equipment weighing more than 500 pounds in any multi-story building. **(T-1)** Supervisors shall ensure heavy loads are evenly distributed according to the floor's safe load limit. **(T-0)** Refer to 29 CFR 1910.22. for additional information.

7.1.9. Exterior Walking and Working Surfaces. The proper layout and condition of exterior surfaces is important to the safe and efficient movement of people and equipment. The placement of walkways and parking areas is controlled by the installation CE.

7.1.9.1. Parking Lots. The parking lots shall be smooth, have good drainage and be free of pedestrian tripping hazards. **(T-0)** Walkways shall be provided. **(T-0)** Entrances and exits shall not have obstructions that block a driver's or pedestrian's view of traffic. **(T-0)**

Supervisors should contact the installation Occupational Safety office and CE for more detailed information. Specifications for signs are contained in UFC 3-120-01, *Design: Sign Standards.*

7.1.9.2. Walkways. Lighting shall be used to highlight hazards. **(T-0)** When loose gravel or crushed rock is used for surfacing, the largest dimensions of material used shall not exceed one-half of an inch. **(T-0)** Motorized vehicles shall not be operated over elevated walkways unless the load bearing capacity of the walkway will support the vehicle's weight. **(T-0)** Broken, uneven or cracked surfaces shall be repaired. **(T-0)**

7.1.9.3. Grounds. All grounds adjacent to work areas shall be kept free of hazardous materials, trash, weeds, unguarded pits, openings or obstacles. **(T-0)**

7.1.9.3.1. Materials shall not be stored, left under or piled against buildings, doors, exits or stairways. **(T-0)**

7.1.9.3.2. Poisonous or toxic plants shall not be used for landscaping without prior approval of the installation medical services. **(T-0)** Weeds shall not be permitted to grow excessively or to accumulate. **(T-0)** Trees and bushes adjacent to walkways shall be trimmed to permit a clear path for pedestrians. **(T-0)**

7.1.9.3.3. All open drainage ditches that present a hazard shall be clearly identified in the daytime, guarded by fences or barriers and illuminated or marked with warning flashers at night. **(T-0)**

7.1.9.4. Construction. All construction work shall be clearly identified by signs that can be read from at least 50 feet, in addition to barriers marked with night reflective materials. **(T-0)** Illumination or warning flashers shall also be used after dark. **(T-0)**

7.1.9.5. Vehicle Repair, Service and Assembly Pits. The use of a fall protection system is not required for those work pits that are less than 10 feet deep provided that:

7.1.9.5.1. Access is limited within 6 feet of the edge of the pit to authorized and trained employees only IAW 29 CFR 1910.30, *Training Requirements*.

7.1.9.5.2. Floor markings at least six (6) feet from the edge of the pit in colors that contrast with the surrounding area or a warning line six (6) feet from the edge of the pit with the use of stanchions that are capable of resisting, without tipping over, a force of at least 16 pounds applied horizontally against the stanchion at a height of 30 inches; or a combination of both. **Note:** When two or more pits in a common area are not more than 15 feet apart, compliance may occur by placing contrasting floor markings at least 6 feet from the pit edge around the entire area of the pits and visible caution signs are posted that meet the requirements of 29 CFR 1910.145, *Specifications for Accident Prevention Signs and Tags*, and state "Caution—Open Pit".

7.2. Stairs and Ramps Requirements. Note: Egress components, such as stairs, ramps, guard rails or hand rails, constructed to any 1970 or newer edition of National Fire Protection Association 101 are acceptable. The selection of a particular type of stairway or ramp is dependent upon the location, intended use and existing environmental conditions, and is normally performed by the installation CE with recommendations from the installation Occupational Safety office and FES Flight. In addition to the below criteria, see National Fire Protection Association 101, UFC 3-600-01, and 29 CFRs 1910.28 and 1910.25, Stairways.

7.2.1. Design Consideration. Stairway and ramp designs may have been based on prior use of a facility, whereas current use may dictate modifications or replacement of components. This could include changing the width, angle of rise, length and vertical clearance, as well as increasing load bearing capacity, inclusion of railings or enclosing open risers.

7.2.2. Strength. Stairs and fixed ramps shall be designed and built to carry a load of 5 times the normal live load anticipated but not less than a moving concentrated load of 1,000 pounds. **(T-0)**

7.2.3. Width. Stairs, if part of the exit access, shall have a minimum width of 36 inches if the occupant load of the building or structure is less than 50 persons. **(T-0)** If the occupant load is greater than 50, the minimum stair width is 44 inches. Fixed ramps, if part of the exit access, shall have a minimum width of 44 inches. **(T-0)** The authority having jurisdiction may reduce this requirement to 30 inches in certain cases. For ramps or stairs not part of the exit access, a minimum width of 22 inches shall be provided. **(T-0)**

7.2.4. Angle of Rise. Stairs shall be installed at angles to the horizontal of 30 to 50 degrees. **(T-0)** For stairs constructed/installed after 17 January 2017, a maximum riser height of 9.5 inches, minimum tread depth of 9.5 inches and a minimum width of 22 inches between vertical barriers is required. Stairs constructed/installed prior to 17 January 2017 are in compliance if they meet the requirements of 29 CFR 1910.25, Table D-1. Tread depth and riser height must be consistent throughout a new facility. **(T-0)** Tread depth and riser heights must also be consistent throughout a staircase. **(T-0)** Where the slope is less than 30 degrees, a ramp with a non-slip surface shall be installed. **(T-0)**

7.2.5. Ramps. Ramps not part of the exit access shall follow guidance in National Fire Protection Association 101 (**https://codesonline.nfpaorg/code**). For ramps that are part of the exit access, a maximum slope of 1 to 8 inches for existing ramps and 1 to 12 for new ramps is allowed.

7.2.6. Width of Landings. Landings and platforms not part of the exit access shall not be less than the width of the stairs and a minimum of 30 inches in length, measured in the direction of travel. **(T-0)** When doors or gates open directly onto a stairway, they shall not reduce the available width of the landing to less than 20 inches for platforms installed before 17 January 2017, and less than 22 inches for platforms installed on or after 17 January 2017. **(T-0)** Landings in stairs or ramps that are part of the exit access shall meet the requirements of National Fire Protection Association 101. **(T-0)**

7.2.7. Vertical Clearance. Where there is less than six (6) feet, eight (8) inches of headroom over stairs, obstructions shall be padded. **(T-0)** When they cannot be padded, obstructions shall be color coded yellow or yellow-and-black stripes to highlight the hazards. **(T-0)** In all cases, caution signs shall be used to warn people of low clearances. **(T-0)**

7.2.8. Treads. All treads shall be slip-resistant and free of projections or lips that could cause a tripping hazard. **(T-0)**

7.2.9. Grating. Open grating type treads are desirable for stairs which are not enclosed. The use of open treads prevents the buildup of rainwater and snow on the tread surface.

7.2.10. Sidewalk Ramps. Sidewalk ramps shall be installed where equipment, such as housekeeping carts or hand trucks, are used. **(T-0)**

7.2.11. Stair Railings and Guards. Every flight of stairs with four (4) or more risers shall have standard guardrails or standard handrails as called for in 29 CFR 1910.25. **(T-0)** The width of the stair shall be measured clear of all obstructions except handrails. **(T-0)**

7.2.12. Illumination. Stairs and ramps shall be lighted so all treads and landings are visible. **(T-0)** Consult the local CE facility design section whenever specific guidance on lighting is required.

7.2.13. Inclined Ladders. Some Air Force facilities have permanent stairways installed which exceed a 50-degree angle. These stairways are commonly referred to as inclined ladders. Where an inclined ladder has been installed, it shall have handrails on both sides and open risers. **(T-0)** Construction/installation after 17 January 2017 shall have stairs installed within the range of 30-50 degrees. **(T-0)**

7.2.14. Maintenance. Stairs and ramps shall be kept clean, free of obstructions or slippery substances, and in good repair at all times. **(T-0)** Supervisors will ensure:

7.2.14.1. Loose boards, insecure treads, protruding nails and torn or worn stair treads are repaired or replaced immediately. **(T-0)**

7.2.14.2. Posters, bulletin boards and other objects that could distract a person's attention are not placed in stairwells or rampways. **(T-0)**

7.2.14.3. Slippery surfaces are replaced or made safe by coating them with nonslip surface materials. **(T-0)**

7.2.14.4. Treads and risers are of uniform size. **(T-0)**

7.2.14.5. Stair nosings (leading edge of the tread) are designed to prevent personnel from catching their heels on the treads. They must be securely fastened and rounded or beveled. **(T-0)**

7.2.14.6. Guardrails and handrails are smooth, free of splinters or burrs and securely mounted. **(T-0)**

7.2.14.7. Outside stairways, entrances, sidewalks, loading docks and ramps are cleared of snow and ice, and that abrasive materials, such as sand, ash or ice melting chemicals, are readily available and used during inclement weather. **(T-0)** This also includes all emergency exits and walks leading from them.

7.3. Fixed Ladders.

7.3.1. Requirements.

7.3.1.1. Acquisition. Fixed ladders, and their parts and accessories, and safety devices shall meet requirements of 29 CFR 1910.23, *Ladders*. **(T-0)** Procurement specifications shall include permanent treatment for corrosion control so future treatment shall not be needed. **(T-1)**

7.3.1.2. Design and Installation. Fixed ladders provide a means of access to roofs, pits, silos, towers, tanks and other limited-access areas. Stairs shall be provided where access is daily or during each shift for gauging, inspection, regular maintenance or when carrying tools or equipment is normally required and sufficient space is available. **(T-0)** Fixed

ladders may be used when a stairway cannot be used. The following paragraphs provide general design and installation criteria for fixed ladders.

7.3.1.2.1. Length. Ladders 24 feet or less shall be of a continuous length. **(T-0)** When they are more than 24 feet and of continuous length, the following requirements apply:

7.3.1.2.2. When platforms are required, they shall not be less than 24 inches wide by 30 inches long and shall be equipped with standard railings. **(T-0)** Toeboards are required where the hazard of objects falling is present. Refer to 29 CFR 1910.29, *Fall Protection Systems and Falling Object Protection—Criteria and Practices*, for additional information.

7.3.1.2.3. Ladder Safety Devices, Cages and Wells. All ladder safety devices such as those that incorporate positioning belts, friction brakes and sliding attachments shall meet the design requirements of the ladders which they serve. **(T-0)** Where a cage is installed, it shall extend a minimum of 42 inches above the top of landing, unless other acceptable protection is provided. **(T-0)** Cages shall extend down the ladder to a point not less than seven (7) feet nor more than eight (8) feet above the base of the ladder. **(T-0)** Refer to 29 CFRs 1910.23 and 1910.28 for specific design and construction information. Ladder safety devices, cages or wells are required on all existing fixed ladders more than 24 feet. **(T-0)**

7.3.1.2.3.1. Existing fixed ladders. Each fixed ladder installed before 19 November 2018, is equipped with a personal fall arrest system, ladder safety system, cage, or well;

7.3.1.2.3.2. New fixed ladders. Each fixed ladder installed on and after 19 November 2018, is equipped with a personal fall arrest system or a ladder safety system;

7.3.1.2.3.3. Replacement. When a fixed ladder, cage, or well, or any portion of a section thereof, is replaced, a personal fall arrest system or ladder safety system is installed in at least that section of the fixed ladder, cage, or well where the replacement is located; and

7.3.1.2.3.4. Final deadline. IAW 29 CFR 1910.28(b)(9)(i)(D), on and after 18 November 2036, all fixed ladders are equipped with a personal fall arrest system or a ladder safety system.

7.3.1.2.4. When a one-section fixed ladder is equipped with a personal fall protection or a ladder safety system or a fixed ladder is equipped with a personal fall arrest or ladder safety system on more than one section, ensure the following:

7.3.1.2.4.1. The personal fall arrest system or ladder safety system provides protection throughout the entire vertical distance of the ladder, including all ladder sections. **(T-0)**

7.3.1.2.4.2. The ladder has self-retracting lifelines and rest platforms at intervals not to exceed 150 feet (45.7 m). **(T-0)**

7.3.1.2.4.3. Ensure ladder sections having a cage or well. **(T-0)**

7.3.1.2.4.4. Are offset from adjacent sections. **(T-0)**

7.3.1.2.4.5. Have landing platforms provided at maximum intervals of 50 feet (15.2). **(T-0) Note:** A cage or well may be used in combination with a personal fall arrest system or ladder safety system provided that the cage or well does not interfere with the operation of the system.

7.3.1.3. Ladder Pitch. The preferred pitch of fixed ladders shall be 75 to 90 degrees from the horizontal. **(T-1)** Ladders with a pitch in excess of 90 degrees are prohibited. Refer to 29 CFR 1910.27, *Scaffolds and Rope Descent Systems* for additional information.

7.3.1.4. Load Capacity. All ladders, platforms, appurtenances and fastenings shall meet the load requirements of 29 CFR 1910.23. **(T-0)**

7.3.1.5. Lighting. Adequate illumination shall be available when using ladders. **(T-0)** Lamps shall be installed so the light does not reflect in a climber's eyes. **(T-0)** Consult the installation CE when specific guidance on lighting is required.

7.3.1.6. Access. Where unauthorized use of a fixed ladder poses a hazard, the facility manager shall ensure the ladders are secured from unauthorized access. **(T-2)** Ladders available to public access require guarding to prevent unauthorized access. The bottom seven (7) feet shall be guarded. **(T-0)** Examples of guarding include the use of a fence with locked gates and making the bottom portion portable or spring loaded and available only as needed. Additionally, there must be a warning sign prohibiting access by unauthorized persons. **(T-0)**

7.3.1.7. Slipping. When the potential for climbers to get mud, oil or grease on their footwear creates a slipping hazard, a mat of crushed rock, a raised platform or a boot scraper shall be provided. **(T-0)**

7.3.1.8. Electric Lines. Electrical conductors shall not be installed on or adjacent to fixed metal ladders, unless they are beyond reach and cannot be used as a handrail or grabbed inadvertently. **(T-0)** This distance shall be at least five (5) feet from the ladder. **(T-0)** If there is any potential for contact with parts of electric equipment or circuits, these parts shall be de-energized and locked out IAW **Chapter 21,** *Hazardous Energy Control*. **(T-0)**

7.3.1.9. Rung Ladders. Rung ladders shall be built into the walls of each manhole over 12 feet deep. **(T-1)** The distance between rungs is the same as other fixed ladders. More detailed design criteria can be found in 29 CFR 1910.23. **Note:** Newly constructed manholes completed on or after 17 January 2017 shall comply with 29 CFR 1910.24. **(T-0)**

7.3.1.10. Grounding and Bonding. Ladders and related equipment shall be grounded and/or bonded, to drain off accumulated static electricity when static electricity is hazardous to the work operation, such as fuel cell repair or refueling vehicle maintenance. **(T-0)** Static discharge plates shall also be provided. **(T-0)**

7.3.2. Inspections.

7.3.2.1. A formal, fully documented inspection of all fixed ladders shall be accomplished upon installation and at least every three (3) years thereafter. **(T-0)** These inspections shall be performed by the installation CE for ladders installed on real property facilities or real property installed equipment. **(T-0)** The using organization is responsible for ensuring inspections are done for facilities and equipment which are not real property. When

qualified personnel are not available in using organizations, the installation CE shall provide assistance. **(T-3)** Inspection documentation shall include the type ladder and safety climb device installed, location, a detailed list of all discrepancies and corrective action status. **(T-2)**

7.3.2.2. Climbers shall be alert to potential hazards and perform informal inspections of fixed ladders prior to every use. **(T-1)** No attempt to climb shall be made until all hazardous conditions are corrected. **(T-1)** Specific hazards to look for during inspections are: loose, worn and damaged rungs or side rails; damaged or corroded bolts and rivet heads; damaged or corroded handrails and brackets on platforms; and deteriorated masonry where fixed ladder anchorages are secured to a structure, including loose or damaged carrier rails or cables.

7.3.3. Maintenance. Repairs made to fixed ladders and related equipment shall meet the following requirements:

7.3.3.1. Materials used shall meet or exceed original construction. **(T-0)**

7.3.3.2. Any modification to ladder components, safety climb device or related equipment shall be coordinated with the property manager and Occupational Safety office, with final approval by the installation CE. **(T-1)**

7.3.3.3. All welding shall be performed by a qualified welder. **(T-0)**

7.3.4. Selection of Personnel. Some individuals become spatially disoriented when working on elevated ladders or platforms. This condition is known as height vertigo. Common reactions to this condition are to "freeze" and hang on to any permanent support or to experience dizziness, nausea, trembling and/or loss of consciousness. Supervisors shall be vigilant in screening and observing employees required to work at heights. **(T-1)** If the supervisor suspects an employee may be subject to vertigo, the employee shall be referred to the local medical facility for evaluation prior to resuming any height work. **(T-1)** Employees descending into pits or shafts may also experience vertigo. Individuals known to experience vertigo shall be disqualified as ladder users. **(T-1)**

7.3.5. Supervisors shall ensure climbers are trained to:

7.3.5.1. Check ladder for defects and slippery substances. **(T-0)**

7.3.5.2. Ensure ladder and climber's footwear are free of slippery substances. **(T-0)**

7.3.5.3. Raise or lower needed tools and materials by handlines after reaching the work position. **(T-0)**

7.3.5.4. Face the ladder and use both hands to grip the rungs or side rails firmly. **(T-0)**

7.3.5.5. Wear slip-resistant shoes with heels. **(T-0)**

7.3.5.6. Climb carefully, without haste and maintain three-point contact. **(T-0)**

7.3.5.7. Never run up or down or jump from the ladder. **(T-0)**

7.3.5.8. Remove hand jewelry (rings) prior to climbing. **(T-0)**

7.4. Portable Ladders.

7.4.1. The following practices are prohibited:

7.4.1.1. Ladders set on unstable surfaces. **(T-0)**

7.4.1.2. Ladders placed in front of doors which open towards the ladder without proper guarding. **(T-0)**

7.4.1.3. Ladders used as scaffolds, unless specifically designed for that purpose. **(T-0)**

7.4.1.4. Personnel reaching too far out to the sides. **(T-0)**

7.4.1.5. Personnel standing too high to maintain their balance. **(T-0)**

7.4.1.6. Use of a defective ladder, e.g., broken rail or rung. **(T-0)**

7.4.1.7. Improvising and using a make-shift ladder. **(T-0)**

7.4.1.8. Personnel carrying materials in their hands while ascending or descending a ladder. **(T-0)**

7.4.1.9. Using a ladder with conductive side rails while working on electrical circuits or near live electrical lines, etc. **(T-0)**

7.4.1.10. Descending with their back to the ladder, unless specifically designed for that purpose. **(T-0)**

7.4.1.11. Paint wood ladders with an opaque coating, since possible defects may be covered up. **(T-0)**

7.4.2. Requirements.

7.4.2.1. Acquisition and Selection Considerations.

7.4.2.1.1. Portable ladders shall meet American National Standards Institute design and construction specifications. **(T-0) Exception:** Fire department ladders shall be maintained and inspected IAW National Fire Protection Association 1931, *Standard for Manufacturer's Design of Fire Department Ground Ladders*, and National Fire Protection Association 1932, *Standard on Use, Maintenance, and Service Testing of In-Service Fire Department Ground Ladders.* **(T-0)**

7.4.2.1.2. There are a variety of ladder styles; selection, to include construction material and proper size, shall be based on where and how the ladder may be used. **(T-1)** Ladders come in five (5) workload ratings. Supervisors shall order Type IAA, IA or I ladders whenever possible. **(T-1)** Type II ladders shall only be considered when local purchase is required and local manufacturers cannot provide Type IAA, IA or I. **(T-1)** Type III ladders shall not be procured for industrial use. **(T-1)** Refer to Table 7.1 for additional information.

Table 7.1. Ladders Workload Ratings.

Ladders Workload Ratings		
Duty Rating	**Ladder Type**	**Working Load (Pounds)**
Extra Heavy Duty	IA	300
Extra Heavy Duty	IAA	375
Heavy Duty	I	250
Medium Duty	II	225
Light Duty	III	200

7.4.2.2. Inspections. Thorough visual inspections of ladders shall be made by the supervisor when the ladder is initially received and prior to being placed in service. **(T-1)** Workers shall perform a visual inspection prior to each use. **(T-0)** Refer to 29 CFR 1910.23 for additional information. Defects or damage to look for include:

7.4.2.2.1. Evidence the ladder was exposed to excessive heat (such as in a fire) or corrosive substances. When ladders are so exposed, their ability to support the designed working load shall be questioned. **(T-0)** The ladder shall be retested IAW manufacturer's requirements. **(T-1)**

7.4.2.2.2. Side rails, steps, rungs or related hardware that are cracked, split or deformed.

7.4.2.2.3. Pulleys, cables and ropes which bind or are frayed.

7.4.2.2.4. Rivets, connections and spreaders for looseness or shearing.

7.4.2.2.5. Nonskid base material that is loose or missing. Metal and metal-reinforced single and extension ladders, except aircraft boarding ladders, shall be equipped with safety shoes, spurs, spikes or combinations thereof to prevent slipping. **(T-0)**

7.4.2.2.6. Ladders with conductive side rails that are not marked for electrical hazards. Ladders not already marked with safety use instructions by the manufacturer shall be stenciled, "DANGER —DO NOT USE AROUND ELECTRICAL EQUIPMENT," in two-inch high red letters or the largest letters the surface will allow (minimum letter size is one inch). **(T-0)**

7.4.2.2.7. Ladders in which rungs and steps designed for use in ascending or descending on metal ladders are not corrugated, knurled, dimpled or coated with skid-resistant materials.

7.4.2.2.8. Ladders with broken or missing steps, rungs or cleats, broken side rails, or other defects shall not be used. **(T-0)**

7.4.2.3. Maintenance. Proper maintenance ensures the safe condition of the ladder. Hardware, fittings and related equipment shall be checked frequently and kept in proper working condition. **(T-0)** All bolts and rivets shall be in place and secured. **(T-0)** Joints between steps or rungs and the side rails shall be tight. **(T-0)** Refer to 29 CFR 1910.23 for additional information.

7.4.2.3.1. Lubricate metal bearings of locks, wheels, pulleys, etc., IAW manufacturer's instructions.

7.4.2.3.2. Replace frayed or worn rope.

7.4.2.3.3. Keep safety feet and other parts in good working condition.

7.4.2.3.4. Coat wood, metal and fiberglass ladders with a suitable protective material IAW manufacturer's instructions. If protective coatings are considered desirable for wooden ladders, use only transparent coatings or wood preservatives to prevent possible defects from being hidden. Protect metal ladders that may come in contact with acids or alkali solutions with a locally approved coating. When location demands, protect metal ladders against corrosion caused by moisture or salt spray. When plastic/fiberglass ladder rails/surfaces have the appearance of exposed fibers or an

apparent color change from weather exposure, they shall be washed with a mild liquid detergent solution and allowed to air dry to determine surface integrity. **(T-1)** Spray or brush the ladder rails with acrylic lacquer, epoxy or other locally approved coating sufficient to cover the exposed fibers. Following the first coat, lightly sand the fiberglass surface with "00" sandpaper, or equivalent, to smooth the glass bristles.

7.4.2.4. Ladders with defects which cannot be immediately repaired shall be removed from service and scheduled for repair or replacement**. (T-0)** Use an AF Form 979, *Danger Tag,* or commercial equivalent, to warn employees that the ladder cannot be used. If a ladder is to be discarded, remove it from the work area and cut it in half to prevent further use. Do not attempt to straighten or use a bent ladder.

7.4.2.5. Requirements Applicable to All Ladders. Refer to manufacturer's instructions. **(T-1)** Additionally, use the following OSHA requirements:

7.4.2.5.1. Inspect ladders before climbing to ensure all parts are in good condition. **(T-0)** To permit inspection, procure and maintain wood ladders with transparent finish only.

7.4.2.5.2. Store ladders in a way that provides easy access for inspection and permits safe withdrawal for use. **(T-0)** When possible, store ladders on racks. Ensure the racks have enough supporting points to keep the ladders from sagging. Do not place material on stored ladders. Store wood ladders in a location free from exposure to the elements and excessive heat or dampness.

7.4.2.5.3. Allow only one person on a portable ladder at any time, unless designed for use by two people. **(T-0)** Only ladders specially designed to support greater loads shall be used in combination with ladder jacks and scaffold planks when an operation requires more than one person. **(T-0)** Refer to **Chapter 17,** *Scaffolding,* for additional guidance. **(T-0)**

7.4.2.5.4. Always maintain three-point contact (two feet and a hand or two hands and a foot) when ascending or descending a ladder, face the ladder and maintain a firm hold on the ladder. **(T-0)**

7.4.2.5.5. Perform work requiring the use of both hands only on stepladders or platform ladders. **(T-0)**

7.4.2.5.6. Place straight and extension-type ladders in a position to have at least one foot of slope for each four (4) feet of ladder length. **(T-0)** For example, a 12-foot extension ladder must be 3 feet from the supporting structure.

7.4.2.5.7. Use ladders of sufficient length to permit employees to reach their work when standing no higher than the third rung from the top of a straight ladder, or the second step from the top of a stepladder. **(T-0) Note:** The top a stepladder is not a step and is not counted as a step when the ladder is greater than five (5) feet in length.

7.4.2.5.8. Do not carry anything that will interfere with the free use of both hands when climbing a ladder. **(T-0)** Raise material and equipment to the working position using a rope and canvas bucket or another approved method.

7.4.2.5.9. Do not stand on the top cap of trestle or combination ladders, nor the top step of stepladders. **(T-0)** Occupational safety staffs shall evaluate and provide

guidance for military-unique operations. **(T-1) Note:** Three-step aircraft ladders are exempted.

7.4.2.5.10. Do not leave ladders in place unattended. **(T-0)**

7.4.2.5.11. Do not use portable metal reinforced ladders when performing work on or near electrical equipment, but use wood or fiberglass ladders. **(T-0)** Keep them clean. Remove all surface buildup of dirt, grease or oils to avoid creating a ready path for electrical current. **(T-0)** Refer to 29 CFR 1910.333, *Electrical-Selection and Use of Work Practices*, for additional information. **Exception:** Fiberglass ladders with metal rungs are acceptable.

7.4.2.5.12. Ladders will be stored when not in use. **(T-1)** On the flightline and outdoor environments, ladders shall be laid down and secured when not in use. **(T-1)** Where possible, employees shall secure or remove the ladder to prevent unauthorized use or tripping hazards. **(T-1) Exception:** The more modern, durable, enhanced ladders such as the Little Giant© ladders can remain standing in environmentally controlled environments, e.g., hangars, spacious warehouses, etc. **(T-1)**

7.4.2.6. Additional Requirements for Extension Ladders. Refer to manufacturer's instructions and the following requirements:

7.4.2.6.1. Develop local procedures for raising and lowering the ladder, if not covered in the manufacturer's instructions.

7.4.2.6.2. To support the top of the ladder at a window opening, an approved attachment per the manufacturer of the ladder shall be attached across the back of the ladder, extending across the window to provide firm support against the building walls or window frames. **(T-1)**

7.4.2.6.3. Short ladders shall not be spliced together to provide long sections. **(T-1)**

7.4.2.6.4. Follow manufacturer's instructions for proper minimum overlap of two-section extension ladders.

7.4.2.6.5. A ladder shall not be used to gain access to a roof unless the top of the ladder extends at least three (3) feet above the point of support eave, gutter or roof line. **(T-1)**

7.4.2.6.6. Hooks may be attached at or near the top of portable ladders to provide added stability.

7.4.2.7. Personnel Training. Personnel who use ladders at any working height shall be trained in the care and use of different types of ladders. **(T-0)** The supervisor or a designated trainer shall conduct this training when an employee is first assigned. **(T-1)** Refer to paragraph **7.3.5** for additional information on ladder training. All training shall include hands-on instruction to include inspection of ladders for defects, possible electrocution hazards, proper positioning and placement of ladders for various job sites. **(T-0)** Training shall be documented IAW instructions in AFI 91-202. **(T-1)**

7.5. Stepladders.

7.5.1. A stepladder is self-supporting, nonadjustable in length, has flat steps and a hinged back.

7.5.2. Employees shall maintain three-point contact ascending or descending stepladders. **(T-0) Exception:** This requirement does not apply to stepladders under four feet.

7.5.3. Bracing on the back legs of stepladders shall not be used for climbing because it is designed solely for increasing stability. **(T-0)**

7.5.4. Stepladders shall be fully opened out and locked in position. **(T-0)**

7.6. Emergency Operations. Ladders used in emergency operations such as firefighting, rescue and tactical law enforcement operations or training for these operations, or designed into or is an integral part of machines or equipment *do not* have to meet the general requirements of 29 CFR 1910.23.

Chapter 8

ELECTRICAL SAFETY

8.1. General Information.

8.1.1. Hazards.

8.1.1.1. Refer to paragraph **1.5,** and AFI 91-202 for further information on the JHA and job safety lesson plan. **Note:** A JHA is not required when existing guidance adequately covers all safety requirements of an operation or process. Example: TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding.*

8.1.1.2. Refer to **Chapter 2,** *General Work Procedures,* and **Chapter 14,** *Personal Protective Equipment (PPE),* for additional guidance.

8.2. Receptacles. Follow National Fire Protection Association 70E, *Standard for Electrical Safety in the Workplace,* Article 245. It is not necessary to replace the cover for small cracks around the mounting screws.

8.2.1. Multiple plug adapters shall not be linked to provide additional or more convenient outlets as this could overload electrical circuits. **(T-0)** At no time shall a multiple plug adapter or strip be plugged into another multiple plug adapter or strip. **(T-0)**

8.2.2. Child Development Centers. Electrical receptacles in Child Development Centers shall comply with the requirements of UFC 4-740-14, *Design: Child Development Centers,* AND *National Electrical Code,* Article 406.12. **(T-0)**

8.2.3. Ground fault circuit interrupter (GFCI) shall be used IAW 29 CFR 1910.304(b). **(T-0)** Receptacles on a two-wire, single-phase portable or vehicle-mounted electrical generator rated not more than five (5) kilowatts (kW), where electrical generator conductors are insulated from the generator frame and other grounded surfaces, shall be permitted without GFCI protection. Receptacles shall be located outside wet process areas or protected by a GFCI. **(T-0)** To protect large areas, GFCI breakers shall be located in the circuit panel. **(T-1)**

8.2.4. Arc-fault Circuit Interrupters. Arc-fault circuit interrupters are required in certain circuits in dwelling units. Refer to *National Electrical Code,* Article 210.12 for guidance. **(T-0)**

8.3. Plugs. Follow National Fire Protection Association 70E, Article 110 (**https://codesonline.nfpaorg/code**).

8.4. Flexible Cords and Extension Cords. Flexible cords and extension cords shall only be used IAW guidance outlined in the National Fire Protection Association 70 Article 240.5(B), National Fire Protection Association 70E, Article 110.5 and as directed by 29 CFR 1910.334, 1910.305(g). **(T-0)**

8.4.1. Extension Cords.

8.4.1.1. If extension cords are used, they shall have a single connection. **Exception:** A heavy duty industrial extension cord with a multiple-outlet junction box may be utilized if the equipment wattage rating does not exceed the extension cord/circuit which it is plugged into. The wattage shall be verified. **(T-0)**

8.4.1.2. Report, replace or dispose of worn, cracked or frayed electrical extension cords, loose or broken electrical wires and worn or broken electrical plugs. Supervisors shall inspect cords frequently for signs of fraying, cracking, wear or any damage that could be an indication of possible short circuiting or overheating and for proper size/rating for the equipment it services. **(T-1)** Defective cords shall be removed from service. **(T-0)**

8.4.1.3. Electrical extension cords may be used when it is impractical to power equipment from facility wiring, such as in large hangars, flightline locations, field environments and when using electrical generators.

8.4.1.4. Only commercially procured extension cords bearing the Underwriters Laboratories or host nation equivalent certification may be used. Extension cords amperage rating must meet or exceed the amperage draw of the device being plugged into it. **(T-1)** The amperage shall be verified. **(T-0)** Extension cords may not be manufactured or altered.

8.4.1.5. Do not hang extension cords over nails, rafters or in a manner that constitutes a safety or fire hazard.

8.4.1.6. Do not place extension cords under rugs, carpets or other combustible material.

8.4.1.7. Refer to 29 CFR 1910.334(a)(2) for visual inspection requirements. **(T-0)**

8.4.2. Refer to 29 CFR 1910.334(a)(3) for grounding of tools and equipment connected by flexible cords requirements. **(T-0)** A grommet, stress relief device or National Electrical Code-approved clamp shall be installed on equipment housings to prevent abrasion of cord insulation and to prevent pull or strain put on the cord‘s internal wiring. **(T-1)** Cords used with heating appliances, such as electric irons, shall meet the requirements of 29 CFR 1910.303(b)(2). **(T-0)**

8.4.3. Users shall inspect cords frequently for signs of fraying, cracking, wearing or damage that could create a short-circuit. **(T-1)** Follow 29 CFR 1910.334(a)(2) for defective electrical equipment and cords.

8.4.4. When possible, equipment power cords shall be suspended from overhead in rigid raceways. **(T-1)**

8.4.5. When disconnecting cords, pull on the plug rather than the cord, to avoid damaging internal connections.

8.4.6. Electrical wiring/conduits shall only be used IAW 29 CFR 1910.305. **(T-0)**

8.4.7. High wattage appliances such as refrigerators, microwaves, coffeemakers, heaters, etc., shall be plugged directly into a facility outlet. **(T-1)** In foreign countries a voltage converter may be required to transform the facility power to match that of the host nation, as many times, overseas power systems operate at a higher voltage (220V) and a lower frequency (50 cycles) than the U. S. standard of 110/120 volts and 60 hertz. In this case, the voltage converter is considered the “direct connection,” or “facility outlet,” required by the guidance. Uses of these voltage converters are therefore permissible, provided neither the rated power, nor current of the transformer is exceeded.

8.4.8. Multi-receptacle surge protectors shall only be used IAW 29 CFRs 1910.303 and 1910.304. **(T-0)**

8.5. Disconnecting Means (Circuit Breakers and Disconnect Switches). Refer to National Fire Protection Association 70, Article 408.4(A), *Circuit Directory or Circuit Identification,* for circuit breakers/fuse box identification requirements. **(T-0)** For example, markings should not merely indicate "motor" or "lights," but "motor, water pump #2" or "lights, front lobby." Spare circuit breakers will be identified as "spare." Supervisors, in conjunction with the installation CE, shall ensure electrical fuse, switch and circuit-breaker boxes are marked with correct voltage, current, wattage, foreign source of power or other ratings, as appropriate. **(T-1)** Personnel shall not stand directly in front of circuit breakers or switches when activating or deactivating them. **(T-0)** Refer to UFC 3-560-01, *Operation and Maintenance: Electrical Safety,* for additional guidance.

8.5.1. Circuit breakers and disconnect switches shall clearly indicate status - open (off) or closed (on). **(T-0)** Refer to National Fire Protection Association 70, and 29 CFR 1910 Subpart S for additional guidance.

8.5.2. Circuit breakers, disconnect switches and fuses shall be readily accessible to employees and building management personnel. **(T-0)** Work space in front shall be clear and unimpeded and shall not be located where exposed to physical damage or in the vicinity of easily ignitable material. Refer to 29 CFR 1910 Subpart S for additional criteria. **(T-0)**

8.5.3. Circuit breakers shall not be taped in the "on" position. **(T-0)** Breakers that trip frequently indicate electrical problems and shall be promptly reported to CE and corrected. **(T-1)**

8.5.4. Employees shall not substitute larger fuses or breakers or use bypass wires, pennies, etc. **(T-0)**

8.5.5. If circuit breaker fails to close or immediately trips after resetting, a qualified electrical employee (electrician) shall be called to troubleshoot the circuit breaker, e.g., installation CE shall be called immediately. **(T-1)**

8.6. Guarding of Live Parts. Premises wiring shall meet National Fire Protection Association 70, Article 215. **(T-1)**

8.7. Equipment Grounding.

8.7.1. Frames of electrical motors, regardless of voltage, shall meet the requirements of 29 CFR 1910.304(g). **(T-0)**

8.7.2. Exposed noncurrent-carrying metal parts of fixed equipment that may be energized under abnormal conditions shall meet the requirements of 29 CFR 1910.304(g). **(T-0)**

8.8. Restrictions. While working on or around live electrical equipment, workers are prohibited from wearing garments with exposed metallic fasteners or flammable articles such as celluloid cap visors. Additionally, clothing shall be of the material necessary to comply with National Fire Protection Association 70E requirements. **(T-0)** Refer to paragraph **2.3** for jewelry and other metal article restrictions.

8.9. Electrical Installations and Equipment. Guidance in National Fire Protection Association 70E, 29 CFR 1910 Subpart S – Electrical, UFC 3-560-01, and AFI 32-1064, *Electrical Safe Practices,* for electrical installations and equipment shall be complied with. **(T-0)** Motor data plates shall be legible and not painted. **(T-0)**

8.9.1. Electrical Repairs. Only authorized, qualified electricians or appliance employees may install or repair electrical equipment. Work will only be performed on electrical equipment that is de-energized, locked out and tagged out IAW National Fire Protection Association 70E and AFI 32-1064. **(T-0)** Refer to paragraph **8.17** for work on energized equipment.

8.9.2. Supervisors shall ensure work areas are inspected for electrical hazards. **(T-1)** Sufficient workspace shall be provided and maintained around electrical equipment to permit safe operation and maintenance IAW 29 CFR 1910.303(g), *600 Volts, nominal, or less;* Table S-1 or 29 CFR 1910.303(h), *Over 600 Volts, nominal;* Table S-2. **(T-0) Note:** High voltage is defined as greater than 600 volts, nominal.

8.9.3. Wires shall be enclosed in an electrically-listed box or control panel. **(T-0)**

8.9.4. In locations requiring the use of special tools (e.g., non-sparking), only tools certified for those areas shall be used. **(T-0)**

8.9.5. When equipment is replaced, a renovation project is planned or new construction is performed that potentially involves more than the control electrical energy in paragraph 8.9.1, make provisions to comply with hazardous energy control requirements in **Chapter 21,** *Hazardous Energy Control.*

8.9.6. Parts of electrical equipment which ordinarily produce arcs, sparks, etc., shall not be operated or used in explosive atmospheres or in close proximity to combustible materials.

8.10. Additional Electrical Equipment Requirements.

8.10.1. Close rack/panel/control box doors at all times except as necessary to accomplish authorized repairs.

8.10.2. Operators shall open and close equipment switches quickly and positively and shall not break contact between brushes and commutators or slip rings while equipment is operating. **(T-1)**

8.11. Electronic Equipment. Turn high voltage equipment off at provided switches and disconnecting means prior to unplugging, unless authorized by applicable technical publications.

8.11.1. Use only approved solvents to clean electronics equipment. Ensure adequate ventilation and wear appropriate PPE when required by applicable guidance (e.g., SDSs, BE occupational and environmental health assessment, etc.), the installation occupational safety office or BE. Vacuuming, with a vacuum approved for the task, is an effective cleaning method. Refer to paragraph **2.4.8.8** for compressed air cleaning requirements.

8.11.2. Technicians shall not use lead pencils, screwdrivers or other unapproved tools to make radio frequency energy tests on electronic equipment as serious burns can result from arcs or faults created by these conditions. **(T-1)**

8.11.3. Personnel shall not hold meters in their hand while performing measurements on energized circuits or equipment. **(T-1)** Use non-conductive, insulated gloves or other effective PPE when necessary to hold meters or metering cables. The holder shall stand on a non-conductive mat or dry surface while using the meter. **(T-1)** Refer to paragraph **14.4.10** for additional guidance.

8.11.4. Workbenches.

8.11.4.1. Workbenches shall be kept clean at all times. **(T-1)**

8.11.4.2. When voltage is applied to equipment being repaired or tested, personnel shall ensure tools and equipment not essential to the test are removed from the bench. **(T-1)**

8.11.4.3. Ground metal workbenches used for repairing and testing electronic equipment to a low resistance ground. **Note:** See TO 00-25-234, *General Shop Practice Requirements for Repair, Maintenance, and Test of Electrical Equipment,* for electrostatic discharge control procedures.

8.11.5. Insulating Matting Specific Requirements (See 29 CFR 1910.137, *Electrical Protective Equipment*).

8.11.5.1. Insulating matting shall be used near electrical apparatus or circuits in high voltage maintenance areas as an additional safety measure to protect personnel. **(T-1)** It shall be used to protect against accidental shock only and shall not be the only means of protection when handling energized wires and circuits. TOs 00-25-234 and 00-25-232, *Control and Use of Insulating Matting for High-Voltage Application*, and MIL-DTL-15562G, *Matting or Sheet, Floor Covering Insulating for High-Voltage Applications*, provide information and instructions on control, use and marking of insulating matting. Insulating matting shall be permanently marked IAW Military-Detail Specifications (MIL-DTL)-15562G. **(T-0)**

8.11.5.2. Supervisors shall consult with installation occupational safety office to determine if insulating matting is required in their areas of responsibility. **(T-3)** This includes areas where potential shock hazards exist and additional protection is needed, floor resistance is lowered due to dampness and where high voltage (greater than 600 volts, nominal) may be encountered, such as high voltage consoles. Areas with electrical repair or test benches (shops), motors or equipment and control panels require insulating matting.

8.11.5.3. Mats shall be cleaned as necessary to prevent contamination, using domestic cleaners, such as carpet cleaners, or other locally approved cleaners required for special situations. **(T-0)**

8.11.5.4. Insulating matting shall be replaced when worn to manufacturer‘s recommended replacement requirements. **(T-0) Note:** Shoes with nails, spikes or cleats shall not be worn on insulating matting. **(T-0)** Penetration of spikes or cleats to the floor can make the matting ineffective.

8.11.5.5. Insulating matting in front of and around electrical workbenches, high voltage cabinets, switch panels, etc., shall be one continuous length or strip. **(T-1)** Where possible, matting shall continue 24 inches beyond the end of the equipment. Overlapping at corners is not required if it produces a tripping hazard. If more than one run or strip of matting is required, the activity supervisor shall determine the amount needed. **(T-1)**

8.11.5.6. Insulating matting shall not be used for nonskid applications such as walkways, hall runners, in front of work benches (non-electric) on work-and-test benches, etc. **(T-0)** General purpose low-cost matting shall be used as it is, and is satisfactory for areas where shock protection is not required. **(T-0)** No certification for use of general purpose matting is required.

8.11.6. Use stools made of fiberglass or other non-conductive materials when working on electrical or electronic equipment.

8.11.7. Supervisors shall establish procedures requiring all accessories used with electronic and electrical equipment be serviceable and safe for use. **(T-1)** Supervisors shall also establish procedures to eliminate or control all hazard potentials to a safe acceptable level. **(T-1)**

8.12. Emergency Equipment (Electrical Safety). In addition to electrical PPE provided to employees, functional managers shall ensure emergency equipment is available at each operating location where maintenance is performed on energized circuits. **(T-1)** High voltage is defined as over 600 volts, nominal. Equipment variations depend on local conditions and the squadron commander or functional manager may add additional items. The equipment may be displayed on a board, stored in an unlocked cabinet or made available in a portable kit, and shall be situated in a conspicuous and prominent location at each site, well-marked and readily accessible IAW 29 CFR 1910.151, *Medical Services and First Aid.* **(T-0)** Equipment shall be protected against chemical, mechanical or environmental deterioration and shall be inspected or tested for serviceability IAW 29 CFR 1910.335, *Safeguards for Personal Protection.* **(T-0)** Emergency equipment shall consist of: **(T-1)**

8.12.1. Safety operating instructions (OI) or procedures for the site. **Note:** If the FES Flight's emergency medical teams are rapidly available and the installation medical clinic operates on limited hours, contact the FES Flight emergency medical teams. **(T-2)**

8.12.2. Cardiopulmonary resuscitation (CPR) instructions.

8.12.3. CPR facemask with disposable mouthpiece.

8.12.4. Emergency phone numbers and building number.

8.12.5. First aid kit provided by the unit. This item is required for work performed in remote locations away from emergency responders. Installation medical treatment facility (MTF) can provide recommendations on contents of the first aid kit. **Note:** IAW OSHA's letter of interpretation for paragraph 1910.151(b) explains that a first aid kit is required if a medical facility is more than three to four minutes away.

8.12.6. Disposable gloves, impervious to body fluids, for first aid use.

8.12.7. Nonconductive cane or hook with insulated handle (with less than 180 degrees of bend).

8.12.8. High voltage insulated lineman's rubber electrical gloves (both inner and outer gloves) if rescuer(s) is (are) likely to contact live wires, conductors or current carrying parts while performing rescue. Voltage rating shall be suitable for voltages encountered in the work area. **(T-1) Note:** Electrical gloves shall be checked before use IAW UFC 3-560-01, and American Society for Testing Materials F496-85, *Specification for In-service Care of Insulating Gloves and Sleeves,* and shall be tested and marked with the next test due date. **(T-0)** This may be accomplished as a step in a JHA prior to the work day or as a step in a unit's daily or weekly work preparation.

8.12.9. A 15-foot length of natural fiber rope, preferably 1/2 or 5/8 inch diameter. **Note:** Synthetic rope may melt or burn quickly when exposed to an electric arc, heat or flame.

8.12.10. Insulated fuse pullers, where required.

8.12.11. Flashlight with nonmetallic case in operating condition.

8.12.12. Grounding stick (shorting stick).

8.12.13. Wool blanket(s), for extinguishing clothing fires and keeping injured person warm.

8.12.14. Appropriate portable emergency signs constructed of nonconductive materials, such as AF Visual Aids (AFVA) 91-303, *DANGER—DO NOT ENERGIZE—PERSON WORKING ON ANTENNA*; (AFVA) 91-304, *DANGER—DO NOT ENERGIZE—WORK IN PROGRESS ON EQUIPMENT*; (AFVA) 91-305, *DANGER—INTERLOCKS DISABLED*; and (AFVA) 91-306, *DANGER—HIGH VOLTAGE*, are available through Air Force Publications web site at **http://www.e-publishing.af.mil**. Refer to **Chapter 29,** *Mishap Prevention Signs and Tags,* for information on safety signs and tags.

8.12.15. Optional site-specific items (rescue breather; insulated lineman‘s gloves, etc.). **Note:** Protect electrostatic sensitive components and equipment IAW TO 00-25-234.

8.13. Automated External Defibrillator. An automated external defibrillator, approved by the installation medical services and training for proper use, may be required if work performed in remote locations away from emergency responders. **Note:** Remote location is defined as emergency care that is more than three to four minutes from the workplace.

8.14. Lighting. Consult installation CE facility design office for specific guidance on lighting. Control of light is important to avoid glare and harsh shadows. Soft shadows are usually acceptable, but harsh shadows shall be avoided since they may obscure hazards or interfere with visibility. **(T-1)**

8.15. Moisture Guarding. Refer to 29 CFR 1910.305, *Wiring Methods, Components, and Equipment for General Use,* for additional guidance.

8.16. Under-voltage Protection. Machines not adequately safeguarded to protect the worker during under-voltage situation or a power failure shall have an under-voltage device installed. **(T-0)** This device prevents the machine from starting up after a power interruption, exposing the worker to the hazards of moving parts.

8.17. Work on Energized Equipment.

8.17.1. Electrical circuits and equipment shall be de-energized before being worked on. **(T-0)** When authorized by the commander, applicable technical data or manufacturer‘s instructions, work may be performed on energized circuits and equipment as necessary to support a critical mission, prevent injury to personnel or to protect property. A qualified electrician checking for the presence of voltage is not considered energized work. For energized work refer to AFI 32-1064, and UFC 3-560-01 for task specific required number of qualified electricians. Depending on the task, one member of the two or three person team shall act as safety observer. **(T-1)** All employees shall be trained in CPR and equipment shutdown procedures and responsible for immediate assistance in an emergency. **(T-0)** Install electrical equipment IAW guidance contained in National Fire Protection Association 70, UFC 3-560-01, and AFI 32-1064. **Note:** Supervisor may be safety observer.

8.17.2. Additional PPE for Work on or Near Energized Equipment. Refer to *National Electrical Code,* Sections 130.3. and 130.7., and UFC 3-560-01, Table 4.1., *PPE Criteria,* for additional guidance.

8.17.2.1. A rubber insulating blanket or other suitable guards shall be used when necessary to work adjacent to energized circuits. **(T-0)**

8.17.2.2. Arc flash protection shall be provided for all Air Force operations exposing personnel performing duties on or in proximity of energized parts operating at 50 volts or more. **(T-0)** Protective clothing required, if any, shall be based on the procedures outlined in UFC 3-560-01, National Fire Protection Association 70E and AFI 32-1064. **(T-0)**

8.17.2.3. Individuals required to work on or near (within 8 feet of) exposed energized equipment over 50 volts shall wear long sleeved, Arc Thermal Performance Value-rated PPE IAW UFC 3-560-01. **(T-0)**

8.17.2.4. Individuals operating or servicing electrical switch-gear over 15 kV shall wear an appropriately Arc Thermal Performance Value-rated blast suit with hood and polycarbonate face shield. **(T-0)** Sheet metal and gypsum building materials do not provide the required minimum level of blast protection.

8.17.2.5. Clothing shall follow requirements of UFC 3-560-01. **(T-0)**

8.17.2.6. Any tools, e.g., hot sticks, insulating rubber sleeves, used as part of the task must follow the requirements of AFI 32-1064 and UFC 3-560-01. **(T-0)**

8.17.2.7. For additional guidance on working on energized equipment, refer to UFC 3-560-01, and AFI 32-1064, *Electrical Safe Practices*.

8.17.3. Work Near Energized Equipment. Refer to UFC 3-560-01 and AFI 32-1064 for additional guidance on working near energized equipment.

Chapter 9

EMERGENCY SHOWER AND EYEWASH UNITS

9.1. Scope. This chapter addresses selection, acquisition, location, installation, maintenance, testing and use of emergency shower and eyewash units. Also included are performance specifications for both permanently-installed and self-contained units. Types of equipment covered are emergency showers, eyewash units, eye and face units, combination units, hand-held drench hoses and eyewash bottles.

9.2. OSHA Requirements.

9.2.1. General Requirements. IAW 29 CFR 1910.151(c) and 29 CFR 1926.50(g), Medical Services and First Aid, where the eyes or body of any employee may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of eyes and body shall be provided in the work area for immediate emergency use. **(T-0)**

9.2.2. Specific Requirements.

9.2.2.1. Storage and Handling of Anhydrous Ammonia. See 29 CFR 1910.111.

9.2.2.2. Telecommunications. See 29 CFR 1910.268.

9.2.2.3. Batteries and Battery Charging. See 29 CFR 1926.441(a)(6).

9.3. Equipment - Acquisition. Emergency shower and eyewash equipment may be locally and centrally procured. The procuring document shall include a requirement that the manufacturer has documented that their equipment meets or exceeds American National Standards Institute/International Safety Equipment Association Z358.1, *Emergency Eyewash and Shower Equipment*, specifications. **(T-1)** Each request for emergency showers and/or eyewashes shall be evaluated by the installation Occupational Safety and BE offices to determine the need for the installation and proper location of units. **(T-1)** Rationale for decisions shall be documented and maintained by the respective owner. **(T-1)** The type of material used, its properties, how the material is dispensed, probability of injury, extent of potential injury and PPE available and used shall be considered in determining the need for the units. **(T-0)**

9.4. Maintenance and Testing.

9.4.1. Permanently-installed shower and eyewash units shall be activated by the supervisor or employee per manufacturer's instruction to verify proper operation. **(T-1)** If the manufacturer's instructions are not available, then the units will be activated weekly. **(T-1)**

9.4.2. The supervisor or employee shall inspect permanently-installed unit(s) monthly IAW manufacturer's instructions and document the inspection when completed. **(T-1)** Documentation shall be maintained to show date of inspection and name of individual performing the test. **(T-0)** This documentation may be kept in a log, computerized or affixed to the equipment by tag or label. **Exception:** Units installed at missile sites, not permanently manned, shall be tested and documented by the team chief during the most frequently performed periodic inspection established for that system. **(T-1)**

9.4.3. Self-contained units shall be tested and inspected IAW the manufacturer's instructions. **(T-0)**

9.4.4. Eyewash bottles shall have instructions and expiration dates, if applicable, permanently affixed to the unit. **(T-0)** They shall be tested, refilled, maintained and disposed of IAW the manufacturer's instructions. **(T-0)**

9.4.5. All units shall be inspected by the installation Occupational Safety office during the annual facility/workplace inspection for proper placement, installation and documentation of supervisory testing and operation. **(T-1)** Inspection personnel shall also randomly check employees to determine if they have adequately trained on the use of emergency equipment. **(T-1)**

9.4.6. Installed units that no longer meet the criteria of the manufacturer's instruction shall be evaluated by the installation occupational safety office for replacement or upgrade. **(T-1)**

Chapter 10

GROUNDS, MOWING AND AGRICULTURE TRACTORS

10.1. General Information. Personnel involved with landscape and grounds maintenance shall observe all safety precautions in this chapter and those recommended by the manufacturers of the equipment. **(T-0)** Always read/comprehend the owner's manual/instructions before operating any type of equipment.

10.1.1. Training. Supervisors shall ensure employees are trained, using manufacturer's manual/instructions, lesson plans, or JHA, prior to the operation of any type of equipment. **(T-0)** Supervisors will provide such instruction at time of initial assignment and refresher training, as required. **(T-0)** Specific requirements for training, licensing and/or certification of equipment operators will be documented IAW AFI 24-301, *Vehicle Operations*. **(T-1)**

10.1.2. PPE is determined through an evaluation of the hazards by the supervisor in consultation with the safety office and BE, and entered into the work center Job Safety Training Outline.

10.1.3. Guard all mower discharge chutes with shields or approved grass catchers to deflect or stop foreign objects being thrown and to prevent operator contact with the blade. **(T-0)** Refer to 29 CFR 1910.243., *Guarding of Portable Powered Tools*, for further guidance on the operation and maintenance of powered lawn equipment.

10.1.4. Use boards and ramps of the appropriate size and construction for the weight of the equipment to be loaded and unloaded from vehicles or trailers.

10.1.5. Always refuel equipment with the engine off and allow the engine to cool first. Do not permit smoking in the area. Refuel equipment prior to use instead of refueling before storing inside a building. Complete refueling outside at least 25 feet away from the building and any open flame source.

10.1.6. Operations during inclement weather will adhere to established policies. **(T-2)** Additional weather information may be found in **Chapter 3,** *Weather Safety*.

10.1.7. When traveling on public roads, highways, local and state vehicle codes shall be used. **(T-0)** Slow- moving vehicle emblems shall be used IAW 29 CFR 1910.145(d)(10). **(T-0)**

10.2. Inspection/Maintenance. The operator shall walk around the equipment and inspect for faults prior to initial setup/use and prior to initial startup on each shift. **(T-0)** The AF Form 1800, *Operator's Inspection Guide and Trouble Report*, or other prescribed form shall be used as an inspection checklist and signed by the operator prior to use. **(T-1)** Manufacturer's procedures or technical data will be used to service or maintain the equipment. **(T-0)**

10.3. Mowing. Maintenance of installation grounds involves various sizes and types of lawnmowers. The two basic mower types are reel (several helical blades rotating around a horizontal shaft) and rotary (one or more knife like blades attached to a vertical shaft). They may be pushed, self-propelled, ridden or towed. If equipped with a fuel shutoff valve, shut off the fuel supply line when parking mowers at the end of the duty day. When possible, leave one to three feet separation space between parked gasoline-operated riding mowers. Never use electric mowers and grass trimmers while it is raining or the grass is wet, excluding light dew. Ensure electric mowers, trimmers and attached extension cords are effectively grounded. **(T-0)** However, listed

or labeled portable tools protected by an approved system of double insulation, or its equivalent, need not be grounded.

10.3.1. Ensure powered mowers (push or self-propelled) riding-rotary, converted sulky and reel power lawnmowers meet design specifications in 29 CFR 1910.243 and American National Standards Institute B71.1. **(T-0) Note:** Manufacturer's specifications identifies if the powered mower meets the requirements of American National Standards Institute B71.1. Deadman controls will not be disabled. **(T-0)**

10.3.2. Prior to mowing, operators shall clear the area of all people and inspect for foreign objects, raised sprinkler heads, holes, soft ground, obstructions or any other condition that could have impact on a safe operation. **(T-1)**

10.3.3. Operators shall never pull the mower backwards while the engine is running; the safety guard on the back may lift the mower off the ground and injure the operator. **(T-1)**

10.3.4. Always mow in a horizontal direction across the face of a steep slope, e.g., hills or banks exceeding a 30-degree angle, and keep firm footing at all times. **(T-0)**

10.3.5. Stay clear of the front of self-propelled mowers during and after starting. Control the mower by hand pressure on the handle, not by foot pressure on the housing.

10.3.6. Do not attempt to clean grass from the chute when the mower is running.

10.3.7. Follow manufacturer's instructions when cleaning, repairing or inspecting the mower.

10.4. Edgers. Guards will always be checked prior to the operation to ensure they are in place. **(T-0)** Edgers will not be used when people are in line with the cutting blade discharge pattern. **(T-1)** Follow manufacturer's instructions when cleaning, repairing or inspecting the edger.

10.5. Commercial Mowing and Turf Care Equipment. Commercial mowing and turf care equipment are used for mowing and maintaining areas too large or rough for residential type mowing equipment, but not large enough to warrant an agricultural tractor mower (described in paragraph 10.9). Commercial mowing equipment shall meet requirements in American National Safety Institute B71.4., *Commercial Turf Care Equipment - Safety Specifications*. **(T-0)** Operators shall read the owner's manual before operating the equipment. **(T-1)**

10.5.1. If commercial mowers are used in areas where they can exceed the maximum slope allowed by the manufacturer, a Rollover Protective Structure and seatbelt shall be installed IAW manufacturer's guidance and used whenever the vehicle is in motion. **(T-0)**

10.5.2. While operating gang reel mowers on a slope, raise the upper reels as a counterbalance to prevent the mower from sliding or turning over. Ensure special equipment designed for steep hills or grades is available or employees can cut by hand using manual tools. **(T-1)**

10.6. Tree and Hedge Trimming. Supervisors shall complete a JHA for both routine and emergency tree maintenance operations. **(T-1)** Critical elements with serious potential to affect employee's safety, such as tree climbing, tree cutting and removal, trimming near electrical lines, use of chain saws, use of high-reach lifts and use of cutters or chipper equipment, shall be included. **(T-1)** Workers shall be trained for emergency conditions, such as adverse weather. **(T-0)** All workers shall receive training in emergency rescue and life-saving first aid techniques, and fall protection/prevention. **(T-1)** Refer to 29 CFR 1910.269, *Electric Power Generation, Transmission, and Distribution*, for additional guidance.

10.6.1. PPE is determined through an evaluation of the hazards by the supervisor in consultation with the safety office and BE, and entered into the work center Job Safety Training Outline.

10.6.2. Two or more employees and an on-site job supervisor, fully qualified in tree maintenance, shall be assigned when routine tree maintenance involves climbing, working from a high reach lift, and while cutting down any tree other than small low trees that would pose no hazards to people, facilities and utility lines. **(T-2)** The area around trees being trimmed or cut and in the vicinity of operating chippers and stump grinders shall be effectively guarded with barricades or identified with cones or streamers to warn personnel against the danger of entry. **(T-0)**

10.6.3. Fall Protection. Fall protection equipment, ropes, D-rings, cutting tools, equipment and climbing gear shall be inspected to ensure it is in safe condition prior to each use. **(T-0)** Any equipment or climbing gear that is frayed, worn, broken or defective shall be removed from service immediately. **(T-0)** Each climber shall have at least one lifeline and one handline, normally nylon, 1/2 inch by 125 feet. **(T-0)** At least 2 – 3/4 inch polypropylene or equivalent lines (250 feet long each) shall be provided for each crew. **(T-0)** The nominal breaking strength of 1/2 inch ropes used for climbing shall not be less than 2,385 pounds. **(T-0)** Climbing and safety ropes shall not be spliced for repair or added length. **(T-0)** The ends of ropes shall be wrapped to prevent fraying. **(T-0)** A climbing rope shall always be used, even when work is performed from a ladder or lift device. **(T-0)** Refer to **Chapter 13,** *Fall Protection,* for additional fall protection requirements.

10.7. Fertilizers.

10.7.1. Fertilizers can become a combustible material and may explode if stored at temperatures over 130° F. When fertilizers become wet and start to decompose, they give off gas that will burn. Some fertilizers also give off toxic gases when burning. The installation FES shall be notified of any evidence of heating, smoking, combustion or fire in fertilizer. **(T-1)** IAW National Fire Protection Association 490, no more than 60 tons of fertilizer (mixtures containing 60 percent or more by weight of ammonium nitrate) shall be stored in a location unless the location and storage facility have been approved by the installation FES. **(T-0)**

10.7.2. When spreading fertilizer, pellets shall not be directed toward anyone. **(T-0)** If personnel enter the area, the spreader shall be turned off. **(T-0)** Fertilizer spreaders shall be cleaned and lubricated daily. **(T-0)** Safety glasses and gloves shall be worn during fertilizing spreading operations. **(T-0)**

10.8. Irrigation Systems. Irrigation systems may involve hazards related to trenching and shoring, confined spaces and/or hazardous energy control. For requirements, refer to 29 CFR 1926, Subpart P – Excavations, 29 CFR 1910.146, *Permit Required Confined Spaces,* and 29 CFR 1910.147, *Hazardous Energy Control (LOTO),* and **Chapter 21,** *Hazardous Energy Control.*

10.9. Agricultural Tractors and Implement Attachments. An agricultural tractor is a two or four-wheel drive or tracked vehicle of 20 or more horsepower designed to furnish the power to pull, carry, propel or drive implements designed for agriculture. **Note:** While some commercial mowing equipment may exceed 20 horsepower, they are not designed as agricultural tractors and fall under guidance in paragraph **10.5**

10.9.1. Rollover Protection. Agricultural tractors with engines exceeding 20 horsepower shall be fitted with Rollover Protective Structure. **(T-0)** If a tractor is not equipped with Rollover Protective Structure, it shall not be operated on sloped areas. **(T-0)** Rollover Protective Structure-equipped tractors shall pass field upset tests (side and rear) specified in 29 CFR 1926.1002, *Protective Frames (ROPS) for Wheel-Type Agricultural and Industrial Tractors Used in Construction*, which shall be indicated by a manufacturer's label permanently attached to the Rollover Protective Structure. **(T-0)** Where a suspended (e.g., air ride or shock absorber equipped) seat is used, the seatbelt shall be fastened to the movable portion of the seat to accommodate the ride motion of the operator. **(T-0)** Seatbelts shall not be worn while operating tractors not equipped with Rollover Protective Structure. **(T-0)**

10.9.2. Procurement. Agricultural tractors procured for the Air Force shall meet the requirements of 29 CFR 1928.51, *Rollover Protective Structures (ROPS) for Tractors Used in Agricultural Operations*, and military specifications. **(T-0)** Where commercially available, agricultural tractors and implement attachments shall be purchased with noise levels at the operator position of less than 85 Decibels-A-Weighted (dBA). **(T-0)**

10.9.3. Training. Every employee who operates an agricultural tractor shall be trained in safe operating procedures and practices dictated by the work environment IAW the Commander's approved training program. **(T-0)** A training plan shall be developed and, at a minimum, shall include all attachments used by the organization and a copy of the most recent noise hazard survey conducted IAW DoDI 6055.12, *Hearing Conservation Program*. **(T-0)**

10.9.4. Hazardous Noise Warnings. If the noise level at the operator position as determined by the noise hazard survey is 85 dBA or greater, tractors shall be marked with a placard stating: "*Caution – Hazardous Noise – Operator Ear Protection Required*." **(T-0)**

10.9.5. Vehicle Emblems. Each agricultural tractor shall have a "*Slow Moving Vehicle*" emblem affixed on the rear that is clearly visible to all traffic approaching the tractor from the rear. **(T-0)** Care shall be exercised to prevent obstructing the rear view of the operator. **(T-1)** Agricultural tractors operated in high traffic areas and at night shall also be equipped with a flashing amber caution light to ensure visibility of the tractor from all directions. **(T-0)** Tractors operating at night shall have headlights installed and used during hours of darkness. **(T-0)**

10.9.6. Guarding and Shielding. All power take-off shafts, including rear-, mid-, or side-mounted shafts, shall be shielded to protect employee from contact with moving machinery parts. **(T-0)**

10.9.6.1. Guards shall be capable of withstanding 250 pounds of force applied downward or inward. **(T-0)**

10.9.6.2. Guards shall be free of burrs and sharp edges or corners, and shall be securely fastened to the equipment. **(T-0)**

10.9.6.3. Guards may be removed for servicing or adjusting attachments only after the tractor has been stopped, the motor shut off, and all shafts, pulleys, and gears have ceased rotating, except where machinery must be running to be properly serviced or maintained. **(T-0)** Guards shall be reinstalled prior to restart of the equipment for operation. **(T-0)**

10.9.6.4. Fenders are guards for employee's protection and shall be kept in place at all times except when servicing. **(T-0)**

10.9.7. Agricultural tractors and implement attachments may be "field modified" for uses other than those intended by the manufacturer when the modification has been certified in writing by the manufacturer or equivalent entity. The manufacturer or equivalent entity must certify the safety of the modified equipment has not been compromised during modification.

10.9.8. Sickle-bar mower blades shall be positioned on the high side of the slope so the pull of gravity will not cause the tractor to turn over. **(T-0)**

10.9.9. Special Considerations for Agricultural Tractors. Riders shall not be allowed on tractors, the draw bar or towed equipment, except where the equipment is specifically designed to allow riders. **(T-0)** Operators shall avoid obstacles on the ground and overhead. **(T-1)** Speed shall be reduced with heavy loads when vision is limited or when operating on rough terrain. **(T-1)**

10.9.9.1. Airfield Operations. When an agricultural tractor is on or in the vicinity of the flightline, a "Slow Moving Vehicle" emblem shall be affixed on the rear that is clearly visible to all traffic approaching the tractor from the rear. **(T-0)** Tractors shall remain in contact with the tower at all times. **(T-1)** Operators shall coordinate with Airfield Management to remediate any foreign object damage (FOD) created by the use of equipment on/near the flightline. **(T-1)** Refer to **Chapter 24,** *Aircraft Flightline – Grounds Operations and Activities,* for further guidance.

10.9.9.2. Operators shall be especially alert when operating over rough ground and limited access areas, and shall reduce vehicle speed when operating on sloping terrain. **(T-1)** Mowing operations shall not be performed on slopes at or greater than a 4-inch (20-25°) drop or rise per foot of travel. **(T-0)** When the operator is in doubt as to the degree of slope, the operation shall cease until the degree of slope is confirmed. **(T-1)** When using a sickle bar to mow slopes, the sickle bar shall be placed on the up-slope side of the tractor. **(T-0)** Lower gears shall be used when going downhill and the wheels shall be allowed to control the tractor speed. **(T-0)**

10.9.9.3. Operators shall park tractors on level surfaces. **(T-1) Exception:** Tractors shall only be left on an incline after the engine has been turned off, gear shift has been placed in the park position (or the lowest gear if standard transmission), and the wheels have been braked and blocked. **(T-1)** The implement attachment shall be lowered to rest on the surface. **(T-0)** After the engine has stopped, the transmission shall be placed in low or reverse. **(T-0)** Automatic transmissions shall be placed in "park" and the engine shall be shut off before the operator dismounts from the tractor or makes adjustments to either the tractor or towed equipment. **(T-0)** For flex-winged mowers, ensure the appendages are folded in the—up position and the locking pins are securely in place. **(T-0)** Steps and platform shall be kept clean of debris. **(T-0)**

10.9.9.4. Increasing engine speed or fastening a post to the rear wheels greatly increases the chances of tipping over backward; therefore, these methods shall not be used. **(T-1)**

10.9.9.5. When pulling a load, operators will hitch only to the draw bar. **(T-0)** The draw bar hitch shall be kept between 13 and 17 inches off the ground. **(T-0)** When moving a front load, the load shall be kept low to the ground and the rear wheels as level as possible. **(T-0)**

Chapter 11

HAND TOOLS, PORTABLE POWER TOOLS AND MACHINERY

11.1. General Requirements.

11.1.1. Tool Procurement. Specific criteria for tool use shall be contained in technical data requiring use of the tool. **(T-1)** Refer to TO 32-1-101, *Use and Care of Hand Tools and Measuring Tools*, for additional guidance and information on tools and equipment. Portable powered tools shall conform to military specifications (Mil Specs), if available. **(T-0)** If Mil Specs applicable to a portable powered tool have not been published, the procuring document shall include a requirement for the tool to meet or exceed requirements in 29 CFR 1910.243, *Guarding of Portable Powered Tools*, and 29 CFR 1910.304, *Wiring Design and Protection.* **(T-0) Note:** When possible, low noise power tools or tools with noise reduction attachments shall be utilized. Additionally, tools should be selected that minimize operator's exposure to noise, vibration and awkward positions.

11.1.2. Machinery Acquisition. Machines and attachments may be locally and centrally procured. Newly acquired machines shall meet the design and construction requirements identified in Mil Specs. **(T-0)** Machines design, foundation requirements, attachments and safety guidance are found in 29 CFR 1910.212, *General Requirements for all Machines.* OSHA standards in **Table 11.1** will be used when no Mil Specs exist. **(T-0)** If a machine is not specifically covered by this standard, a Mil Spec or an OSHA standard, the installation occupational safety office shall be contacted for assistance in identifying applicable criteria. **(T-1)**

11.2. Tools.

11.2.1. Hand Tools.

11.2.1.1. IAW 29 CFR 1910.242, *Hand and Portable Powered Tools and Equipment, General*, and 29 CFR 1926.302, *Tools-Hand and Power, General*, supervisors are responsible for the safe condition of tools and equipment used by employees.

11.2.1.2. Refer to paragraph **2.4.8.8** for compressed air cleaning requirements.

11.2.1.3. Supervisors and employees shall frequently inspect all hand tools used in the operations under their supervision. **(T-1)** Defective tools shall be immediately removed from service. **(T-0)**

11.2.1.4. Employees carrying hand tools while on ladders, scaffolds, platforms or work stands shall use carrying bags, e.g., shoulder bags or backpacks, or tool belts for tools that are not in use. **(T-0)** Employees shall not intentionally drop tools from elevated surfaces or throw tools to each other. **(T-0)**

11.2.2. Non-powered Hand Tools.

11.2.2.1. Screwdrivers. Screwdrivers shall not be used as a prying tool, punch, wedge, chisel, punch bar, nail puller or be struck with a hammer. **(T-0)** If the tips of any screwdriver or special fastener are worn or misshaped they shall be repaired or replaced. **(T-0)**

11.2.2.2. Chisels and Punches. Chisels shall be kept sharp with the edge ground true. **(T-0)** Cold chisels and punches with mushroom heads shall not be used. **(T-0)** A chisel or punch holding device shall be used when working space permits. **(T-0)** The angle of cut shall be away from the body. **(T-0)** Safety goggles shall be worn when using a chisel, punch or an alignment drift. **(T-0)**

11.2.2.3. Wrenches. Damaged, bent or broken wrenches, including those with sprung jaws, shall not be used. **(T-0)** Wrenches shall not be struck with a hammer unless designed for this purpose. **(T-0)** Worn box wrenches or sockets shall be replaced. **(T-0)**

11.2.2.4. Hammers. A hammer of suitable design, size and weight for the task shall be used. **(T-0)** Hammers with loose or damaged handles shall not be used until the handle is repaired/replaced. **(T-0)** A hammer shall be discarded if it shows dents, cracks, chips, mushrooming or excessive wear. **(T-0)**

11.2.2.5. Saws. Crosscut saws shall be used for cutting (wood or lumber) across the grain, ripsaws for cutting with the grain and hacksaws for cutting metal. **(T-0)** Saws with broken teeth or broken or cracked handles shall not be used. **(T-0)** Saw teeth shall be kept sharp and well set to prevent binding. **(T-0)** If a saw binds while cutting, the employee shall not attempt to force it through the stock. **(T-0)** If the saw sticks in damp or gummy wood, a small amount of oil or paraffin applied to the blade will make it cut smoothly.

11.2.2.6. Pliers, Hand Snips and Cutters. Pliers are designed for gripping and cutting operations and shall not be used as a substitution for a wrench or any purpose for which it was not intended. **(T-0)** Hand snips are designed for cutting sheet-metal. Hand snips shall not be hammered on to make a cut. **(T-0)** Cutters are designed for use on wire, rods or bolts, and shall not be used to pull nails or as a pry bar. **(T-0)**

11.2.2.7. Knives. Hook-bill knives, utility knives or other similar extremely sharp knives, when not in use, shall be stored in a holder or sheath. **(T-0)** Employees shall always cut away from their body. **(T-0)** Hacking motions shall not be applied when cutting. **(T-0)** Jackknives, multipurpose tools or pocketknives with locking capability shall be removed from service when the locking mechanism is inoperative. **(T-0)**

11.2.2.8. Crowbars and Wrecking Bars. Makeshift bars, such as pipes or other metal objects, shall never be used in place of crowbars and wrecking bars. **(T-0)** Crowbars shall have a point or toe to grip the object to be moved and a heel to act as a pivot or fulcrum. **(T-0)** A block of wood may be used under the heel to prevent the crowbar from slipping and injuring the user or fellow employees. Damaged crowbars shall not be used. **(T-0)** Case-hardened steel tools shall never be used to strike crowbars or wrecking bars. **(T-0)** Only plastic, wood or soft metal objects shall be used to hammer on pry-type bars. **(T-0)**

11.2.2.9. Files. Files shall never be cleaned by being struck against a vise or other metal object, because they chip and break easily. **(T-0)** They shall not be used as a pry bar. **(T-0)** Broken files shall be discarded and not made into a center punch, chisel or other type of tool, since the hardened steel may fracture in use. **(T-0)** Supervisors shall ensure defective handles are replaced immediately. **(T-0)**

11.2.2.10. Shovels, Rakes, Ice Chippers and Sod Lifters. None of these tools shall be used as prying tools. **(T-0)** Replace defective handle immediately. These tools shall be properly stored when not in use. **(T-0)** When shovels, rakes, hoes and similar tools are not in use at

the job site, they shall be positioned where the working surface cannot be stepped on. **(T-0)**

11.2.2.11. Chains. The chain shall be inspected before and after each use. **(T-0)** The chain shall not be held in the hand when pressure is applied, nor shall an employee stand closer than one-half the length of the chain when the chain is under tension. **(T-0)**

11.2.3. Portable Power Tools. See 29 CFR 1910 Subpart P for detailed information.

11.2.3.1. Electric power tools shall either be of the approved double-insulated type or grounded IAW with 29 CFR 1926, Subpart K, Electrical. **(T-0)** The use of electric cords for hoisting or lowering shall not be permitted. **(T-0)**

11.2.3.2. Extension Cords. Refer to **Chapter 8,** *Electrical Safety,* for information on extension cord requirements for electric power tools. **Note:** Consideration may be needed for portable power tools purchased in host nations where Underwriters Laboratories and/or National Fire Protection Association 70 are not recognized.

11.2.3.3. Use of GFCI devices is recommended with handheld power tools such as routers, planers and shears. Refer to 29 CFR 1910.304 for additional information.

11.2.3.4. Fire Hazards. Electric power hand tools shall not be used near flammable materials or in explosive atmospheres unless approved to meet *National Electrical Code* requirements for the type of area and atmosphere in which the tool is to be used. **(T-0)**

11.2.3.5. Grounding. All portable electric tools with exposed metal parts shall be grounded IAW the *National Electrical Code* to prevent electric shock. **(T-0)** Approved three-wire cords shall be used to effectively ground these tools. **(T-1)** The ground prong of a three-wire plug shall never be removed. If a cord is found with the ground prong removed, it shall be removed from service, rendered unusable and turned in for repair or replacement. **(T-0)** Refer to 29 CFR 1910.304 for additional information.

11.2.3.6. Damp or Wet Locations. Electric powered tools used in damp or wet locations, such as in tanks, boilers or outdoors, shall be grounded, unless double insulated. **(T-0)** GFCI devices shall be used IAW the *National Electrical Code*. **(T-0)** Refer to 29 CFR 1910.304 for additional information.

11.2.4. Powder-actuated tools. Powder-actuated tools shall meet the requirements of 29 CFR 1926.302(e) and American National Standards Institute 10.3, *Safety Requirements for Explosive-Actuated Fastening Tools.* **(T-0)** Employees using powder-actuated tools shall pass a written and hands-on practical use examinations. Employees shall carry their certification card while using these tools. **(T-0) Note:** Storage of powder-actuated shells may require an explosive storage license. Contact the installation weapons safety office for guidance.

11.3. Machinery. Refer to 29 CFR 1910, Subpart O, *Machinery and Machine Guarding,* for additional guidance.

11.3.1. Safe Operations.

11.3.1.1. Supervisors will maintain manufacturers‘ manuals for all machinery or equipment under their control. **(T-1)** In the absence of these, supervisors shall develop JHAs and local OIs. This includes job safety, maintenance (e.g., cleaning and sanitizing), lubrication and inspection. **(T-1)** Identify location of training instructions (manufacturer’s

manuals, JHAs or local OIs) in the workcenter Job Safety Training Outline. Ensure only authorized employees operate and maintain shop equipment. **(T-0)** Refer to 29 CFR 1910.212., and 1910.263., *Bakery Equipment,* for additional information.

11.3.1.2. Supervisors shall periodically evaluate machinery or equipment operators to ensure they are following proper and safe operating procedures. Machines shall be used only for work within the rated capacity specified by the machine manufacturer. **(T-0)**

11.3.1.3. Machines shall not be operated unless all guards are securely in place and operational. **(T-0)** Any time guards are to be removed, follow HEC procedures. Refer to 29 CFR 1910.212, 29 CFR 1910.147, *The Control of Hazardous Energy (Lockout/Tagout),* and **Chapter 21,** *Hazardous Energy Control.*

11.3.1.4. Employees operating, helping or observing machine operations shall comply with PPE requirements for each particular machine and work area. **(T-0)** Refer to 29 CFR 1910.132, *Personal Protective Equipment,* and **Chapter 14,** *Personal Protective Equipment (PPE),* for additional information.

11.3.1.4.1. Machine operators or other personnel in close proximity to machines/equipment shall not wear loose fitting clothing, neckties, rings, bracelets, etc.

11.3.1.4.2. Hair nets or caps shall be worn to keep long hair under control and safely away from moving machinery, power transmission apparatus or moving parts. **(T-0)**

11.3.1.5. The operator shall allow all moving parts to come to a complete stop before any attempt is made to clean or clear jammed work or debris from any part of a machine. **(T-0)** Chips or other particles shall be removed using brushes, tools designed for such a purpose or compressed air. **(T-0)** Refer to paragraph **2.4.8.8** for compressed air cleaning requirements.

11.3.1.6. Refer to **Chapter 8,** *Electrical Safety,* for additional guidance on under-voltage protection.

11.3.2. Inspection and Maintenance.

11.3.2.1. Supervisors shall ensure all machines are inspected upon receipt to detect and correct defects. **(T-0)** Follow manufacturer's instructions and TO 34-1-3, *Inspection and Maintenance – Machinery and Shop Equipment*, for periodic inspection requirements. **(T-1)**

11.3.2.2. Operator's inspection shall be conducted prior to the start of each shift, following a new setup or when operators change. **(T-0)** This inspection shall ensure operating components are in good working order, and guards, interlocks and other protective devices are activated or in place, operating properly and in proper adjustment. **(T-0)** Records of inspections and any machine maintenance shall be maintained on AFTO Form 244 IAW TO 34-1-3.

11.3.2.3. Repairs or maintenance beyond the operator's qualifications shall only be accomplished by a qualified technician. **(T-1)** Any maintenance and repair, regardless of whether it is performed by an operator or qualified technician, shall be performed IAW work center hazardous energy control program requirements. **(T-0)** Refer to **Chapter 21** for specific guidance on hazardous energy control.

11.3.3. References. Refer to **Table 11.1**

Table 11.1. OSHA Standards for Machinery.

OSHA Standards	
Subject	**OSHA Standards**
The Control of Hazardous Energy (Lockout/Tagout)	29 CFR 1910.147
Machinery & Machine Guarding	29 CFR 1910 Subpart O
Machinery & Machine Guarding (Definitions)	29 CFR 1910.211
General Requirements for all Machines	29 CFR 1910.212
Woodworking Machinery Requirements	29 CFR 1910.213
Abrasive Wheel Machinery	29 CFR 1910.215
Mechanical Power Presses	29 CFR 1910.217
Mechanical Power Transmission Apparatus	29 CFR 1910.219

11.3.4. Training. Employees shall be trained by the supervisor or a designated trainer on all machinery or equipment they are required to use prior to use. **(T-0)** Only trained personnel or those undergoing supervised on-the-job training shall operate shop machinery or equipment. **(T-0)** Training shall be documented and immediately available in the work center.

11.3.4.1. Operators shall be trained on machine or equipment maintenance or repairs they are required and qualified to perform. **(T-0)**

11.3.4.2. Supervisors and operators shall receive training on lockout and tagout procedures contained in **Chapter 21**, as appropriate, to ensure the purpose of the program is understood. (**Note:** Services craft or hobby shop patrons shall be trained by the supervisor or a designated trainer on the proper operation, safety procedures, hazard recognition and emergency procedures for each piece of equipment they will use.) **(T-1)** An Arts and Crafts Equipment Qualification card shall be issued to identify the machinery the patron is authorized to operate. **(T-1)** Personnel shall not operate machines or equipment if this card is not available. Services patrons, e.g., base hobby shops, shall receive general awareness training to understand the Hazardous Energy Control program, but shall not apply or remove locks or tags. **(T-1)**

11.3.5. Machine Layout Requirements.

11.3.5.1. Machines subject to movement because of vibration, rotation or other reasons shall be securely fastened to prevent their movement while operating. **(T-0) Exception:** Machines, such as meat slicers, cause very little vibration or movement and can be satisfactorily held in position with rubber feet.

11.3.5.2. Sufficient space for material handling and maintenance shall be provided around each machine. **(T-0)** The installation occupational safety office and CE shall be contacted for assistance on layout issues.

11.4. Specific Requirements for Machinery.

11.4.1. Refer to 29 CFR 1910.213 and 1910.147 for electrical requirements and safeguards.

11.4.1.1. The motor START switch shall be protected against accidental or inadvertent operation. **(T-0)** Refer to 29 CFR 1910.217 for additional information.

11.4.1.2. Electrical hardwiring of all machinery shall be installed IAW National Fire Protection Association 70. **(T-0)**

11.4.2. Safeguarding devices shall be installed, adjusted and used IAW manufacturer's operating and maintenance instructions. **(T-0)** Refer to 29 CFR 1910.212, 1910.213 and 1910.217 for additional safe distance and maximum opening requirements.

11.4.3. Safety Devices.

11.4.3.1. Devices such as anti-kickback dogs and fingers or safety hold-down wheels shall be installed when ripping material. **(T-1)** Anti-kickback dogs and fingers shall be inspected before each use and kept sharp to maintain their holding power. **(T-1)**

11.4.3.2. When procuring new table saws, purchase them with skin sensing safety features, if available, to prevent injury. **(T-1)** This type sensing technology detects contact with the skin, immediately shutting off the motor and stopping the blade.

11.4.3.3. The working part of a band saw blade, between the guide rolls and the upper wheel enclosure, shall be guarded to prevent accidental human contact with the saw blade. **(T-0)** The guard shall be self-adjusting and attached to the gauge so that, in any position the guard will protect the saw blade at the front and outer side. **(T-0)**

11.4.4. Safeguarding by Location or Distance. Before attempting safeguarding by location or distance, a thorough JHA of each machine and particular situation shall be performed by the supervisor with consultation from the installation occupational safety office as needed. **(T-1)** The analysis must clearly identify that employees are protected from dangerous moving parts and one of the restrictions in paragraph **11.4.3** is met. **(T-0)**

11.4.4.1. To safeguard by location, the machine or its dangerous moving parts must be positioned so hazardous areas are not accessible or do not present a hazard to an employee during the normal operation of the machine. **(T-0)** This may be accomplished by locating a machine where a building design feature, such as a wall, protects the employee and other personnel. Additionally, enclosure walls or fences can restrict access to machines. Another possible solution is to have dangerous parts located high enough to be out of the normal reach of any employee.

11.4.4.2. Unguarded moving parts of machines shall be at least eight (8) feet above the work level, e.g., floor, platform or passageway. Refer to 29 CFR 1910.212 for additional information.

11.4.4.3. Machines with live parts shall be in an enclosed area with a locked entrance. **(T-1)** The enclosure (wall or fence) shall be at least eight (8) feet high. **(T-1)** Refer to 29 CFR 1910.219 for additional information.

11.4.5. Related Equipment (Shield and Holding Tools). While these aids do not give complete protection from machine hazards, they could provide the operator an extra margin of safety. Since these aids are not used instead of the safeguards, sound judgment is needed in their application.

11.4.5.1. Shields may be used to provide protection from flying particles.

11.4.5.2. Holding tools designed to aid material placement in and out of machinery shall be used to prevent placing hands in the danger zone. **(T-1)** These tools are not a substitute

for guarding required by this or any other machine standard. They shall only be used to supplement guard protection provided. **(T-1)**

11.4.6. Exhaust Ventilation. Machines that develop fine dust and fumes must be evaluated by installation BE to safeguard workers. **(T-0)** Refer to AFMAN 48-155, *Occupational and Environmental Health Exposure Controls*, and 29 CFR 1910.94, *Ventilation*, for additional guidance.

11.4.7. Illumination. Refer to paragraph **7.1.3** for additional guidance.

11.4.8. Machine energy isolating devices shall be capable of being locked out by a designed hasp or other attachment or an integral part to which, or through which, a lock can be affixed or the energy isolated by simply disconnecting an electrical plug. **(T-1)**

11.4.9. Wheel and Spindle Speeds.

11.4.9.1. The spindle rpm of grinders shall be shown on the machine in a location readily visible to the operator. **(T-0)** It is the supervisor‘s and employee‘s responsibility to verify the speed of the wheel spindle to ensure the speed is correct for the size and type of wheel used. Refer to 29 CFR 1910.215 for additional information.

11.4.9.2. All grinding wheels shall have the operating speed affixed to the wheel. **(T-0)** Those without a rating shall be tagged and removed from service until the rpm rating is validated. **(T-0)**

Chapter 12

MATERIAL HANDLING EQUIPMENT

12.1. General Information.

12.1.1. Documentation. This chapter specifies use of AFTO Form 95, *Significant Historical Data*, AFTO Form 244, *Industrial/Support Equipment Record*, AF Form 1800, *Operator's Inspection Guide and Trouble Report*, and general purpose forms for documenting maintenance and inspection actions. With the growing use of automated systems for tracking these activities, requiring specific paper forms may impede use of more efficient automated processes. Therefore, use of MAJCOM or locally devised paper or automated system for documenting inspections, maintenance and other activities is acceptable in place of specified AFTO Forms 95 and 244 and general purpose forms if they contain the same information called for by the designated form. Electronic signatures are acceptable. While this standard offers an optional alternative to paper AFTO Forms 95 and 244 and general purpose forms, MAJCOMs, NAFs, local procedures, Technical Orders and other Air Force guidance may continue to require use of these forms. Please check the prescribing directive(s) before discontinuing use of any forms. Maintenance units shall follow documentation guidance in AFI 21-101, *Aircraft and Equipment Maintenance Management*, and 00-20 series TOs. **(T-1)**

12.1.2. Training Currency for Deployment. Supervisors shall ensure personnel scheduled for deployment are current/trained in operations on this equipment prior to deploying. **(T-0)** Additionally, supervisors at deployed locations shall verify personnel are current in operations before they operate the equipment, and provide additional training as needed for personnel to safely operate any new type equipment. **(T-0)**

12.1.3. Materials Handling Equipment (MHE) Not in Regular Service.

12.1.3.1. Cranes, hoists and derricks idle for at least one month, but less than six (6) months, shall be inspected prior to placing in service. **(T-0)**

12.1.3.2. Cranes idle for a period of six (6) months or more shall be inspected IAW paragraphs **12.8.2.5.1**, **12.8.2.5.2** and **12.11.2.2.2** prior to placing in service. **(T-1)** Standby cranes shall be inspected at least semiannually IAW paragraphs **12.9.2.4.2**, **12.9.2.4.3** and **12.11** **(T-0)** The need for more frequent inspections of cranes exposed to an adverse environment shall be determined by the user. **(T-1)**

12.1.3.3. Any hoist idle for six (6) months or more shall be given a complete inspection IAW paragraph **12.6.3.5.2** prior to placing in service. **(T-0)**

12.1.3.4. A derrick idle for over six (6) months shall be given a complete inspection IAW requirements of paragraph **12.6.3.5.2** before placing in service. **(T-0)** Standby derricks shall be inspected at least semiannually IAW paragraph **12.6.3.5.2** **(T-0)** Those exposed to adverse environments shall be inspected more frequently. **(T-1)**

12.1.4. Dimensions. While dimensions mentioned in this document refer to inch measurements, equipment built with metric measurements shall be maintained and repaired with metric dimensioned parts, unless inch dimensioned parts are permitted by applicable TO, item manager or manufacturer. **(T-1)** If the manufacturer is no longer in business or technical

guidance is not available, parts selection shall be based on the recommendation of a licensed professional engineer. **(T-1)**

12.1.5. Inspections. MHE (specifically hoists, slings, cranes, derricks) and associated components will be inspected for damage or wear at intervals specified (frequent and/or periodic), including observations during operation. **(T-0)** Deficiencies will be carefully examined and a determination made by the operator and the shop or facility supervisor as to whether they constitute a safety hazard. **(T-1)**

12.1.5.1. Frequent. A visual/prior to use inspection will be performed by the operator or designated person daily or prior to use. **(T-0)** A daily inspection is only required if specified by a TO, manufacturer's instructions or other governing directive. Otherwise, a prior to use inspection will be required prior to the first use of the day for any MHE, unless MAJCOM or installation has more stringent directives. **(T-1)** The inspection shall be documented on an AFTO Form 244 or MAJCOM or locally devised paper or automated systems IAW paragraph **12.1.1,** annotating the date, time, initials of the person performing the inspection and any discrepancies noted during the inspection. **(T-1)** The record of inspection shall be maintained by the using agency until the next periodic inspection has been performed. **(T-1)**

12.1.5.2. Periodic. A complete inspection will be performed by a qualified person at intervals between 1 and 12 months. **(T-0)** The required intervals of periodic inspections will be based on the type of use experienced by the equipment: Normal service – annually; heavy service – semiannual; severe service – quarterly (see **Attachment 1,** Terms-Service). **(T-1)** Follow periodic inspection schedules outlined in applicable technical orders and/or manufacturer's instructions where intervals between 1 and 12 months are established. **(T-1)** The inspection will be documented on AFTO Form 95, AFTO Form 244 or MAJCOM or locally devised paper or automated systems IAW paragraph **12.1.1** and maintained on file 36 months after the periodic inspection is complete, unless otherwise noted. **(T-1)** During the periodic inspection, some systems may require the removal of covers or parts to gain access. Appropriate hazardous energy control procedures will be used where removal of covers or parts expose individuals to an uncontrolled energy source (e.g., an electrical or mechanical hazard) and result in accidental start-up of equipment. **(T-0)** Refer to **Chapter 21,** *Hazardous Energy Control,* for additional guidance. Disassembly of the MHE or major components, not designed to be removed or opened, is not required for the sole purpose of the inspection. If the individual performing the periodic inspection finds evidence of damage or wear that constitutes a potential hazard, further inspection to determine cause or to repair the system may be required and total disassembly or removal of major components may be necessary. Consult manufacturer's instructions, where available, for additional guidance. **Exception:** For nuclear-certified MHE, perform the periodic inspection semiannually.

12.1.5.3. Mandatory Monthly Inspections. Wire ropes, chains and hooks associated with overhead and gantry cranes shall be thoroughly inspected monthly. **(T-0)** Inspections for each item shall be documented (separate documentation) on the AFTO Form 95 or MAJCOM or locally devised paper or automated system IAW paragraph **12.1.1** and maintained on file for one year. **(T-1)** Documentation will include date and time of the monthly inspection, signature of the inspector, an identifier for the equipment inspected

and condition of the equipment. **(T-0)** Inspection criteria will be IAW applicable paragraphs from this chapter and applicable manufacturer instructions, as required. **(T-1)**

12.1.5.4. Frequency. Inspections identified as monthly and annual inspections will be considered as such and not a 30 or 365 day inspection. **(T-1)** The next inspection must occur by the last day of the respective month. **(T-1)** For example, a monthly inspection conducted on 4 February, the next inspection must be completed by 31 March. **(T-1)** An annual inspection conducted on 4 February 2009, the next inspection must be completed by 28 February 2010. **(T-1)**

12.1.5.5. New or Modified MHE. Prior to initial use, all newly procured or modified (altered or repaired) MHE shall be inspected to ensure compliance with the provisions of this standard. **(T-0)**

12.1.5.6. Hook, Sling and Hook Certification. Hook, sling and hook certification documents received from the manufacturer when hoists, slings or hooks are purchased or repaired shall be maintained for the life of the equipment (or until the hooks are replaced). **(T-1)** For repaired items, the previous certification shall be replaced with the new documentation. **(T-1)**

12.1.6. For cranes and derricks used in construction, consult with installation CE and refer to 1926.1400, *Cranes and Derricks in Construction.*

12.2. Special Requirements.

12.2.1. Material Handling Equipment Parked Inside Warehouses. The decision to park gasoline-or diesel-powered material handling equipment in general purpose warehouses is the responsibility of the group commander responsible for the designated warehouse. **(T-2)** The group commander will be the approval authority with recommendations by the installation FES Flight, BE office and Occupational Safety office. **(T-2)** The following safety considerations/operating rules shall be considered prior to parking:

12.2.1.1. The warehouse shall be equipped with an automatic fire suppression system or heat sensor devices. **(T-1)**

12.2.1.2. The equipment shall be parked so it does not block fire aisles, fire-fighting equipment, fire alarm boxes, stairways, elevators or fire exits. **(T-0)**

12.2.1.3. An oil absorbent compound shall be placed under any equipment leaking oil or grease. **(T-1)** A metal pan may be used in conjunction with the compound. Leaking equipment shall be repaired. **(T-1)**

12.2.1.4. The warehouse supervisor shall conduct daily inspections to ensure powered materials handling equipment is parked in designated locations, equipment does not contain excessive grease and lint, and gasoline lines, tanks, oil seals and so forth are not leaking. **(T-1)**

12.2.1.5. A minimum of 10-foot clearance shall be maintained between parked equipment and combustible materials. **(T-1)**

12.2.1.6. Gasoline or diesel powered equipment used in multistory buildings shall be parked on the ground floor when not in use. **(T-1)** Refer to paragraph **12.3.5.2** for additional guidance.

12.2.2. Battery Charging and Servicing Operations. Refer to **Chapter 31,** *Batteries – Maintenance, Handling and Storage Requirements*, and National Fire Protection Association 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations*, for charging installation design and servicing batteries requirements.

12.2.3. Liquid Petroleum Gas Powered Materials Handling and Lifting Equipment.

12.2.3.1. Operators shall not park liquid petroleum-gas industrial and lift trucks near sources of heat, open flames or similar sources of ignition, or near inadequately ventilated pits. **(T-0)**

12.2.3.2. Trucks equipped with a permanently mounted liquid petroleum-gas container shall be refueled outdoors. **(T-0)**

12.2.3.3. Exchange of removable fuel containers shall be done outdoors. **(T-0) Exception:** The exchange may be done indoors if the exchange is made in a well ventilated area away from ignition sources and one of the following methods is used to minimize release of fuel from the fuel lines:

12.2.3.3.1. Use an approved quick-closing coupling (a type closing in both directions when uncoupled) in the fuel line. **(T-0)**

12.2.3.3.2. Close the shutoff valve at the fuel container and allow the engine to run until the fuel in the line is exhausted. **(T-0) Note:** Ensure all indoor container change-out operations are approved by the installation FES Flight. **(T-2)**

12.2.3.4. Containers shall be kept secured at all times. **(T-0)**

12.2.4. Petroleum Equipment Servicing.

12.2.4.1. Units with internal combustion engines shall not be refueled inside warehouses or while the engine is running. **(T-1)** Refueling shall be accomplished in outside areas approved by the installation FES Flight. **(T-2)**

12.2.4.2. When fuel is spilled during servicing, operations shall be stopped and equipment cleaned up according to local procedures prior to restarting fuel servicing operation. **(T-0)** Notify the FES Flight if a significant spill occurs. **(T-1)**

12.2.5. Storage Racks/Shelving.

12.2.5.1. The load size and rating of storage racks/shelving shall be determined by the manufacturer's specifications or by a qualified person if manufacturer's specifications do not specify the load size and rating for the storage racks/shelving. **(T-1)**

12.2.5.2. The load size and rating shall be posted on the storage rack/shelving unit. **(T-0)**

12.2.5.3. Storage racks/shelving shall be properly aligned, plumb, secured and level as per manufacturer's installation instructions/specifications. **(T-0)**

12.2.5.4. Keep aisles clear. **(T-0)** Insufficient clearance may result in rack/shelving damage from handling equipment operations.

12.2.5.5. Inspections of storage racks/shelving units shall follow manufacturer's instructions and/or recommendations and include:

12.2.5.5.1. Frequency of inspection and preventative maintenance. **(T-1)**

12.2.5.5.2. Inspection of all recommended storage racks/shelving components. **(T-1)**

12.2.5.5.3. Inspections shall be documented on AFTO Form 95, or MAJCOM or locally devised automated systems. Refer to paragraph **12.1.1** for additional guidance. **(T-1)**

12.2.5.6. Defective storage racks/shelving shall be tagged with AF Form 979, *Danger Tag*, or AF Form 981, *Out of Order*. **(T-1)**

12.2.5.7. Workers shall report any damage to racks at time of incident, specifically damage due to mechanical equipment, and shall be documented on AFTO Form 95, or MAJCOM or locally devised automated systems. **(T-1)** Refer to paragraph **12.1.1** for additional guidance.

12.2.5.8. Repair defective storage racks in a timely manner. **(T-1)** Document repairs on MAJCOM or locally devised automated systems. **(T-1)**

12.2.6. Roll-up Doors. See paragraph **2.7** for roll up door requirements.

12.3. Powered Industrial Trucks.

12.3.1. Hazards. Injury or death may occur when powered industrial trucks are improperly operated, inadvertently driven off loading docks, tipping, striking personnel, etc. Most incidents also involve property damage, including damage to overhead sprinklers, racking, pipes, walls and machinery. Most injuries and property damage are caused by unsafe operating procedures, lack of safety-rule enforcement, insufficient or inadequate training and operator error. Refer to 29 CFR 1910.178, *Powered Industrial Truck*, for additional guidance. Common operator errors associated with powered industrial trucks include:

12.3.1.1. Jerky starts and stops.

12.3.1.2. Failure to give proper signals when turning.

12.3.1.3. Traveling too fast and turning too sharply.

12.3.1.4. Failure to sound horn at intersections or when entering or exiting a building.

12.3.1.5. Turning too wide on corners.

12.3.1.6. Cutting corners too sharply.

12.3.1.7. Positioning forklift truck tines too high when traveling, either empty or loaded. Tines shall be no higher than six (6) inches above the surface, as measured from bottom most part of load to surface. **(T-0)**

12.3.1.8. Lowering loads too fast.

12.3.1.9. Failure to ensure pallet load is properly balanced and stacked.

12.3.1.10. Failure to ensure forks (tines) are fully under the load before lifting.

12.3.1.11. Striking the pallet or floor with the tines.

12.3.1.12. Driving across bridge plates too fast, and failure to observe load carrying capacity on bridge plates.

12.3.1.13. Failure to release parking brake before traveling.

12.3.1.14. Driving forward when vision is restricted by the load.

12.3.1.15. Failure to secure load to mast or tie down points when transporting over a distance.

12.3.1.16. Traveling in reverse without a spotter, too quickly and failure to see obstructions.

12.3.1.17. Raising/lowering the load while still in motion.

12.3.2. General Requirements.

12.3.2.1. Acquisition. Commercially procured materials handling and lifting equipment or parts shall conform to the specifications in 29 CFRs 1910.176, *Handling Materials--General*, 1910.177, *Servicing Multi-Piece and Single Piece Rim Wheels*, and 1910.178, *Powered Industrial Truck*, American National Standards Institute B56.1, *Safety Standard for Low Lift and High Lift Trucks*, and National Fire Protection Association 505, *Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations.* **(T-0)**

12.3.2.2. Local modifications of centrally procured materials handling equipment shall be done only with approval of equipment item managers and requirements referenced in paragraph **12.3.4.2** **(T-1)** Local purchase acquisition requests shall be coordinated with the installation Occupational Safety office. **(T-1)**

12.3.3. Training.

12.3.3.1. Each activity requiring training on powered materials handling and lifting equipment shall designate qualified personnel as instructors to train and supervise the operator trainee. **(T-1)** The names and grades of instructor candidates shall be provided to the vehicle operations officer who shall thoroughly screen each for background and experience in the type of equipment for which instruction shall be given. **(T-1)** A list of approved instructors shall be retained on file by the using agency and the vehicle operations section. **(T-1)**

12.3.3.2. Lesson plans for each vehicle shall be accomplished by the unit IAW AFI 24-301, *Vehicle Operations*. **(T-1)** Lesson plans (course content) shall include formal instruction, hands-on demonstrations by the instructor with practical exercises performed by the trainee and an evaluation of the trainee's performance to confirm their knowledge of equipment operations and service instructions. **(T-1)** Refer to paragraph **12.3.3.5** for additional guidance on documenting training.

12.3.3.3. The trainee shall furnish the Operator Records and Licensing staff with written certification on the AF Form 171, *Request for Driver's Training and Addition to U. S. Government Driver's License.* **(T-1)**

12.3.3.4. Materials handling and lifting equipment training will include:

12.3.3.4.1. Equipment design, to include restrictions, limitations and hazards relative to the environment where used, e.g., steering, maneuvering and visibility. **(T-0)**

12.3.3.4.2. Operating and maintenance instructions, including manufacturer's instructions and those contained in this standard. **(T-0)**

12.3.3.4.3. Safe loading and unloading requirements. **(T-0)**

12.3.3.4.4. Operating techniques inside and outside of warehouses. **(T-0)**

12.3.3.4.5. Flightline rules and regulations, when applicable. **(T-1)**

12.3.3.4.6. Fire extinguisher training (initial and annual). Refer to **Chapter 6,** *Fire Protection and Prevention,* for additional guidance. **(T-0)**

12.3.3.4.7. Use of attachments such as extended forks or tines or personnel lift pallets. **(T-0)**

12.3.3.4.8. Clearances, heights and limitations. **(T-0)**

12.3.3.4.9. Safety clothing and equipment. Refer to **Chapter 14,** *Personal Protective Equipment (PPE),* for additional guidance. **(T-1)**

12.3.3.4.10. Fire protection, fuel spills, maintenance of equipment, smoking, etc. Refer to **Chapter 6** for additional guidance. **(T-0)**

12.3.3.4.11. Operating restrictions in potentially hazardous storage areas, which include flammable, toxic, lumber, coal, etc. Refer to **Chapter 22,** *Flammable and Combustibles,* for additional guidance. **(T-0)**

12.3.3.4.12. Load composition and stability. **(T-0)**

12.3.3.4.13. Damage that may be caused by acid or caustic material. **(T-0)**

12.3.3.4.14. Workplace related topics such as surface condition; local policies on stacking, unstacking, and load manipulation; pedestrian traffic; and narrow aisles. **(T-0)**

12.3.3.4.15. Applicable information contained in paragraphs **12.2** and **12.3.2.1** of this standard. **(T-1)**

12.3.3.5. Document initial and, as required, refresher training in appropriate records, e.g., AF Form 623, *Individual Training Record Folder*, AF Form 1098, *Special Task Certification and Recurring Training*, AF Form 55, *Employee Safety and Health Record,* or MAJCOM directed record system. **(T-1)**

12.3.3.6. In addition to initial training and certification, a qualified instructor shall evaluate each operator at least once every three (3) years and provide refresher training in relevant topics any time there is reason to believe there is a need. **(T-0)** The evaluation shall include, but not be limited to, changes in types of equipment in use, change in operating environment; direct observation of performance; reportable mishaps, reports of near-misses; complaints regarding an operator's bad driving habits; physical fitness; and other indications that an operator is not capable of safely performing assigned duties. **(T-1)** A written/automated record of each operator's evaluation shall be kept on file by the instructor for review. **(T-1)**

12.3.4. Safeguarding Requirements.

12.3.4.1. Materials lifting equipment powered by an internal combustion engine shall have an adequate fire extinguisher available. **(T-0)** Size, type and location shall be determined by the installation FES Flight and owning organization, and shall be based on the risk assessment for the operation being conducted. **(T-1)** Additional requirements may be mandated by AFIs, TOs or other directives for specific environments and operations.

12.3.4.2. The maximum load capacity shall be posted on each piece of lifting equipment, in view of the operator. **(T-0)** Modifications and additions which affect capacity and safe operation require manufacturer's written approval. **(T-0)** If modifications and/or additions are completed, capacity, operation and maintenance instruction plates, tags or decals shall be changed accordingly. **(T-0)** Refer to paragraph **12.3.2.1** for additional guidance.

12.3.4.3. All high-lift rider trucks shall be equipped and operated with overhead guards to protect the operator from falling objects. **(T-0)** Overhead guards shall not be covered with material that could obstruct the operator's vision. **(T-0)**

12.3.4.4. Where steering must be accomplished with one hand and a steering hand wheel is used, steering knobs or equivalent may be used, provided they do not protrude beyond the outside periphery of the hand wheel. **(T-1)**

12.3.4.5. Load backrest extensions shall be used when necessary to minimize the possibility of the load falling rearward. **(T-0)**

12.3.4.6. When a forklift is used to elevate personnel, an approved safety pallet shall be used. **(T-0)**

12.3.4.7. The operator shall remain at the controls at all times when personnel are on the safety pallet, but shall not move the forklift. **(T-0)**

12.3.4.8. Instructions prohibiting movement of the forklift with personnel on the safety pallet shall be posted on the pallet in plain sight, visible to the operator and all personnel. **(T-0)**

12.3.5. Safe Operations.

12.3.5.1. Whenever possible, electric or battery powered equipment shall be used indoors. **(T-1)** Internal combustion engines shall not be operated inside buildings unless an exhaust system or other ventilation approved by BE is installed and used. **(T-1)** Administrative areas, e.g., offices, must be protected from exhaust buildup either by distance or positive air flow pressure in relation to the warehouse activities. **(T-0)** When internal combustion engine equipment is used inside warehouses, ventilation requirements shall be determined by BE personnel to preclude exposure of workers to carbon monoxide gas. **(T-1)** Refer to AFMAN 91-201, *Explosives Safety Standards,* for operating in explosives and weapons areas.

12.3.5.2. Internal combustion engine equipment shall not be warmed up inside a building and shall be turned off when not in use. **(T-0)**

12.3.5.3. Liquid petroleum gas fuel industrial trucks may be used in buildings or structures approved by the installation FES Flight, Occupational Safety office and BE. **(T-1)** If used inside buildings or structures, there shall be no more than two 10-gallon fuel containers on the truck, and the truck shall not be left unattended with the engine running. **(T-1)** Refer to paragraph **12.3.5.1** for additional guidance.

12.3.5.4. Operation of high and low lift trucks, which include platform, pallet trucks, rider trucks, reach trucks, side loader trucks, picker trucks, straddle lift trucks, etc.

12.3.5.4.1. Personnel shall not ride on powered lift equipment unless a passenger seat is part of the manufacture design. **(T-0)**

12.3.5.4.2. The operator shall not extend any portion of body between the uprights of the mast or outside the running lines of the equipment. **(T-0)**

12.3.5.4.3. When leaving powered lifts unattended, operators shall fully lower the forks, neutralize controls, shut power off and set brakes. **(T-0)** They shall chock the wheels if the vehicle is parked on an incline. **(T-0)** At the close of business each day, liquid petroleum powered and gasoline operated MHE shall be parked on the warehouse parking ramp, drip pans in place. **(T-1)**

12.3.5.4.4. Operators shall use caution when traveling on docks or loading platforms and remain clear of the edge. **(T-0)**

12.3.5.4.5. Operators shall not use forklifts to push or pull objects, such as freight cars, or to open and close freight and warehouse doors. **(T-0) Exception:** When side loading vans are not available, munitions containers with permanently installed skids may be pushed or pulled into open-ended vans with the use of a spotter. Ensure safety precautions, such as keeping personnel clear of potentially hazardous areas, have been considered and included in the procedure. **(T-1)**

12.3.5.4.6. Operators shall set brakes and dock locks or put wheel chocks in place to prevent any movement of trucks, trailers or railroad cars while loading or unloading. **(T-0)** Fixed jacks shall be used to support semi-trailers during loading or unloading when the trailer is not coupled to the tractor. **(T-0)** The operator shall check the flooring of trucks, trailers and railroad cars for breaks and weakness before driving onto them. **(T-0)** Loads shall not be transferred across the tailgate when it is supported solely by its chain. **(T-0)** The tailgate must be supported by the mating surface across its entire width or a bridge plate shall be used. **(T-0)** Refer to paragraph **12.3.5.5.13** for additional requirements.

12.3.5.4.7. Operators shall ensure sufficient head room or clearance under overhead installations, lights, pipes, sprinkler systems, etc. **(T-0)**

12.3.5.4.8. Personnel shall not stand or pass under the elevated portion of a lift when loaded or empty.

12.3.5.5. When traveling, operators shall:

12.3.5.5.1. Observe all established driving procedures and shall not exceed five (5) miles per hour inside warehouses. **(T-0)** Under normal traffic conditions, operators shall keep to the right and maintain a safe distance (approximately three truck lengths) from the truck ahead. **(T-0)** Operators shall keep trucks under control at all times, especially during turns and while traveling over slippery or wet floors and rough surfaces. **(T-0)**

12.3.5.5.2. Not pass other vehicles or pedestrians at intersections, blind corners or at other dangerous locations. **(T-0)**

12.3.5.5.3. Slow down and sound the horn at cross aisles, warehouse entrances and exits or at other dangerous locations where vision is obstructed. **(T-0)** Operators shall be prepared to stop and will not proceed until the way is clear. **(T-0)**

12.3.5.5.4. Travel with the load trailing when loads obstruct the forward view. **(T-0)**

12.3.5.5.5. Cross railroad tracks diagonally whenever possible to avoid jarring of the load. **(T-0)**

12.3.5.5.6. Not park lifts closer than eight (8) feet from the center of railroad tracks. **(T-0)**

12.3.5.5.7. Drive a loaded lift with the load upgrade when traveling up or down ramps or grades. A spotter shall be used if the operator's vision is obscured by the load. **(T-0)** Unloaded trucks shall be operated on all grades with the forks downgrade. **(T-0)** Caution shall be used on all grades. **(T-0)** The load on the forks shall be tilted back as far as necessary to clear the road surface. **(T-0)**

12.3.5.5.8. Operate the lift at a speed that will permit it to stop in a safe manner. **(T-0)** Horseplay or stunt driving shall not be permitted. **(T-0)**

12.3.5.5.9. Not travel with lift forks elevated more than six (6) inches above the ground or surface or as necessary to clear surface projections. **(T-0)**

12.3.5.5.10. Tilt the mast back when transporting loads when operating a mast with tilt capability. **(T-0)**

12.3.5.5.11. Make smooth starts, turns and stops to prevent the load from shifting or the truck from overturning. **(T-0)**

12.3.5.5.12. Ensure dock boards or bridge plates:

12.3.5.5.12.1. Are anchored or equipped with stops at both ends near the edges of the platform of the car or truck to prevent them from sliding. **(T-0)**

12.3.5.5.12.2. Are strong enough to carry the load. **(T-0)**

12.3.5.5.12.3. Have handholds or other effective means to permit safe handling. **(T-0)**

12.3.5.5.12.4. Are of proper width and length. **(T-0)**

12.3.5.5.12.5. Contain a nonskid surface. **(T-0)**

12.3.5.5.13. Approach elevators slowly and enter squarely after the elevator car is properly level. **(T-0)** Once on the elevator, the operator will neutralize the controls, shut off the power and set the brakes. **(T-0)**

12.3.5.5.14. Ensure motorized hand trucks enter elevators or other confined areas with the load end first. **(T-0)**

12.3.5.6. When loading, the operator shall:

12.3.5.6.1. Ensure only stable or safely arranged loads are transported. **(T-0)**

12.3.5.6.2. Not exceed the rated capacity of the lift. **(T-0)**

12.3.5.6.3. Take extra care in securing, manipulating, positioning and transporting the load when attachments are used. **(T-0)**

12.3.5.6.4. Use extreme care when tilting loads forward or backward, particularly when high tiering. **(T-0)** The operator shall not tilt equipment forward with a fork's engaging means elevated, except to pick up a load. **(T-0)** An elevated load shall not be tilted forward except when the load is in a deposit position over a rack or stack. **(T-0)** When stacking or tiering, operators shall only use enough backward tilt to stabilize the load. **(T-0)**

12.3.5.6.5. Not use more than the manufacturer's specified counterweight system to increase lifting capacity. **(T-0)**

12.3.5.6.6. Not align, bump or push stacks with a lift. **(T-0)**

12.3.5.7. When operating warehouse tractor (tug)-trailer trains, operators shall:

12.3.5.7.1. Obey all traffic regulations and shall not exceed 10 miles per hour when towing trailers. **(T-0)** When traveling on base roads, trains shall keep to the extreme right and, if operated at night or in periods of low visibility, lights shall be used. **(T-0)** Towing of aircraft engines shall be IAW TO 00-85-20, *Engine Shipping Instructio*ns. **(T-1)**

12.3.5.7.2. Not permit passengers to ride on tractors unless adequate seats are installed. **(T-0)**

12.3.5.7.3. Tow no more than four (4) loaded or empty trailers with a tractor or tug. **(T-0) Exception:** Six (6) A/M326 palletized cargo trailers may be towed behind one tractor.

12.3.5.7.4. Ensure the train is arranged with the most heavily loaded trailer next to the towing vehicle, the next heaviest second in line, and so on to avoid jackknifing trailer trains. **(T-0)**

12.3.5.7.5. Make sure couplings are secure before moving a trailer or train. **(T-0)** Pintle assemblies and towing connections shall be secured with a pintle hook and safety pin that will positively lock towing connections. **(T-0)**

12.3.5.7.6. Ensure loads placed on the trailer directly behind the towing tractor are not stacked so high that they prevent or obstruct the operator's view of the remaining trailers. **(T-0)**

12.3.5.7.7. Reduce speeds on uneven roadways to reduce jarring of material. **(T-0)**

12.3.5.8. When operating a straddle-lift truck, operators shall:

12.3.5.8.1. Ensure all loads placed on trucks are blocked sufficiently to prevent any part of the cargo coming in contact with the surface over which the cargo is transported. **(T-0)**

12.3.5.8.2. Carry hoist shoes in the up position to avoid striking any obstruction when the truck is not loaded. **(T-0)**

12.3.5.8.3. Avoid sudden stops, especially when the truck is loaded. **(T-0)**

12.3.5.8.4. Ensure all guards and safety devices are in proper repair at all times. **(T-0)**

12.3.5.8.5. Ensure straddle trucks, operated on base roads at night or in periods of low visibility, are equipped with headlights and taillights. **(T-0)**

12.3.5.9. Operators who load and unload aircraft using materials handling and lifting equipment will ensure the instructions in TO 36M-1-141, *Operator and Operation Instruction—Material Handling Equipment System Components of 463L,*, TO 36M2-3-35-11, *Operation and Operator Maintenance Instructions, Truck, Aircraft Cargo Loading/Unloading 60,000 Pound Capacity,* TO 36M2-3-45-1, *Halvorsen 25K Aircraft Cargo Loaders,* applicable aircraft Dash 9, and the following are complied with: **(T-1)**

12.3.5.9.1. Ensure center of gravity is as close to the forklift frame as possible, but no further than 1/2 the length of the tines, raise the load until clear of the surface and tilt the tines backward prior to transporting. **(T-0)**

12.3.5.9.2. When leaving powered lifts or cargo loading equipment unattended, fully lower the forks, neutralize the controls (place the transmission in the lowest gear or park if an automatic transmission), shut the power off and set the brakes. **(T-0)** Chock the wheels if the vehicle is parked on an incline. **(T-0)**

12.3.5.9.3. Always use a spotter when a K-loader or forklift is operated in congested areas or is approaching or in close proximity to an aircraft. **(T-1)**

12.3.5.9.4. Do not pitch K-loader cargo platforms forward to aid on- or off-loading of cargo. **(T-1)**

12.3.5.9.5. Depending upon K-loader design, the rear of the loader may track/swing outward or inward cutting a corner during sharp turns. **(T-1)** Operators must ensure turn clearances are adequate and use a spotter when necessary. **(T-1)**

12.3.5.9.6. Ensure the appropriate tie-down is used to secure cargo to the K-Loader deck based on the type of cargo being transported. **(T-1)**

12.3.5.9.7. Secure dunnage to equipment prior to transport. **(T-1)**

12.3.5.9.8. Never leave cargo loading equipment on the ramps or taxiways where it could be a hazard to taxiing or towed aircraft. **(T-1)**

12.3.5.9.9. Do not exceed 5 miles per hour near aircraft and 10 miles per hour on ramps. **(T-1)**

12.3.5.9.10. Remove ice or snow from equipment before loading or unloading. **(T-1)**

12.3.5.9.11. When using hand pallet jacks inside an aircraft, use at least two (2) people. **(T-1)**

12.3.5.9.12. Exercise extreme care when using pry bars to move cargo inside an aircraft and be thoroughly familiar with pry bar use limitations and techniques to prevent damage. **(T-1)**

12.3.5.9.13. Do not allow personnel to position themselves between:

12.3.5.9.13.1. Pallets being loaded or unloaded. **(T-1)**

12.3.5.9.13.2. Moving pallets and materials handling equipment positioned outside

the aircraft when off-loading. **(T-1)**

12.3.5.9.14. To prevent damage to pallets or aircraft flooring, check all floor areas prior to loading or unloading to ensure loose items are removed. **(T-1)** Immediately report any damage resulting from aircraft loading or unloading to the supervisor. **(T-1)**

12.3.6. Inspections. All powered industrial trucks shall be inspected daily or prior to use as defined in **Attachment 1,** *Terms* (Daily or Prior To Use Inspection), by the operator. **(T-0)** Equipment shall be kept clean. **(T-0)** When inspecting equipment, operators will use AF Form 1800, *Operator's Inspection Guide and Trouble Report.* **(T-1)** Refer to paragraph **12.1.1** concerning use of paper forms and automated systems. When available, manufacturer's instructions shall be consulted for additional inspection items appropriate to the specific equipment. **(T-1)** Equipment with safety defects shall be immediately removed from service until corrected. **(T-0)** Examples of safety defects are malfunctioning brakes, steering mechanisms, control mechanisms, warning devices, lights, lifting mechanisms, guards or tilt mechanisms, fuel leaks, worn or damaged tires, or damaged exhaust systems.

12.3.7. Maintenance.

12.3.7.1. Repairs to material handling equipment assets under Vehicle Management's control shall be accomplished by Vehicle Maintenance (maintenance agreement may be necessary for locally procured assets). **(T-1)** Deviations to this requirement shall be approved by host Vehicle Maintenance or installation vehicle maintenance contractor. **(T-1)**

12.3.7.2. Equipment shall be cleaned in designated locations and only with cleaning agents approved by the installation FES Flight and BE. **(T-1)**

12.4. Conveyors.

12.4.1. Hazards. Hand and finger injuries may occur when personnel place their hands between boxes or other objects on conveyors or attempt to remove or free jammed objects. Injuries also occur from hand or finger contact with conveyor rollers.

12.4.2. Requirements.

12.4.2.1. Acquisition. Refer to American Society of Mechanical Engineers B20.1, *Safety Standard for Conveyors and Related Equipment*. Ensure:

12.4.2.1.1. All chains, sprockets, belts, couplings and other moving parts to drive conveyors are enclosed or guarded. **(T-0)**

12.4.2.1.2. A safety device is installed to prevent hands from being pinched between power and idler rollers. **(T-0)**

12.4.2.1.3. All electric motors, controls, wiring and their installation comply with National Fire Protection Association 70, *National Electrical Code.* **(T-0)**

12.4.2.1.4. Manually-operated hinged sections are designed with spring tension to minimize effort required to move them. **(T-0)**

12.4.2.1.5. Mechanically-operated sections have positive catches or stops to hold them. **(T-0)**

12.4.2.1.6. Horizontally-hinged sections are designed so they cannot roll, vibrate or shift out of the intended position. **(T-0)**

12.4.2.1.7. All overhead conveyors have rails or roller guards to hold objects on the conveyor, and sheet metal guards, wire mesh or suitable material under the conveyor line to guard against material falling from the conveyors. **(T-0)**

12.4.2.1.8. Rails or guards are installed whenever there is danger of material falling from any conveyor. **(T-0)**

12.4.2.1.9. All conveyors installed within seven (7) feet of the floor or surface have crossovers or passages. **(T-0)**

12.4.2.1.10. If clear passageways cannot be provided under or around a conveyor, that crossover stiles are installed if possible so workers don't have to climb on the conveyor. **(T-0)**

12.4.2.1.11. Stiles have stairs with non-slip treads, standard handrails and 4-inch toeboards. **(T-0)**

12.4.2.1.12. If a crossover cannot be installed to clear objects on the conveyor, that a hinge is installed so it can be swung out of the way when not in use. **(T-0)**

12.4.2.1.13. If crossover stiles are not feasible, that metal plates with non-slip treads are installed in the conveyor just below and between the rollers. **(T-0)**

12.4.2.1.14. Handrails that clear the load on the conveyor are provided. **(T-0)**

12.4.2.1.15. All starting and stopping devices are clearly marked, clear of obstructions and readily accessible. **(T-0)**

12.4.2.1.16. All starting and stopping devices are recessed or guarded to prevent accidental contact by persons or moving objects. **(T-0)**

12.4.2.1.17. If a conveyor has two or more stop switches, that such switches are arranged so the conveyor cannot be restarted until the actuating stop switch (the switch that originally broke the circuit) has been reset to running or "on" position. **(T-0)**

12.4.2.1.18. Electrical or mechanical interlocking devices, which will automatically stop a conveyor to prevent jam-ups, are provided. **(T-0)**

12.4.2.1.19. The open end of every roller conveyor is equipped with a stop that projects automatically above the rollers when a hinged section is opened, and retracts automatically when closed. **(T-0)**

12.4.2.1.20. Retarders, brakes or similar devices are used to prevent loads from "running away" at or near the end of an inclined reciprocating conveyor. **(T-0)**

12.4.2.1.21. Hinged sections of a power conveyor are interlocked so they cannot be raised while the conveyor is in operation, or so the conveyor will stop automatically when a section is opened. **(T-0)**

12.4.2.1.22. Powered conveyors have lockout switches so power can be locked out during maintenance. Refer to **Chapter 21** for additional guidance.

12.4.2.2. Training. Workers using conveyors shall be thoroughly trained on procedures for:

12.4.2.2.1. Starting and stopping conveyors. **(T-1)**

12.4.2.2.2. Loading and unloading conveyors to prevent overloading and jamming. **(T-1)**

12.4.2.2.3. Clearing jams. **(T-1)**

12.4.2.2.4. Making adjustments.

12.4.2.2.5. Hazardous energy control procedures. **(T-1)** Refer to **Chapter 21** for additional guidance.

12.4.2.2.6. Safe operations outlined in paragraph **12.4.2.3** **(T-1)**

12.4.2.3. Safe Operations. Workers shall:

12.4.2.3.1. Not ride on, step on or cross over conveyors except at designated locations. **(T-0)**

12.4.2.3.2. Not operate conveyors unless all guards are in place. **(T-0)**

12.4.2.3.3. Check the entire conveyor before starting the system, to ensure it is clear of personnel. **(T-0)**

12.4.2.3.4. Place small objects in tote boxes on conveyors. **(T-0)**

12.4.2.3.5. Not place hands or fingers between moving objects, fixed parts of the conveyor rollers or on the rollers. **(T-0)**

12.4.2.3.6. Not take off guards at end of conveyor or from belts feeding the conveyor. **(T-0)**

12.4.2.3.7. Use caution in clearing jam-ups of boxes or other objects on the conveyor to prevent hand or finger injuries. **(T-0)**

12.4.2.3.8. Remain outside of the path of overhead conveyors to prevent being struck by falling objects. **(T-0)**

12.4.2.3.9. Report defective or worn shafts, rollers or bearings that may break and permit rollers to fall from the frame. **(T-0)**

12.4.2.3.10. Not wear loose clothing, loose sleeves or jewelry that may catch in the conveyor. **(T-0)**

12.4.2.3.11. Keep hair securely tied back to prevent being caught in moving parts of the equipment. **(T-0)**

12.4.2.3.12. Keep the area around them free of obstructions to permit a clear view of the conveyor and ready access to the devices. **(T-0)**

12.4.2.4. Inspections. Supervisors shall ensure the entire conveyor system is inspected daily. **(T-1)** Defective parts that affect safe operation of the system shall be replaced prior to continued operation. **(T-0)** Operators shall ensure crossover walkway surfaces are in good condition. **(T-0)**

12.4.2.5. Maintenance. No work shall be initiated on a power conveyor until the power switch or disconnect has been locked and tagged out. **(T-0)** Refer to **Chapter 21** for lockout/tagout procedures.

12.5. Manual Hoisting and Pulling Devices.

12.5.1. Hazards. Some common hazards associated with misuse of lever-operated hoists can be attributed to use of extensions (cheater bars), indirect pulls and the lack of proper storage and maintenance procedures.

12.5.2. Requirements.

12.5.2.1. Acquisition. Lever-operated hoists shall meet the requirements and specifications of recognized industry standards. **(T-0)**

12.5.2.1.1. Capacity of all lever-operated devices shall be permanently and conspicuously marked in a readily visible place on the hoist. **(T-0)**

12.5.2.1.2. Only ratchet and pawl and load brake hoists, which include a means to prevent a suspended load from self-lowering, shall be procured. **(T-0)** Lowering under load shall be by operation of the hoist lever. **(T-0)**

12.5.2.2. Safe Operations.

12.5.2.2.1. Lever-operated hoists shall only be used in a direct pull. **(T-0)** Where indirect pulls are permitted by design of the hoist, a sheave or pulley of adequate size shall be used. **(T-0)**

12.5.2.2.2. Hoist cables, ropes and chains shall not be wrapped around the load. **(T-0)** Use only slings or other approved lifting fixtures. **(T-0)** For example, cargo straps shall not be used for lifting, unless stated in approved Air Force technical data. **(T-1)** Refer to paragraph **12.7** for additional information on slings.

12.5.2.2.3. Positive action safety latches shall be installed on all hooks. **(T-0)**

12.5.2.2.4. Hooks shall not be point loaded unless designed for this purpose. **(T-0)** All loads shall be seated in the saddle of the hook. **(T-0)**

12.5.2.2.5. Extensions to levers, such as cheater bars or pipes, unless designed and permanently installed by the manufacturer, shall not be used to increase leverage. **(T-0)**

12.5.2.2.6. Manually operated lever hoists shall only be operated by personnel trained on use of the equipment. **(T-0)** Operator qualifications shall be as determined by the facility manager, shop supervisor or designated representative. **(T-2)**

12.5.2.2.7. The rated capacity shall not be exceeded except for authorized load tests. **(T-0)**

12.5.2.2.8. Hoists shall be attached to well defined dead-end points capable of withstanding the intended load. **(T-0)**

Note: Lifeline attach points shall not be used for hoists. **(T-0)**

12.5.2.2.9. Operators must be careful to avoid pinch points during handling. **(T-0)**

12.5.2.3. Inspections.

12.5.2.3.1. Frequent Inspections. Frequent inspections will include checking for:

12.5.2.3.1.1. Loose or worn parts, nuts, bolts, etc. **(T-0)**

12.5.2.3.1.2. Cracked or broken welds or parts. **(T-0)**

12.5.2.3.1.3. Damage to hooks: deformation, chemical damage, cracks or defective safety latches. Hooks having more than 5 percent of normal throat opening or any apparent bend or twist from the plane from the original baseline measurements shall be replaced. **(T-0)** Refer to paragraph **12.11.5.1.1**

12.5.2.3.1.4. Bent or deformed pawls. **(T-0)**

12.5.2.3.1.5. Lubrication. **(T-0)**

12.5.2.3.2. Periodic.

12.5.2.3.2.1. Complete inspection of all wire rope, chain and fittings or attachments. **(T-0)**

12.5.2.3.2.2. Inspection of brakes, pawls or other holding features. **(T-0)**

12.5.2.3.2.3. Inspection of chain length. Chains elongated more than 1/4 inch in 12 inches shall be removed from service. **(T-0)**

12.5.2.3.3. Identification tags shall be attached to all hoists. **(T-0)** Tags shall include the following information:

12.5.2.3.3.1. Date of annual inspection. **(T-0)**

12.5.2.3.3.2. Date of load test. **(T-0)**

12.5.2.3.3.3. Capacity of hoist. **(T-0)**

12.5.2.3.3.4. Identification number of hoist. **(T-0)**

12.5.2.4. Maintenance. Maintenance shall be performed IAW the manufacturer's instruction or applicable TO. **(T-0)**

12.5.2.5. Testing.

12.5.2.5.1. Operational Tests. All new hoists, those which have had load-suspension parts altered, replaced or repaired, and hoists that have not been used within the preceding 12 months shall be operationally tested before use. **(T-0)** The test shall consist of operating all functions of the hoist under a no-load condition to test all functions of the hoist, including hoisting and lowering, operation of brakes and testing of all limit, locking and safety devices. **(T-0)**

12.5.2.5.2. Load Tests.

12.5.2.5.2.1. Prior to initial use, all new hoists shall be tested, by the manufacturer or a qualified person, at not less than 100 percent or more than 125 percent of the rated load, unless otherwise recommended by the manufacturer, as defined in **Attachment 1, Terms. (T-0)** Using organizations shall maintain written certification that all required load testing has been accomplished. **(T-1)**

12.5.2.5.2.2. Before being returned to service, all hoists with altered, replaced or repaired load-suspension parts shall be load tested by the manufacturer or a

qualified person at not less than 100 percent or more than 125 percent of the rated load, unless otherwise recommended by the manufacturer. **(T-0)** This load test shall include all functions outlined in paragraph **12.5.2.5** **(T-0)** The replacement of load chain or rope is specifically excluded from this test; however, an operational test under a no-load condition shall be conducted prior to putting the hoist back into service. **(T-0)**

12.5.2.5.2.3. Records of these tests shall be maintained indefinitely in a location determined by the user. **(T-0)**

12.6. Hoists. This section outlines basic requirements for power-operated hoists used for vertical lifting and are not permanently mounted to other equipment, e.g., a crane, monorail or derrick that serves as a supporting structure. **(T-0)** Refer to paragraph **12.8** for additional requirements associated with hoists used as components of overhead, gantry and underhung cranes and monorail systems. See additional requirements in paragraph **12.9** for mobile and locomotive cranes and paragraph **12.10** for derricks. Requirements for hoists in these applications are more detailed due to the equipment's capability for lateral movement in addition to a straight vertical lift.

12.6.1. Hazards. The most common hazards associated with hoists are overloading, dropping or slipping of the load from improper hitching or slinging, obstruction to load passage and failure to stabilize the load during the movement. Injury severity is increased by personnel not wearing required PPE, such as hard hat, gloves, safety-toe shoes and eye protection.

12.6.2. Human Factors. Human factors, such as inattention and failure to keep the load clear of people and objects, are also factors which result in mishaps.

12.6.3. Requirements.

12.6.3.1. Acquisition. Overhead hoists shall meet design specifications, characteristics and rules of American Society of Mechanical Engineers B30.7, *Winches*, B30.10, *Safety Standard for Cableways, Cranes, Derricks, Hoists, Hook*s, *Jacks and Slings*, and B30.16, *Overhead Underhung and Stationary Hoists*. **(T-0)** When applicable, a system safety program shall be established. **(T-1)** The guidelines of Crane Manufacturers Association of America 70, *Specification for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes*, and Crane Manufacturers Association of America 74, *Specification for Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist*, shall be followed. **(T-0) Note:** Nuclear-certified hoists must also meet requirements in AFMAN 91-118, *Safety Design and Evaluation Criteria for Nuclear Weapon Systems.* **(T-1)**

12.6.3.2. General.

12.6.3.2.1. Platforms. Hoist platforms shall have suitable side and overhead protection to prevent operator injury from a falling load. **(T-0)**

12.6.3.2.2. Signals. Standard operating signals, understood by operators and signalers, shall be used in hoist operations. **(T-0)**

12.6.3.2.3. Engines and Motors. Hoist engines and motors shall be guarded to protect personnel. **(T-0)**

12.6.3.2.4. Brakes. Self-locking brakes, capable of holding at least 125 percent of the rated capacity, shall be installed on all hoists. **(T-0)**

12.6.3.2.5. Electric Hoists. The conductors and switches of electric hoists shall be guarded against accidental contact. **(T-0)**

12.6.3.2.6. Loads. All loads shall be balanced on hoist carriages and secured to prevent slipping or shifting. **(T-0)**

12.6.3.2.7. Slack Chain. A chain container shall be provided where slack chain hanging from a hoist may be a hazard. **(T-0)**

12.6.3.2.8. Hooks. Latch-type safety hooks shall be installed on all hoists. **(T-0)**

12.6.3.2.9. Load Rating. The rated capacity shall be permanently marked on the hoist or its load block and shall be legible from the operating position. **(T-0)**The rated capacity for each member of the suspension device, when used as intended, shall be equal to the other suspension members to which it is attached. **(T-0)** When this is not feasible, a plan shall be developed to identify special precautions that shall be taken to ensure the lowest rated suspension member's rated capacity is not exceeded. **(T-0)**

12.6.3.2.10. Warnings. Information concerning operating procedures shall be posted by all hoists or displayed on a label affixed to the hoist, controls or block and shall include cautions regarding: **(T-0)**

12.6.3.2.10.1. Lifting more than the rated capacity. **(T-0)**

12.6.3.2.10.2. Operating the hoist when the hook is not centered under the hoist. **(T-0)**

12.6.3.2.10.3. Operating a damaged or malfunctioning hoist. **(T-0)**

12.6.3.2.10.4. Operating a rope hoist with a rope not properly seated in its groove. **(T-0)**

12.6.3.2.10.5. Lifting people or loads over people. **(T-0)**

12.6.3.2.10.6. Operating the hoist with twisted, kinked or damaged chain or rope. **(T-0)**

12.6.3.2.10.7. Removing or obscuring the warning label. **(T-0)**

12.6.3.2.11. Pendants. The pendant station shall be supported by a cable, chain or rope that will protect the electrical conductors against strain. **(T-0)** Pendant control stations shall be constructed to prevent electrical shock and shall be clearly marked for identification of functions. **(T-0)**

12.6.3.2.12. Support. The supporting structure of the hoist, including tripod, trolley, monorail, crane or facility beam shall be designed to withstand the load and forces imposed by the hoist. **(T-0)**

12.6.3.2.13. Location. The hoist shall be installed to give the operator room to remain clear of the load at all times. **(T-0)**

12.6.3.2.14. Remote Operated Hoists. Remote operated hoists shall function so that if the central signal for any hoist motion becomes ineffective, hoist motion shall stop. **(T-0)**

12.6.3.2.15. Tag Lines. Tag lines shall be used on free-swinging loads to help guide and prevent striking nearby objects. **(T-0)**

12.6.3.2.16. Upper Limit Switches. Upper limit switches shall be installed and operable on all powered hoists. **(T-0)**

12.6.3.3. Qualification of Operators. Manually operated hoists shall be operated only by personnel trained and qualified to use the equipment or trainees under direct supervision of a qualified trainer/instructor. **(T-0)** Power operated hoists shall be operated only by trained and qualified persons designated by the appropriate supervisor. **(T-0)** The operator shall be familiar with all hoist operating controls and be instructed in the operations to be performed. **(T-0)** Training shall include the warnings on the hoist, manufacturer's instructions and requirements outlined in paragraphs **12.6.3.4.1** and **12.6.3.4.2** below. **(T-0)** Maintenance and test personnel and qualified inspectors may also operate hoists in the performance of their duties. **(T-0)**

12.6.3.4. Safe Operations.

12.6.3.4.1. Operating Practices.

12.6.3.4.1.1. Operators, who must divert their attention while operating a hoist, will stop the hoist until their undivided attention can be paid to the operation of the hoist. **(T-0)**

12.6.3.4.1.2. When a Danger, Out of Order, Do Not Start or Equipment Lockout tag is attached to the starting controls, the hoist operator shall not apply power to the unit or start operations until the condition has been corrected and the tag and any lock(s) are removed. **(T-0)** Requirements for tags and locks are prescribed in **Chapter 21** and **Chapter 29,** *Mishap Prevention Signs and Tags*. **(T-0)** Refer to paragraph **12.6.3.6.5.1** for additional guidance.

12.6.3.4.1.3. Before starting the hoist, the operator shall ensure all personnel are clear of the area. **(T-0)**

12.6.3.4.1.4. The operator shall be familiar with the equipment and its proper care. **(T-0)** If adjustments or repairs are necessary or any damage is observed or suspected, the operator shall promptly report the problem to the supervisor. **(T-0)**

12.6.3.4.1.5. Operators shall ensure their hands are clear of all moving parts before operating hoists. **(T-0)**

12.6.3.4.1.6. On chain hoists, the operator shall have safe access to the hand chain. **(T-0)**

12.6.3.4.1.7. Manual hoists shall never be operated by other than hand power. **(T-0)**

12.6.3.4.2. Handling the Load.

12.6.3.4.2.1. The rated capacity shall not be exceeded except for properly authorized tests. **(T-0)** If it is known or suspected that a hoist may have been overloaded (other than a required and approved test load), the supervisor shall ensure that all frequent and periodic inspections are completed prior to use. **(T-0)** Refer to paragraphs **12.6.3.5.1** and **12.6.3.5.2**

12.6.3.4.2.2. The hoisting rope or chain shall not be wrapped around the load. **(T-0)**

12.6.3.4.2.3. The load shall be attached to the hook, equipped with a safety latch, by means of slings or other devices designed specifically for the load being lifted. **(T-0)**

12.6.3.4.2.4. Slings or other devices shall be seated properly in the saddle of the hook before lifting operations begin. **(T-0)**

12.6.3.4.2.5. The load shall not be moved or lifted more than a few inches until it is well balanced in a sling or lifting device and center of gravity is known. **(T-0)**

12.6.3.4.2.6. Hoisting the load. Ensure that:

12.6.3.4.2.6.1. Hoist ropes or chains are not twisted about each other. **(T-0)**

12.6.3.4.2.6.2. The load does not contact any obstruction. **(T-0)**

12.6.3.4.2.6.3. Ropes or chains are protected against sharp edges of the load. **(T-0)**

12.6.3.4.2.7. The rope or chain shall be properly seated on the drum sheaves or sprockets before starting the lift. **(T-0)**

12.6.3.4.2.8. Hoists shall not be operated until the hoist unit is centered over the load. **(T-0)**

12.6.3.4.2.9. A hoist shall not be used for hoisting personnel unless specifically designed for this purpose and only if it is the safest means of accomplishing the work. **(T-0)**

12.6.3.4.2.10. Loads shall not be carried over personnel. **(T-0)**

12.6.3.4.2.11. The operator shall test the brakes each time a load is handled by raising the load just enough to clear the floor or supports and checking for brake action. **(T-0)** The lift shall be continued only after ensuring the braking system is operating properly. **(T-0)**

12.6.3.4.2.12. No loaded rope hoist drum shall be lowered where less than two (2) wraps of rope remain on the drum. **(T-0)** Distinctive rope markings may be used to warn the operator the rope wrap limit is being reached. **(T-0)**

12.6.3.4.2.13. The operator shall inch the hoist upward to engage a load and avoid unnecessary stops and starts. **(T-0)**

12.6.3.4.2.14. Suspended loads shall not be left unattended. **(T-0)**

12.6.3.4.2.15. The upper limit device shall not be used as a normal operating control except to inch the hook into place for storage between uses. **(T-0)**

12.6.3.4.2.16. If a load must remain suspended for a considerable time, a pawl or other equivalent means, rather than the brake alone, shall be used to hold the load. **(T-0)** The ground area below the suspended load shall be barricaded to prohibit entry of personnel or equipment. **(T-0)**

12.6.3.4.2.17. Excessive jogging or inching (rapid, repeated starts and stops) of

hoist controls shall be avoided. **(T-0)** Premature wear or possible uncontrolled movement could occur. **(T-0)**

12.6.3.4.3. Personal Protective Equipment (PPE).

12.6.3.4.3.1. Protective helmets shall be worn if there is a potential for injury from falling objects or moving equipment. **(T-0)**

12.6.3.4.3.2. Safety-toe shoes shall be worn by all personnel involved in materials handling when there is a danger of injuries. **(T-0)**

12.6.3.4.3.3. Safety goggles shall be worn when eye injury hazards, such as work-generated dirt, dust or other airborne particles are present. **(T-0)**

12.6.3.4.3.4. Gloves shall be worn by workers performing hooking, unhooking, loading, handling tag lines or unloading operations, when there is a potential for injury from punctures and severe cuts, lacerations and abrasions. **(T-0)**

12.6.3.5. Inspections. The following items shall be inspected for damage or wear at intervals specified, including observations during operation. **(T-0)** Deficiencies shall be carefully examined and the operator and shop or facility supervisor shall determine if they are a safety hazard. **(T-0)**

12.6.3.5.1. Frequent Inspections. Frequent inspections will include:

12.6.3.5.1.1. Past inspection records — review for discrepancies and inspection dates. **(T-0)**

12.6.3.5.1.2. All controls and operation mechanisms —inspect for proper operation as described in paragraph **12.6.3.7.1** **(T-0)** On pendant controls, inspect the electrical and support cable for condition and ensure all labels are present and legible. **(T-0)**

12.6.3.5.1.3. All safety devices, including the upper limit switches — check for proper operation as described in paragraph **12.6.3.7.1** **(T-0)** The block or hoist shall be "inched" into the limit switch, or running at slow speed on multi- or variable-speed hoists, to prevent possible damage. **(T-0)**

12.6.3.5.1.4. Air and hydraulic systems — inspect for deterioration or leakage. **(T-0)**

12.6.3.5.1.5. Hoist chains — inspect and document as outlined in paragraph **12.11.3.1** **(T-0)**

12.6.3.5.1.6. Hoist braking system — check for proper operation. **(T-0)**

12.6.3.5.1.7. Hooks — inspect and document as outlined in paragraph **12.11.5.1** **(T-0)** Hooks having more than five (5) percent of normal throat opening or any apparent bend or twist from the plane from the original baseline measurements shall be replaced. **(T-0)**

12.6.3.5.1.8. Wire ropes — inspect and document as outlined in paragraph **12.11.2.2** **(T-0)**

12.6.3.5.1.9. Other components or hardware — inspect for general security and

serviceability. **(T-0)**

12.6.3.5.2. Periodic. The periodic inspection shall include items in paragraph **12.6.3.5.1,** plus the following:

12.6.3.5.2.1. Past inspection records, AFTO Forms 95 and 244, and any other paper or electronic system records — review for anomalies and discrepancies. **(T-0)**

12.6.3.5.2.2. Drums, load sprockets, and sheaves — check for cracks, uneven wear or other damage. **(T-0)** Sheave grooves shall be smooth and free from surface irregularities which could cause rope damage. **(T-0)**

12.6.3.5.2.3. Motor or load brake — inspect for excessive wear. **(T-0)**

12.6.3.5.2.4. Wire ropes — inspect and document as outlined in paragraph **12.11.2.2** **(T-0)**

12.6.3.5.2.5. Hoist chains — inspect and document as outlined in paragraph **12.11.3.1** **(T-0)**

12.6.3.5.2.6. Hooks — inspect and document as outlined in paragraph **12.11.5.1** Hooks having more than five (5) percent of normal throat opening or any apparent bend or twist from the plane from the original baseline measurements shall be replaced. **(T-0)**

12.6.3.5.2.7. Friction disc — check for wear, glazing or oil contamination. **(T-0)**

12.6.3.5.2.8. Pawls, cams or ratchets on brake mechanisms — check for wear. **(T-0)**

12.6.3.5.2.9. Pawl springs — look for corroded, stretched or broken springs. **(T-0)**

12.6.3.5.2.10. Hook blocks, suspension housing, outrigger, hand chain wheels, chain attachments, clevises, yokes, suspension bolts, shafts, gears, bearings, pins, rollers, locking and clamping devices — look for worn, cracked, corroded or distorted parts. **(T-0)**

12.6.3.5.2.11. Supporting structure — check continued ability to support the imposed loads. **(T-0)**

12.6.3.5.2.12. Controller contactors, limit switches and push button stations on electrical apparatus — look for signs of pitting or deterioration. **(T-0)**

12.6.3.5.2.13. Fasteners — check for evidence of loosening. **(T-0)**

12.6.3.5.2.14. Nuclear-certified hoists—see additional requirements in paragraphs **12.6.3.7.3** and **12.11.5.1.4** **(T-0)**

12.6.3.6. Maintenance.

12.6.3.6.1. Preventive Maintenance. The using organization shall establish a preventive maintenance program based on the manufacturer's recommendations. **(T-1)** If manufacturer's instructions cannot be obtained, the using organization shall contact the Air Force equipment item manager for assistance. **(T-1)** Preventive maintenance shall be documented on the AFTO Form 244, AFTO Form 95 or MAJCOM or locally

devised paper or automated system IAW paragraph **12.1.1,** as appropriate. **(T-1)** These records shall be maintained for the life of the equipment at a location determined by the user. **(T-1)**

12.6.3.6.2. Lubrication. All moving parts of the hoist for which lubrication is specified shall be regularly lubricated. **(T-0)** Manufacturer's or TO recommendations for points and frequency of lubrication and quantity and type of lubricant to be used shall be followed. **(T-0)** Machinery shall be stationary, with energy sources locked out, while lubricants are applied. **(T-0)**

12.6.3.6.3. Rope Replacement and Maintenance. Refer to paragraphs **12.11.2.3** and **12.11.2.4**

12.6.3.6.4. Adjustments and Repairs. Repair, replacements or adjustments shall be made as necessary to ensure correct performance of all hoist components. **(T-0)**

12.6.3.6.4.1. Replace all worn braking components such as friction discs, ratchets, pawls and pawl springs. **(T-0)**

12.6.3.6.4.2. Replace worn, corroded or otherwise damaged load chain and rope. **(T-0)**

12.6.3.6.4.3. Replace hooks showing defects (see paragraph **12.11.5.1**). Repair or replace damaged hook safety latches. **(T-0)**

12.6.3.6.4.4. Replace load supporting components which are cracked, bent or excessively worn. **(T-0)**

12.6.3.6.4.5. Replace missing or illegible warning labels. **(T-0)**

12.6.3.6.4.6. Replace pitted or burned electrical contacts in sets only. **(T-0)**Lubricate controller parts as recommended by the manufacturer. **(T-0)**

12.6.3.6.4.7. Keep pendant control stations clean and function labels legible. **(T-0)**

12.6.3.6.4.8. Adjust all functional operating mechanisms, brakes and pawls, limit switches and other limiting devices to ensure correct functioning. **(T-0)**

12.6.3.6.5. Maintenance Procedures. The following precautions shall be taken before adjustments or repairs are started on a hoist:

12.6.3.6.5.1. A lock and a danger or equipment lockout tag shall be placed on the hoist and all energy controls (air, electrical, hydraulic, etc.) locked out IAW **Chapter 21** when adjustments, modifications or repairs are scheduled. **(T-0)** The hoist operator will not apply power to the equipment or start operations until the conditions have been corrected and the tag and lock removed IAW **Chapter 21. (T-0)**

12.6.3.6.5.2. Drum pawls shall be engaged or other means provided to prevent load ropes from inadvertently rotating the mechanism. **(T-0)**

12.6.3.7. Testing.

12.6.3.7.1. Operational Tests. All new hoists and those which have had load-suspension parts altered, replaced or repaired shall be operationally tested before use.

(T-0) The test shall consist of operating all functions of the hoist under a no-load condition to test all functions of the hoist, including hoisting and lowering, operation of brakes and testing of all limit, locking and safety devices. **(T-0)** Trip-setting of limit devices shall be determined by tests under no-load conditions. Conduct tests first by hand, if practical, and then under slowest possible speed. **(T-0)** Test with increasing speeds up to maximum speed. **(T-0)** Actuated mechanisms shall be located so they trip switches or limiting devices in sufficient time to stop motion without damage to the hoisting arrangement. **(T-0)** On hoists having adjustable trip-setting limit devices, care shall be exercised to achieve adjustment setting without the load block striking the hoist frame or without all the slack being taken out of the unloaded chain or less than one wrap of rope on the drum. **(T-0)**

12.6.3.7.2. Load Tests. Prior to initial use, all new hoists shall be tested, by the manufacturer or a qualified person, at not less than 100 percent or more than 125 percent of the rated load, unless otherwise recommended by the manufacturer. **(T-0)** Using organizations will maintain written certification that all required load testing has been accomplished. **(T-1)** A hoist with altered, replaced or repaired load suspension parts shall be tested at not less than 100 percent or more than 125 percent of the rated load prior to being returned to service. **(T-0)** This load test shall include all functions outlined in paragraph **12.6.3.7.1** **(T-0)** The replacement of load chain or rope is specifically excluded from this test; however, an operational test under a no-load condition shall be conducted prior to putting the hoist back into service. **(T-0)** Refer to paragraph **12.6.3.7.1** Maintain records of these tests as required by paragraph **12.6.3.8** **(T-0)**

12.6.3.7.3. Test nuclear-certified hoists, as required, in paragraphs **12.6.3.7.1** and **12.6.3.7.2,** and annually thereafter at not less than 100 percent or more than 125 percent of rated capacity. **(T-0)** Perform annual tests in conjunction with one of the two semiannual inspections. **(T-0)** Refer to note in paragraph **12.6.3.5.2**

12.6.3.7.4. Hoists, cranes or other similar lifting devices, regardless of type, required to lift critical loads, as defined in **Attachment 1, Terms** (Critical Loads), shall be tested as stated in paragraphs **12.6.3.7.1** and **12.6.3.7.2** and annually thereafter at not less than 100 percent or more than 125 percent of rated capacity. **(T-0)** Air Force materials shall be designated as critical loads for purposes of lifting or hoisting by an appropriate Program Manager or the functional manager at the facility where the lift will occur. **(T-1)** Prior to accomplishing load tests on equipment attached to facility structural members, a qualified person, e.g. civil engineer, shall assess the sufficiency of the structure to withstand the loads being tested. **(T-0)** Items for consideration in making a critical load determination include, but are not limited to:

12.6.3.7.4.1. Personnel injury or significant adverse health impact. **(T-0)**

12.6.3.7.4.2. Damage resulting in serious economic consequences (non-availability of funds to repair or replace item). **(T-0)**

12.6.3.7.4.3. Damage resulting in unacceptable delay to schedule (mission impairment) or adverse programmatic impact (e.g., loss of vital data). **(T-0)**

12.6.3.7.4.4. Undetectable damage that would jeopardize future operations or

safety of a facility. **(T-0)**

12.6.3.7.4.5. Damage that may occur without exceptional care in handling because of close-tolerance installation, high susceptibility to damage or other unusual characteristic. **(T-0)**

12.6.3.7.4.6. Damage that would result in significant release of hazardous materials. **(T-0)**

12.6.3.7.4.7. Damage that may occur because the item, although non-critical, must be lifted above a critical item, e.g., loads of any sort in close proximity to a nuclear component or near concentrations of hazardous materials. **(T-0)**

12.6.3.7.5. Test weights utilized for rated load tests shall be tagged or adequately marked indicating total weight in pounds and owner or agency identification number. **(T-0)** Reinforcing (rebar) steel shall not be used for test weight lift points. **(T-0)**

12.6.3.7.6. Inspections shall be documented on AFTO Form 95 or MAJCOM or locally devised paper or automated systems as outlined in paragraph **12.6.3.8** **(T-1)**

12.6.3.8. Historical Records. A MAJCOM or locally devised paper or automated system, with dated and signed record of all periodic inspections, repairs and tests shall be maintained indefinitely in a location determined by the user. **(T-1)** Refer to paragraph **12.1.1** for additional guidance.

12.7. Slings.

12.7.1. Hazards. Improper use of slings can cause injury, death and property damage. **(T-0)** Mishaps often occur when loads are dropped or slip because the sling or its attachments break. Most sling mishaps can be attributed to inadequate design, improper selection, poor inspection, failure to make sure loads are properly attached and secured, or improper storage and care. Common causes for sling mishaps include:

12.7.1.1. Use of damaged or defective slings.

12.7.1.2. Unauthorized modifications to slings.

12.7.1.3. Kinks in supporting ropes and cables.

12.7.1.4. Overloaded slings.

12.7.1.5. Improperly balanced loads which allow them to slip.

12.7.1.6. Loads not securely attached to the slings.

12.7.1.7. Not using pads to protect sling from sharp edges or corners.

12.7.1.8. Loads hitting obstructions.

12.7.1.9. Personnel standing or walking under suspended loads.

12.7.1.10. Personnel placing hands between sling and load before sling is tightened around load.

12.7.1.11. Sling failure caused by damage when slings are pulled from under a load.

12.7.1.12. Improperly rigged loads.

12.7.1.13. Use of unauthorized equipment such as cargo straps, as slings.

12.7.2. General Requirements.

12.7.2.1. Acquisition. Slings procured for Air Force use shall comply with design and manufacturing requirements in 29 CFR 1910.184, *Sling*s, and American Society of Mechanical Engineers B30.9, *Sling*s. **(T-0)** Specifications for procurement of slings shall contain enough information to ensure that manufacturers comply with all design, construction and testing criteria contained in references above. **(T-0) Note:** Locally manufactured slings that do not meet the engineering requirements of American National Standards Institute/American Society of Mechanical Engineers B30.9 are prohibited and shall be disassembled and removed from service. **(T-0)**

12.7.2.2. Identification and Marking. Slings shall be marked or identified on the sling or on durable and legible tags or labels as follows:

12.7.2.2.1. Alloy steel chain slings shall be permanently marked with size, manufacturer's grade, rated capacity and angle upon which the rating is based, its reach, number of legs and manufacturer's name. **(T-0)**

12.7.2.2.2. Wire rope slings shall be marked with the rated capacity and manufacturer. **(T-0)** Rating capacities include recommended safe working load for the type(s) of hitch(es), angle of use and number of legs if more than one. **(T-0)**

12.7.2.2.3. Metal mesh slings shall have a durable marking permanently attached that states the rated capacity for vertical basket hitch and choker hitch loadings, and marked with the manufacturer's name. **(T-0)**

12.7.2.2.4. Synthetic web slings shall be permanently marked with the name of the manufacturer, the manufacturer's code or stock number, the rated capacity for types of hitches used and the type of synthetic material used. **(T-0)**

12.7.2.3. Inspections.

12.7.2.3.1. Frequent Inspections. A visual inspection shall be performed by the operator or designated person daily or prior to use. **(T-0)** If damage, defects or abuse is detected, the sling shall be removed from service until periodic testing is done. **(T-0)** This inspection will be documented on AFTO Form 244. **(T-1)** Refer to paragraph **12.1.1** concerning use of paper forms and automated systems. **Note:** A prior to use visual inspection accomplished for the first use of the day will suffice for a 24-hour period, e.g., if a sling is used six times during the day, the prior to use inspection for the first use will meet the requirement. **(T-1)**

12.7.2.3.2. Periodic. The following items will be inspected:

12.7.2.3.2.1. Remove all dirt, grease or oil from all sling components. **(T-0)**

12.7.2.3.2.2. Visually inspect all parts for excessive wear, deformations, fraying, stretching and any other defects that may reduce the sling's rated capacity. **(T-0)** Refer to the specific requirements of paragraphs **12.7.3.1** through **12.7.3.5**

12.7.2.3.2.3. Remove sling from service if any component shows defects or deterioration as noted in paragraphs 12.7.3.1 through **12.7.3.5** **(T-0)**

12.7.2.4. Testing. (**Note:** For nuclear-certified slings and wire rope assemblies, use the appropriate 11N series TOs for testing criteria.) **(T-0)**

12.7.2.4.1. Proof Testing. Prior to initial use, all new slings shall be proof tested by the manufacturer or a qualified person. See requirements for specific types of slings in paragraphs **12.7.3.1.1**, **12.7.3.2.1**, **12.7.3.3.1**, **12.7.3.4.1** and **12.7.3.5.1** **(T-0)** Using organizations shall maintain written certification that all required proof testing has been accomplished. **(T-1) Note:** Written proof test certification is not required for new synthetic rope and web slings manufactured IAW American Society of Mechanical Engineers B30.9 and not used to lift nuclear or critical loads. **(T-0)** However, repaired synthetic rope and web slings shall be proof tested IAW paragraph **12.7.2.4.2** **(T-0)**

12.7.2.4.2. All repaired and reconditioned slings shall be proof tested by the manufacturer or a qualified person IAW the specific requirements of paragraphs **12.7.3.1.1**, **12.7.3.3.1** and **12.7.3.5.1** prior to being returned to service. **(T-0)** A record of the most recent proof test shall be retained on file. **(T-0)**

12.7.2.4.3. Load Testing. Any periodic load testing of slings, spreader-bars, lifting beams or other specialized lifting attachments at any load above rated capacity is not a recognized inspection procedure under OSHA's interpretation of 29 CFR 1910.184(e)(4). **(T-0)** Periodic load testing shall only be accomplished with written permission and procedural guidance from the sling manufacturer or equivalent Air Force organization (e.g., the specific equipment TO or the item manager for locally manufactured equipment). **(T-0)**

12.7.3. Specific Requirements.

12.7.3.1. Alloy Steel Chain Slings.

12.7.3.1.1. Prior to use, all new, repaired or reconditioned alloy steel chain slings, including all welded components in the sling assembly shall be proof tested to 200 percent of rated capacity. **(T-0)**

12.7.3.1.1.1. For multiple leg slings, each leg shall be proof tested to 200 percent of the single leg rated load. **(T-0)**

12.7.3.1.1.2. Master links and master coupling links for double or triple leg slings shall be proof tested to 200 percent of the single leg rated load times the number of legs connected to the link. **(T-0)**

12.7.3.1.2. Hooks, rings, oblong or pear-shaped links, welded or mechanical coupling links or other attachments shall have a rated capacity at least equal to that of the alloy steel chain with which they are used. **(T-0)** The sling shall not be proof tested in excess of the rated capacity of the weakest component. **(T-0)**

12.7.3.1.3. Unauthorized makeshift links or fasteners, such as those formed from bolts or rods, shall not be used. **(T-0)**

12.7.3.1.4. Alloy steel chain slings shall not be used with loads more than the rated capacities. **(T-0)** Slings not included in this table shall be used only IAW the manufacturer's recommendations. **(T-0)**

12.7.3.1.5. Alloy steel chain slings shall be permanently removed from service if exposed to heat above 1,000 degrees Fahrenheit (F). **(T-0)** When exposed to service temperature in excess of 600 degrees F, maximum working load limits shall be reduced according to the chain or sling manufacturer's recommendations. **(T-0)**

12.7.3.1.6. Worn or damaged alloy steel chain slings and attachments shall not be used until repaired (or reconditioned) and proof tested by the manufacturer or a qualified person. **(T-0)**

12.7.3.1.7. Mechanical coupling links or low carbon steel repair links shall not be used to repair broken lengths of chain. **(T-0)**

12.7.3.1.8. Alloy steel chain slings with cracked or deformed master links, coupling links or other components shall be removed from service. **(T-0)**

12.7.3.1.9. Slings will be removed from service if hooks are cracked, have any visibly apparent been or twist from the plane of the unbent hook (original manufacturer or baseline measurements), any distortion causing an increase in throat opening of five (5) percent, not to exceed ¼ inch (or as recommended by the manufacturer), or any wear exceeding 10 percent (or as recommended by the hook manufacturer) of the original manufacturer or baseline section dimension of the hook. **(T-0)** Refer to paragraph **12.11.5.1**

12.7.3.2. Wire Rope Slings.

12.7.3.2.1. Prior to initial use, all new wire rope slings shall be proof tested as follows:

12.7.3.2.1.1. Proof load for swaged-socket and poured-socket assemblies shall be IAW the wire rope or fitting manufacturer's recommendations. **(T-0)**

12.7.3.2.1.2. Proof load for single leg hand tucked slings shall be not less than 100 percent or more than 125 percent of the rated capacity. **(T-0)**

12.7.3.2.1.3. Proof load for mechanical splice single leg slings and endless slings shall be 200 percent of the vertical rated capacity. **(T-0)**

12.7.3.2.1.4. Proof load for multiple leg bridle slings shall be applied to the individual legs and shall be 200 percent of the vertical rated capacity of a single leg sling of the same size, grade and construction of rope. **(T-0)**

12.7.3.2.2. Wire rope slings shall not be used with loads in excess of capacities. Slings not included in these tables shall be used only IAW the manufacturer's recommendations. **(T-0)**

12.7.3.2.3. Minimum sling lengths are determined as follows:

12.7.3.2.3.1. Cable laid and 6 by 19 and 6 by 37 slings shall have a minimum clear length of wire rope between splices, sleeves or end fittings 10 times the component rope diameter. **(T-0)**

12.7.3.2.3.2. Braided slings shall have a minimum clear length of wire rope between loops or end fittings 40 times the component rope diameter. **(T-0)**

12.7.3.2.3.3. Cable laid grommets, strand laid grommets and endless slings shall have a minimum circumferential length of 96 times their body diameter. **(T-0)**

12.7.3.2.4. Fiber core wire rope slings of all grades shall be permanently removed from service if exposed to temperatures in excess of 200 degrees F. **(T-0)** When non-fiber core wire rope slings of any grade are used above 400 degrees F or below minus 60 degrees F, sling manufacturer recommendations regarding use at that temperature shall be followed. **(T-0)**

12.7.3.2.5. Wire rope slings shall be removed from service if any of the following conditions are present:

12.7.3.2.5.1. Ten randomly distributed broken wires in one rope lay or five broken wires in one strand in one rope lay. **(T-0)**

12.7.3.2.5.2. Wear or scraping of 1/3 the original diameter of outside individual wires. **(T-0)**

12.7.3.2.5.3. Kinking, crushing, bird caging or any other damage that distorts the wire rope structure. **(T-0)**

12.7.3.2.5.4. Heat damage. **(T-0)**

12.7.3.2.5.5. Cracked, deformed or worn s. **(T-0)**

12.7.3.2.5.6. Sling hooks that have any visibly apparent bend or twist from the plane of the unbent hook (original manufacturer or baseline measurements), any distortion causing an increase in throat opening of five (5) percent, not to exceed ¼ inch (or as recommended by the manufacturer), or any wear exceeding 10 percent (or as recommended by the hook manufacturer) of the original manufacturer or baseline section dimension of the hook. **(T-0)** Refer to paragraph **12.11.5.1.1**

12.7.3.2.5.7. Corrosion of rope or s. **(T-0)**

12.7.3.2.6. Only new rope shall be used to fabricate slings. **(T-0)** Use of repaired or reconditioned rope is prohibited. **(T-0)**

12.7.3.2.7. Slings used in a choker hitch shall be long enough so the choke point is on the rope and never on a splice. **(T-0)**

12.7.3.3. Metal Mesh Slings.

12.7.3.3.1. All new and repaired metal mesh slings, including handles, shall be proof tested at a minimum of 150 percent of their rated capacity before use. **(T-0)** Elastomer impregnated slings shall be proof tested before they are coated. **(T-0)**

12.7.3.3.2. Handles shall have a rated capacity at least equal to the metal fabric and exhibit no deformation after proof testing. **(T-0)**

12.7.3.3.3. The fabric and handles shall be joined so that:

12.7.3.3.3.1. The rated capacity of the sling is not reduced. **(T-0)**

12.7.3.3.3.2. The load is evenly distributed across the width of the fabric. **(T-0)**

12.7.3.3.3.3. Sharp edges shall not damage the fabric. **(T-0)**

12.7.3.3.4. Coatings which damage the sling and diminish the rated capacity shall not be applied. **(T-0)**

12.7.3.3.5. Except for required proof tests, metal mesh slings shall not be used to lift loads in excess of their rated capacities. **(T-0)** Slings not included in this table shall be used only IAW the manufacturer's recommendations. **(T-0)**

12.7.3.3.6. Metal mesh slings not impregnated with elastomers may be used from minus 20° F to 550o F without decreasing the working load limit. **(T-0)** Metal mesh slings impregnated with polyvinyl chloride or neoprene may be used only from 0oF to 200o F. **(T-0)** For operations outside these temperature ranges or for metal mesh slings impregnated with other materials, the sling manufacturer's recommendations shall be followed. **(T-0)**

12.7.3.3.7. Metal mesh slings shall be removed from service if any of the following conditions are present:

12.7.3.3.7.1. Broken weld or broken brazed joint along the sling edge. **(T-0)**

12.7.3.3.7.2. Reduction in wire diameter of 25 percent due to abrasion or 15 percent due to corrosion. **(T-0)**

12.7.3.3.7.3. Lack of flexibility due to distortion of the fabric. **(T-0)**

12.7.3.3.7.4. Distortion of the female handle so slot depth is increased more than 10 percent. **(T-0)**

12.7.3.3.7.5. Distortion of either handle so width is decreased more than 10 percent. **(T-0)**

12.7.3.3.7.6. Reduction of 15 percent of the original cross-sectional area of metal at any point around the handle eye. **(T-0)**

12.7.3.3.7.7. Distortion of either handle out of its plane. **(T-0)**

12.7.3.3.7.8. Cracked end fitting. **(T-0)**

12.7.3.3.7.9. A broken wire in any part of the mesh. **(T-0)**

12.7.3.4. Natural and Synthetic Fiber Rope Slings. **(T-0)**

12.7.3.4.1. Prior to use, new fiber rope slings shall be proof tested to 200 percent of the vertical rated load. **(T-0) Note:** Written proof test certification is not required for new synthetic rope slings manufactured IAW American Society of Mechanical Engineers B30.9, *Slings,* and not used to lift nuclear or critical loads. **(T-0)**

12.7.3.4.2. Fiber rope slings made from conventional three-strand construction rope shall not be used with loads in excess of rated capacities. **(T-0)**

12.7.3.4.3. Cargo straps shall not be used as a sling or part of a sling configuration. **(T-0)**

12.7.3.4.4. Slings not included in these tables shall be used only IAW the manufacturer's recommendations. **(T-0)**

12.7.3.4.5. Natural and synthetic fiber rope slings, except for wet frozen slings, may be used in a temperature range from (minus) 20oF to (positive) 180oF without decreasing the working load. **(T-0)** For operations outside this temperature range and

for wet frozen slings, or where rope and slings have been stored in a chemically active environment, the sling manufacturer's recommendations shall be followed. **(T-0)**

12.7.3.4.6. Spliced fiber rope slings shall not be used unless spliced IAW the following minimum requirements and any additional manufacturer recommendations:

12.7.3.4.6.1. In manila rope, eye splices shall consist of at least three (3) full tucks. **(T-0)** Short splices shall consist of at least six (6) full tucks, three (3) on each side of the splice center line. **(T-0)**

12.7.3.4.6.2. In synthetic fiber rope, eye splices shall consist of at least four (4) full tucks. **(T-0)** Short splices shall consist of at least eight (8) full tucks, four (4) on each side of the center line. **(T-0)**

12.7.3.4.6.3. Strand end tails shall not be trimmed flush with the surface of the rope immediately adjacent to the full tucks. **(T-0)** This applies to all types of fiber rope and both eye and short splices. **(T-0)** For fiber rope, the tail shall project at least six (6) rope diameters beyond the last full tuck. **(T-0)** Where a projecting tail interferes with the use of the sling, the tail shall be tapered and spliced into the body of the rope using at least two (2) additional tucks (which shall require a tail length of approximately six (6) rope diameters beyond the last full tuck). **(T-0)**

12.7.3.4.6.4. Fiber rope slings shall have a minimum clear length of rope between eye splices equal to 10 times the rope diameter. **(T-0)**

12.7.3.4.6.5. For all eye splices, the eye shall be sized to provide an included angle of not greater than 60 degrees at the splice when the eye is placed over the load or support. **(T-0)**

12.7.3.4.6.6. Only clamps specifically designed for fiber ropes shall be used for splicing. **(T-0)**

12.7.3.4.6.7. Knots shall not be used in lieu of splices. **(T-0)**

12.7.3.4.7. Fiber rope slings shall not be used if s that contact the rope have sharp edges or projections. **(T-0)**

12.7.3.4.8. Natural and synthetic fiber rope slings shall be removed from service if any of the following conditions are present:

12.7.3.4.8.1. Abnormal wear. **(T-0)**

12.7.3.4.8.2. Powdered fiber between strands. **(T-0)**

12.7.3.4.8.3. Broken or cut fibers. **(T-0)**

12.7.3.4.8.4. Variations in size or roundness of strands. **(T-0)**

12.7.3.4.8.5. Discoloration or rotting. **(T-0)**

12.7.3.4.8.6. Distortion of hardware in the sling. **(T-0)**

12.7.3.4.9. Only new rope shall be used to make fiber rope slings. **(T-0)** Use of repaired or reconditioned fiber rope slings is prohibited. **(T-0)**

12.7.3.5. Synthetic Web Slings.

12.7.3.5.1. Prior to use, all new and repaired synthetic web slings shall be proof tested to 200 percent of rated capacity. **(T-0) Note:** Written proof test certification is not required for new synthetic rope slings manufactured IAW American Society of Mechanical Engineers B30.9, *Slings*, and not used to lift nuclear or critical loads. **(T-0)**

12.7.3.5.2. Synthetic webbing shall be of uniform thickness and width, and selvage edges shall not be split from the webbing's width. **(T-0)**

12.7.3.5.3. Fittings shall be:

12.7.3.5.3.1. Of a minimum breaking strength equal to that of the sling. **(T-0)**

12.7.3.5.3.2. Free of all sharp edges that could damage the webbing. **(T-0)**

12.7.3.5.4. Stitching shall be the only method used to attach end fittings to webbing and to form eyes. **(T-0)** The thread shall have an even pattern and contain a sufficient number of stitches to develop the full breaking strength of the sling. **(T-0)**

12.7.3.5.5. Except for required proof tests, synthetic web slings shall not be used with loads in excess of rated capacities specified in **Table 12.1** through **Table 12.3** **(T-0)** Slings not included in these tables shall be used only IAW the manufacturer's recommendations. **(T-0)**

12.7.3.5.6. When synthetic web slings are used, the following precautions shall be taken:

12.7.3.5.6.1. Nylon web slings shall not be used where acid or phenolic fumes, vapors, sprays, mists or liquids are present. **(T-0)**

12.7.3.5.6.2. Polyester and polypropylene web slings shall not be used where caustic fumes, vapors, sprays, mists or liquids of acids are present. **(T-0)**

12.7.3.5.6.3. Web slings with aluminum fittings shall not be used where caustic fumes, vapors, sprays, mists or liquids are present. **(T-0)**

12.7.3.5.7. Synthetic web slings of polyester and nylon shall not be used at temperatures in excess of 180° F. Polypropylene web slings shall not be used at temperatures in excess of 200° F. **(T-0)**

12.7.3.5.8. Slings, including webbing and fittings, with temporary or makeshift repairs shall not be used. **(T-0)**

12.7.3.5.9. Synthetic web slings shall be removed from service if any of the following conditions are present:

12.7.3.5.9.1. Damage from acid or caustic materials. **(T-0)**

12.7.3.5.9.2. Melting or charring of any part of sling surface. **(T-0)**

12.7.3.5.9.3. Snags, punctures, tears or cuts. **(T-0)**

12.7.3.5.9.4. Broken or worn stitches. **(T-0)**

12.7.3.5.9.5. Distortion of fittings. **(T-0)**

12.7.3.5.10. When not in use, slings shall be stored in clean, dry areas that will protect the sling materials. **(T-0)**

12.8. Overhead, Gantry, and Underhung Cranes and Monorail Systems. This paragraph outlines requirements for overhead and gantry cranes, including top-running single or multiple girder bridge with top-running trolley hoists, top-running single-girder bridge with underhung hoists and monorails/underhung cranes and others having the same fundamental characteristics. Hoist requirements of paragraph **12.6** are applicable to this chapter. Hoist requirements of this chapter also apply to hoists used as components of cranes or monorail systems.

12.8.1. Hazards. The most serious injury potential from cranes and monorails is caused by loads contacting personnel. Bruises, lacerations, pinching and fractures are associated with loading, unloading and load transporting operations. Common operator errors include:

12.8.1.1. Striking personnel or objects with moving loads.

12.8.1.2. Personnel falling from equipment.

12.8.1.3. Dropping or slipping loads, usually caused by improper hitching or slinging.

12.8.1.4. Personnel not wearing required PPE, such as hard hats, gloves, safety-toe shoes and eye protection.

12.8.1.5. Overloading.

12.8.1.6. Obstruction to free passage of load.

12.8.1.7. Misuse of equipment.

12.8.1.8. Inadvertent movement of equipment or loads.

12.8.1.9. Failure to use available safety devices such as brakes, locks and warning signals.

12.8.1.10. Failure to detect equipment deficiencies or malfunctions.

12.8.1.11. Acceptance of “minor” deficiencies, which can develop into major or critical deficiencies.

12.8.1.12. Deviation from approved procedures.

12.8.1.13. Improper and insufficient training.

12.8.2. Requirements.

12.8.2.1. Acquisition.

12.8.2.1.1. All new overhead and gantry cranes constructed and installed on or after 31 August 1971 will meet American Society of Mechanical Engineers B30.2, *Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist*), and B30.11, *Monorails and Underhung Crane*s. **(T-0)** Cranes constructed before 31 August 1971 shall be modified to conform to these design specifications, unless a qualified person can show the crane cannot feasibly or economically be altered and substantially complies with requirements of this standard. **(T-1)** Contracts for procurement of overhead and gantry cranes shall mandate compliance with Crane Manufacturers Association of America 70, or Crane Manufacturers Association of America 74, as applicable, and appropriate American Society of Mechanical Engineers/American Society of Mechanical Engineers B30

series standards. **(T-0) Note:** Nuclear-certified hoists must also meet requirements in AFMAN 91-118. **(T-1)**

12.8.2.1.2. Hazards shall be identified by a System Safety Analysis, MIL-STD-882, *DoD Standard Practice for System Safety*, or commercial equivalent. **(T-0)** The procuring activity shall specify the required analyses, such as preliminary hazard analysis or operating hazard analysis. **(T-1)**The results of these analyses shall be included in applicable contract deliverable documents. **(T-1)**

12.8.2.2. General.

12.8.2.2.1. Cranes may be modified and re-rated, if the modifications and the supporting structures are checked thoroughly by a qualified engineer or the equipment manufacturer. **(T-0)** The crane shall be tested IAW paragraph **12.8.2.7** **(T-0)**The new rated capacity shall be displayed on the crane or hoist. **(T-0)**

12.8.2.2.2. The rated capacity of the crane shall be plainly marked on each side of the crane. **(T-0)** If the crane has more than one hoisting unit, each unit shall have its rated capacity marked on it or its load block, and this marking shall be clearly visible from the floor or ground. **(T-0)**

12.8.2.2.3. A minimum clearance of three (3) inches overhead and two (2) inches laterally shall be maintained between crane and obstructions. **(T-0)**

12.8.2.2.4. Where passageways or walkways are provided, obstructions shall not be placed so the safety of personnel is jeopardized by movements of the crane. **(T-0)**

12.8.2.2.5. The general arrangement of the cab and location of control and protective equipment shall be such that all operating handles are within convenient reach of the operator when facing the area served by the load hook or while facing the direction of travel of the cab. **(T-0)** The arrangement shall allow the operator a full view of the load hook in all positions. **(T-0)**

12.8.2.2.6. Pendant and cab hoist controls for trolley and bridge movement shall use compass points (north, south, east and west) as the preferred identification whenever possible. **(T-0)**

12.8.2.2.7. Hoists utilizing synchronous controls for multiple point lifting movements shall be of failsafe design to preclude inadvertent operation caused by malfunctions of selector switches, power failure or improper sequencing of controls. **(T-0)**

12.8.2.2.8. Access to the cab and bridge walkway shall be by a conveniently placed fixed ladder, stairs or platform requiring no step over any gap exceeding 12 inches. **(T-0)** Fixed ladders shall be designed and installed IAW 29 CFR 1910.27, *Fixed Ladder*s. Also, refer to **Chapter 7,** *Walking – Working Surfaces* for specific ladder requirements. **(T-0)**

12.8.2.2.9. A carbon dioxide or dry chemical (or equivalent) fire extinguisher rated at least 10 BC shall be kept in the cab. **(T-0)**

12.8.2.2.10. Pendant control boxes and fixed control stations shall be constructed to prevent electrical shock and be clearly and legibly marked for identification of functions. **(T-0)**

12.8.2.2.11. Except for floor-operated cranes, a gong, buzzer or other effective warning signal shall be provided for each power traveling crane. **(T-0)**

12.8.2.2.12. The hoist of all electric traveling cranes shall have an over-travel limit switch in the hoisting direction. **(T-0)**

12.8.2.2.13. Emergency descent means shall be provided on all crane cabs. **(T-0)** Rope hand line is not acceptable. Only approved controlled descent devices shall be used. **(T-0)**

12.8.2.2.14. Crane operators shall not be placed in situations dangerous to life, health or which may pose safety hazards. **(T-0)**

12.8.2.2.15. Lift eyes or lift points used to attach slings, clevis, shackles or hooks shall be constructed of forged or alloy steel. **(T-0)** Rebar steel shall not be permitted as attach points for any load. **(T-0)**

12.8.2.2.16. Monorail Hoists. Monorail hoists shall not be used to move objects by pulling side-ways, unless designed for that purpose. **(T-0)** Each trolley frame shall be safeguarded against spreading. **(T-0)** Monorail track and track supports shall be installed IAW manufacturer's installation specifications and capable of safely carrying intended loads. **(T-0)** Rail stops shall be provided at ends of the monorail track and will extend at least as high as the radius of the wheels. **(T-0)** At switches, turntables and transfer tables, automatic bumpers shall drop into position to prevent the trolley running off open ends of fixed and movable track if not properly lined up with each other. **(T-0)** Conversely, the track shall be interlocked with the bumpers so the track cannot move until rail stops are in position. **(T-0)**

12.8.2.2.17. Refer to paragraph **12.11** for information on hoisting equipment, such as sheaves, ropes and equalizers. **(T-0)**

12.8.2.3. Qualification of Operators. Cranes shall be operated only by properly trained and qualified personnel or trainees under the direct supervision of a qualified trainer/instructor as designated by the appropriate supervisor. **(T-0)** The operator shall be familiar with all operating controls of the hoist and be instructed in operations to be performed. **(T-0)** Instructions shall include warnings on the hoist, manufacturer's instructions and requirements in this paragraph and paragraph **12.8.2.4** below. **(T-0)**

12.8.2.3.1. Cab-Operated and Pulpit-Operated Equipment.

12.8.2.3.1.1. Operators shall be qualified by military Air Force specialty training, training from a qualified person or instructor, or provide satisfactory evidence of prior qualification and experience. **(T-0)** Qualification shall be limited to the specific type equipment for which examined. **(T-0)**

12.8.2.3.1.2. Operators shall meet the following minimum physical qualifications of American Society of Mechanical Engineers B30.5, *Mobile and Locomotive Cranes* (5-3.1.2: *Qualifications for Operators)*:

12.8.2.3.1.2.1. Have vision of at least 20/30 in one eye, and 20/50 in the other, with or without corrective lenses. **(T-0)**

12.8.2.3.1.2.2. Be able to distinguish red, green and yellow, regardless of

position of colors, if color differentiation is required for operation. **(T-0)**

12.8.2.3.1.2.3. Test for ordinary conversation in one ear, with or without a hearing aid to ensure there is adequate hearing for a specific operation. **(T-0)**

12.8.2.3.1.2.4. Evidence of physical defect, or emotional instability which could render the operator a hazard to themselves or others, or which, in the opinion of the examiner or supervisor, could interfere with the operator's safe performance, may be sufficient cause for disqualification. **(T-0)** In such cases, specialized clinical or medical judgments and tests may be required. **(T-0)** **Note:** A history of epilepsy or a disabling heart condition may be sufficient reason for disqualification, upon recommendation from proper medical authority. **(T-0)**

12.8.2.3.1.3. Potential operator trainees shall have good depth perception, field of vision, reaction time, manual dexterity or coordination and no tendencies to dizziness or similar undesirable characteristics. **(T-0)** Physical defects such as loss of arm, hand, leg, foot or gross loss of function thereof shall be considered as cause for denial of acceptance into an entry level training program for operators. **(T-0)**

12.8.2.3.2. Floor-Operated Equipment.

12.8.2.3.2.1. Operators shall pass a practical operating examination administered by a qualified operator or instructor. **(T-0)**

12.8.2.3.2.2. Qualification shall be limited to the specific type equipment for which examined. **(T-0)**

12.8.2.4. Safe Operations.

12.8.2.4.1. Cab-Operated and Pulpit-Operated Equipment.

12.8.2.4.1.1. Equipment shall only be operated only by:

12.8.2.4.1.1.1. Qualified person. **(T-0)**

12.8.2.4.1.1.2. Trainees under the direct supervision of a qualified person. **(T-0)**

12.8.2.4.1.1.3. Maintenance and test personnel, when necessary in performance of their duties. **(T-0)**

12.8.2.4.1.1.4. Qualified inspectors. **(T-0)**

12.8.2.4.1.2. No one, other than personnel specified above, will enter a cab or pulpit, except for maintainers and supervisors whose duties require them to do so, and then only when performing their duties and with the knowledge of the operator or appointed person. **(T-0)**

12.8.2.4.2. Floor-Operated Equipment. Equipment shall only be operated by:

12.8.2.4.2.1. Qualified person. **(T-0)**

12.8.2.4.2.2. Trainees under the direct supervision of a qualified person. **(T-0)**

12.8.2.4.2.3. Maintenance and test personnel, when it is necessary in the performance of their duties. **(T-0)**

12.8.2.4.2.4. Qualified inspectors. **(T-0)**

12.8.2.4.3. Remote-Operated or Automatic Equipment. Remote control or automatic equipment involves a wide variety of service requirements and conditions. Each installation shall be carefully analyzed and the operation reviewed at least monthly for the first six (6) months to determine whether paragraph **12.8.2.4.1** or **12.8.2.4.2** will apply. **(T-0)**

12.8.2.4.4. Operating Practices.

12.8.2.4.4.1. Operators shall not divert their attention while actually engaged in operating the equipment. **(T-0)**

12.8.2.4.4.2. An operator shall not operate equipment when physically or mentally unfit. **(T-0)**

12.8.2.4.4.3. The operator will respond to signals only from the person directing the lift or a designated signal person, but will obey a stop signal at all times. **(T-0)**

12.8.2.4.4.4. Each operator shall be held directly responsible for the safe operation of the equipment. **(T-0)** When safety is in doubt, the operator will stop and refuse to handle loads until safety has been ensured. **(T-0)**

12.8.2.4.4.5. IAW 29 CFR 1910.179, *Overhead and Gantry Cranes,* a warning signal, if required, shall be sounded each time before traveling and intermittently during travel, particularly when approaching personnel. **(T-0)**

12.8.2.4.4.6. Before leaving the equipment unattended, the operator will lower the load to the ground, place controls in the "*OFF*" position, and open the main line switch of the equipment. **(T-0)**

12.8.2.4.4.7. If the operator finds the main or emergency switch open (off) when starting on duty, he or she will not close it (turn it on) until making certain no one is on or about the equipment. **(T-0)** If there is a warning tag on the main switch or the switch is locked out, only the supervisor or person placing the tag or lock shall remove it as prescribed in **Chapter 21**. **(T-0)**

12.8.2.4.4.8. Before closing the main switch, the operator shall ensure all controllers are in the "*OFF*" position. **(T-0)**

12.8.2.4.4.9. If power goes off during operation, the operator will immediately move all controllers to the "*OFF*" position. **(T-0)**

12.8.2.4.4.10. The operator shall be familiar with the equipment and its proper care. **(T-0)** If adjustments or repairs are necessary (or any damage is observed) the operator shall report it promptly to the appointed person and notify the next operator of the deficiencies when changing shifts. **(T-0)** The results of the above shall be carefully recorded in the logbook, in full detail, and shall be dated and signed. **(T-1)**

12.8.2.4.4.11. Contacts with stops or other equipment shall be made with extreme caution and only after all persons on or below equipment are aware of the action. **(T-0)**

12.8.2.4.4.12. Before departing the work area, operators of outdoor cranes shall secure them to prevent inadvertent movement. **(T-0)**

12.8.2.4.4.13. When a wind-indicating alarm is given, the bridge on outside cranes shall be anchored. **(T-0)**

12.8.2.4.4.14. Before performing any maintenance work, the operator or maintainer will lock the main switch in the open position. **(T-0)** Refer to **Chapter 21** for proper lockout/tagout procedures. **(T-0)**

12.8.2.4.4.15. All controls shall be tested by the operator when beginning a new shift except when an operation is in progress. **(T-0)** If any controls do not operate properly, they shall be adjusted or repaired before operations begin. **(T-0)** Refer to **Chapter 21** for proper lockout/tagout procedures. **(T-0)**

12.8.2.4.5. Handling the Load.

12.8.2.4.5.1. Equipment shall not be loaded beyond rated capacity except for tests IAW paragraph **12.8.2.7.2** **(T-0)**

12.8.2.4.5.2. When attaching the load, ensure:

12.8.2.4.5.2.1. Hoist chain or hoist rope is free from kinks or twists and not wrapped around the load. **(T-0)**

12.8.2.4.5.2.2. Load is attached to load hook by slings or other approved devices. **(T-0)**

12.8.2.4.5.2.3. Care is taken to ensure sling clears all obstacles. **(T-0)**

12.8.2.4.5.2.4. Slings or other approved devices are seated properly in the hook saddle before operation. **(T-0)**

12.8.2.4.5.3. When moving the load:

12.8.2.4.5.3.1. Appointed person directing the lift shall ensure the load is secured and properly balanced in the sling or lifting device before lifting more than a few inches. **(T-0)**

12.8.2.4.5.3.2. Before starting to lift, check that:

12.8.2.4.5.3.2.1. Hoist rope or chain is not kinked or twisted. **(T-0)**

12.8.2.4.5.3.2.2. Multiple part lines are not twisted around each other. **(T-0)**

12.8.2.4.5.3.2.3. The hook is brought over the load in a way that prevents swinging. **(T-0)**

12.8.2.4.5.3.2.4. The rope is seated in drum grooves and sheaves, if there is or has been a slack rope condition. **(T-0)**

12.8.2.4.5.3.3. Tag lines shall be used on all free swinging loads. **(T-0)**

12.8.2.4.5.4. During hoisting, care shall be taken that:

12.8.2.4.5.4.1. There is no sudden acceleration or deceleration of the moving load. **(T-0)**

12.8.2.4.5.4.2. Load does not contact any obstructions. **(T-0)**

12.8.2.4.5.4.3. Equipment is not used for side pulls except when specifically authorized by a qualified person who has determined the suitability of the equipment. **(T-0)**

12.8.2.4.5.4.4. The operator does not hoist, lower or travel while anyone is on the load or hook unless specifically recommended by the manufacturer, approved by MAJCOM, DRU or FOA, and so indicated on a permanent name plate attached to the hoist. **(T-0)** Refer to paragraph **12.11.7** and 29 CFR 1926.1400, *Cranes and Derrick*s *in Construction*, for additional guidance. **(T-0)**

12.8.2.4.5.4.5. The operator does not carry loads over personnel. **(T-0)**

12.8.2.4.5.4.6. The operator tests the brakes each time a load is handled by raising the load two (2) inches above floor or ground level and applying the brakes. **(T-0)**

12.8.2.4.5.4.7. The load is not lowered beyond two (2) full wraps of rope remain on the hoisting drum. (**Exception:** One wrap may remain on drum if a lower limit device is provided.) **(T-0)**

12.8.2.4.5.4.8. When two (2) or more cranes are used to lift one load, one designated person shall be responsible for the operation. **(T-0)** He or she shall analyze the operation and instruct all personnel involved in proper positioning, rigging of load and movements to be made. **(T-0)**

12.8.2.4.5.4.9. The operator shall not leave his/her position at the controls while the load is suspended. **(T-0)**

12.8.2.4.5.4.10. A warning signal shall be given when starting the equipment and when the load or hook approaches near personnel. **(T-0)**

12.8.2.4.5.4.11. Appropriate clearance shall be maintained between electrical power sources and any part of the crane. **(T-0)** Refer to paragraph **12.9.2.3.39** for specific guidance.

12.8.2.4.6. Signals and Instruction. Voice communication equipment (telephone, radio or equivalent) shall be fully operational when used. **(T-0)** Signals and instructions shall be distinct at all times. Hand signals shall be conspicuously posted on or immediately near all cranes. **(T-0)**

12.8.2.4.7. Personal Protective Equipment (PPE).

12.8.2.4.7.1. Protective helmets shall be worn if falling objects or moving equipment pose a hazard. **(T-0)**

12.8.2.4.7.2. Safety-toe shoes shall be worn by all personnel when a foot hazard exists. **(T-0)**

12.8.2.4.7.3. Protective safety goggles shall be worn when eye hazards, such as work-generated dirt, dust, or other airborne particles are present. **(T-0)**

12.8.2.4.7.4. Gloves shall be worn when hooking, unhooking, loading, handling

tag lines or unloading operations, and to protect hands from punctures, severe cuts, lacerations and abrasions. **(T-0)**

12.8.2.4.7.5. Before using any PPE, refer to JHA guidance in paragraph **1.5** and **Chapter 14. (T-1)**

12.8.2.4.8. Miscellaneous Requirements.

12.8.2.4.8.1. Ladders and Footwalks.

12.8.2.4.8.1.1. Workers shall keep hands unencumbered while using ladders. **(T-0)**

12.8.2.4.8.1.2. Articles too large to be carried in pockets or belts shall be lifted and lowered by hand line. **(T-0)**

12.8.2.4.8.1.3. Footwalks shall be kept free of loose tools, parts or other tripping hazards. **(T-0)**

12.8.2.4.8.2. Cabs.

12.8.2.4.8.2.1. Necessary clothing and personal belongings shall be stored so they do not interfere with access or operation. **(T-0)**

12.8.2.4.8.2.2. Tools shall be stored in approved tool boxes. **(T-0)** Wastes shall be disposed of in appropriate containers. **(T-0)** No loose articles shall be left in or about the cab. **(T-0)**

12.8.2.4.8.3. Fire Extinguishers. Supervisors shall ensure operators are familiar with the operation and care of fire extinguishers provided. **(T-0)** Refer to paragraph **12.8.2.2.9** for specific guidance.

12.8.2.5. Inspections.

12.8.2.5.1. Frequent Inspections. Frequent inspections will include the items in paragraph **12.6.3.5.1,** as applicable, and the following:

12.8.2.5.1.1. The track and its support for signs of weakness, wear or misalignment. **(T-0)**

12.8.2.5.1.2. Tanks, valves, pumps, lines and other parts of air or hydraulic systems for leakage. **(T-0)**

12.8.2.5.2. Periodic. This inspection shall include requirements in paragraphs **12.6.3.5.2** and **12.8.2.5.1,** as applicable, plus the following: **(T-0)**

12.8.2.5.2.1. Deformed, cracked or corroded members. **(T-0)**

12.8.2.5.2.2. Worn, cracked or distorted parts, such as pins, bearings, wheels, shafts, gears, rollers, locking and clamping devices, bumpers, switch baffles, interlock bolts and trolley stops. **(T-0)**

12.8.2.5.2.3. Worn drive wheels and/or tires. **(T-0) Note:** For suspended powered monorail or overhead gantry systems, inspect the following in addition to requirements above:

12.8.2.5.2.3.1. Power rails for misalignment at all splices, switches and rail-

end joints. **(T-0)**

12.8.2.5.2.3.2. All rail hangers for security. **(T-0)**

12.8.2.5.2.3.3. Idlers at switches. Clean paths and lubricate as necessary. **(T-0)**

12.8.2.5.2.3.4. Switches throughout rail travel for alignment. **(T-0)**

12.8.2.5.2.4. See paragraph **12.8.2.7.3** for additional requirements for nuclear loads.

12.8.2.6. Maintenance.

12.8.2.6.1. Preventive Maintenance.

12.8.2.6.1.1. The using organization shall establish a preventive maintenance program based on the manufacturer's recommendations. **(T-0)** If manufacturer's instructions cannot be obtained, the using organization shall contact the Air Force equipment item manager for assistance. **(T-0)** Preventive maintenance shall be documented on AFTO Form 95 or AFTO Form 244, or MAJCOM or locally devised paper or automated system IAW paragraph **12.1.1,** as appropriate. **(T-1)** These records shall be maintained for the life of the equipment at a location determined by the user. **(T-1)**

12.8.2.6.1.2. All replacement parts shall be obtained from the original equipment manufacturer or a manufacturer-approved source. **(T-0)**

12.8.2.6.2. Maintenance Procedures.

12.8.2.6.2.1. The following precautions shall be taken before adjustments and repairs are started:

12.8.2.6.2.1.1. Movable equipment shall be moved to a location where it will cause the least interference with other moving equipment and operations in the area. **(T-0)**

12.8.2.6.2.1.2. All controllers shall be placed at the "*OFF*" position. **(T-0)**

12.8.2.6.2.1.3. If electrically powered, the main or emergency switch shall be locked in an open (off) position except for tests. **(T-0)** A danger or equipment lockout tag shall be placed on the main switch. **(T-0)** Refer to **Chapter 21** for specific guidance on lockout/tagout procedures.

12.8.2.6.2.1.4. Where other moving units are in operation on the same runways or monorail track, rail stops or other suitable means shall be provided to prevent interference with the idle equipment. **(T-0)**

12.8.2.6.2.1.5. Where temporary protective rail stops are not possible or practical, a signal person shall observe the approach of an active unit and warn the operator before reaching an unsafe distance from the idle unit. **(T-0)**

12.8.2.6.2.2. Equipment not readily moved from its operating location can be inspected and maintained at the site, providing precautions to protect inspection and maintenance personnel. **(T-0)**

12.8.2.6.2.3. After adjustments and repairs, the equipment shall not be operated

until all guards are reinstalled, safety devices reactivated and tools and maintenance equipment removed. **(T-0)** Lockout/tagout devices shall only be removed by the supervisor or person who attached them. **(T-0)**

12.8.2.6.3. Adjustments and Repairs.

12.8.2.6.3.1. The using agency shall ensure any unsafe conditions disclosed by inspection are corrected before operation of the crane or monorail system is resumed. **(T-0)**Adjustments and repairs shall be done only by qualified personnel. **(T-0)**

12.8.2.6.3.2. Adjustments shall be made to ensure correct functioning of all components such as:

12.8.2.6.3.2.1. Control systems. **(T-0)**

12.8.2.6.3.2.2. All operating mechanisms. **(T-0)**

12.8.2.6.3.2.3. Limit switches. **(T-0)**

12.8.2.6.3.2.4. Drive wheels, squaring shafts, couplings, roller chain drives, bumpers and stops. **(T-0)**

12.8.2.6.3.2.5. Interlocks, crossovers, track switches and track-openers. **(T-0)**

12.8.2.6.3.2.6. Collector shoes or wheel limit switches, electrical control systems, pushbutton stations or controllers. **(T-0)**

12.8.2.6.3.2.7. Brakes, hoist mechanisms, hydraulic units, hydraulic or pneumatic valves and controls. **(T-0)**

12.8.2.6.3.2.8. Power sources. **(T-0)**

12.8.2.6.3.3. Repairs or replacements shall be provided promptly as needed for safe operation such as:

12.8.2.6.3.3.1. Hoist mechanisms showing defects as in paragraph **12.6.3.5** **(T-0)**

12.8.2.6.3.3.2. Hooks showing damage as in paragraph **12.11.5** **(T-0)**

12.8.2.6.3.3.3. Damage to components listed in paragraph **12.8.2.6.3.2,** which constitute a safety hazard. **(T-0)**

12.8.2.6.3.3.4. Load attachment chains and rope slings showing defects. **(T-0)**

12.8.2.6.3.3.5. All critical parts which are cracked, broken, bent or excessively worn. **(T-0)**

12.8.2.6.3.3.6. Dirty pendant control stations and illegible function labels. **(T-0)**

12.8.2.6.4. Rope Maintenance. Refer to paragraph **12.11.2.3** **(T-0)**

12.8.2.6.5. Rope Replacement. Refer to paragraph **12.11.2.4** **(T-0)**

12.8.2.7. Testing.

12.8.2.7.1. Operational Tests.

12.8.2.7.1.1. Prior to use, all new, reinstalled, altered, repaired and modified cranes and cranes not used within the preceding 12 months shall be operationally tested by a qualified person. **(T-0)** The operational test shall consist of operating all functions of the hoist under a no-load condition to test all hoist functions including hoisting and lowering, operation of brakes, testing of all limit, locking, safety devices and: **(T-0)**

12.8.2.7.1.1.1. Trolley travel. **(T-0)**

12.8.2.7.1.1.2. Bridge travel. **(T-0)**

12.8.2.7.1.1.3. Interlocking mechanism, track switches, drop sections and lift sections. **(T-0)**

12.8.2.7.1.2. The trip-setting of hoist limit switches shall be determined by tests with an empty hook traveling in increasing speeds up to the maximum speed. **(T-0)** The limit switch actuating mechanism shall be located to trip the switch under all conditions, in sufficient time to prevent contact of hook or load block with any part of trolley. **(T-0)**

12.8.2.7.1.3. Hoist limit switch. **(T-0)**

12.8.2.7.1.3.1. At the beginning of each operator shift, during each periodic maintenance, whenever a malfunction is suspected, or after unusually heavy use, the operator or maintainer will check the upper-limit switch under no load, with the block "inched" into the limit switch or run in at slow speed. **(T-0)** If the switch does not operate properly, the operator will immediately notify the operation supervisor. **(T-0)**

12.8.2.7.1.3.2. The hoist limit switch which controls the upper limit of travel of the load block shall never be used as an operating control. **(T-0)**

12.8.2.7.2. Load Tests. All new cranes or cranes with altered, replaced or repaired load suspension parts shall be load tested prior to use at not less than 100 percent or more than 125 percent of rated load of the equipment, unless otherwise recommended by the manufacturer. **(T-0)** Prior to accomplishing load tests on equipment attached to facility structural members, a qualified person, e.g., civil engineer shall assess the sufficiency of the structure to withstand the loads being tested. **(T-0)** The test shall be conducted as follows: **(T-0)**

12.8.2.7.2.1. Hoist the test load a distance to assure load is supported by the crane and held by hoist brake(s). Refer to paragraph **12.6.3.7.2** for hoist test. **(T-0)**

12.8.2.7.2.2. Transport test load by the trolley or carrier for the full length of the bridge. **(T-0)**

12.8.2.7.2.3. Transport the test load by the bridge for the full length of the runway in one direction with trolley or carrier as close to the extreme right-hand end of the crane as practical and in the other direction with trolley or carrier as close to the left-hand end of the crane as practical. **(T-0)**When cranes operate on more than two (2) runways (multiple-truck cranes), the crane will also transport the test load the full length of the runway with the trolley or carrier positioned at each intermediate end truck. **(T-0)**

12.8.2.7.2.4. For monorail systems, follow paragraph **12.8.2.7.2.1** for the hoist test and transport test load by the carrier for the full length of the monorail system. **(T-0)**

12.8.2.7.2.5. On hoists incorporating overload devices, a load test shall be accomplished with a test load of least 100 percent of rated capacity, after which the overload device shall be tested. **(T-0)**

12.8.2.7.2.6. Test weights for load testing shall be tagged or marked indicating total weight in pounds and owner or agency identification number. **(T-0)**Rebar steel shall not be used for test weight lift points. **(T-0)**

12.8.2.7.3. For nuclear-certified hoists, perform tests as stated in paragraphs **12.8.2.7.1** and **12.8.2.7.2,** and annually thereafter at not less than 100 percent or more than 125 percent of rated capacity. **(T-0)** Users may perform annual tests in conjunction with one of the two semiannual inspections outlined in paragraph **12.8.2.5.2** **(T-0)** **Exception:** The annual load test may be performed as either a static or dynamic test as determined by a qualified person. **(T-0)**

12.8.2.8. Historical Records. A written, dated and signed record of all periodic inspections, repairs and tests shall be maintained indefinitely at a location determined by the user. **(T-2)** Refer to paragraph **12.1.1** concerning use of paper forms and automated systems.

12.9. Mobile and Locomotive Cranes.

12.9.1. Hazards.

12.9.1.1. One of the greatest hazards with mobile crane operations is electrocution from equipment contacting energized electric lines.

12.9.1.2. Other hazards include overloading; side loading; rope or hydraulic failure; striking people or objects with moving loads or movable parts of the crane; dropping or slipping of the load due to improper hitching or slinging; and slipping or falling from equipment.

12.9.2. Requirements.

12.9.2.1. Acquisition.

12.9.2.1.1. All crawler, locomotive and truck cranes shall meet design specifications, characteristics, and rules of American Society of Mechanical Engineers/American Society of Mechanical Engineers B30.5, *Mobile and Locomotive Cranes.* **(T-0)**

12.9.2.1.2. All new mobile hydraulic cranes constructed and used on or after 25 January 1982 shall meet American Society of Mechanical Engineers/American Society of Mechanical Engineers B30.5. **(T-0)** Equipment manufactured prior to 25 January 1982, and still in replacement codes A through J, need not be modified or retrofitted to conform to this standard. General design considerations which shall be included in procurement documents include:

12.9.2.1.2.1. Load Ratings and Charts. A substantial and durable rating chart with clearly legible letters and figures shall be securely fixed to the crane cab in a location easily visible to the operator while seated at the control station. **(T-0)** A duplicate load rating chart (legible from the ground) shall also be provided on the

outside of the crane. **(T-0)** The load rating chart for truck cranes shall list loads for the crane operating both with and without counterweights. **(T-0)**

12.9.2.1.2.2. Two-Blocking Prevention. A two-blocking damage preventive feature shall be provided on telescoping boom cranes to prevent damage to the hoist rope or other machine components when hoisting the load, extending the boom or lowering the boom on a crane with a stationary hoist mounted to the rear of the boom hinge. **(T-0)**

12.9.2.1.2.3. Boom Angle Indicator. A boom angle indicator shall be provided on all cranes. **(T-0)**

12.9.2.1.2.4. Overload Protection. Devices such as "*Load Moment Indicators*" are designed to alarm the operator and de-energize the crane when attempting to lift a load beyond the crane's capabilities. Although these devices are of minimal value in routine base-level Air Force operations, they may be of value in construction where loads may not be defined or identified or not properly released from its transporter. The user must evaluate anticipated use of the crane to determine the need for such a device. **(T-1)**

12.9.2.1.2.5. Color Coding for Strike Hazard. Parts of crane cabs that extend beyond the main chassis when rotated shall be color coded yellow and black on the lower areas to highlight the strike hazard to ground personnel. **(T-0)** Colors shall be reflective for night operations. **(T-0)**

12.9.2.1.2.6. Guarding of Machinery. Exposed moving parts such as gears, set screws, projecting keys, chains, chain sprockets and reciprocating parts (a hazard to personnel) shall be guarded. **(T-0)**

12.9.2.1.2.7. Unguarded Machinery. Some crane hazards, such as rotating equipment or holes, cannot be mechanically safeguarded. Personnel will exercise extreme care when exposed to unguarded rotating equipment or holes. **(T-1)** Such conditions shall be clearly marked with appropriate warning decals. **(T-0)**

12.9.2.1.2.8. Main Switch. If the mobile crane is electrically powered and incorporates a main or master switch, the switch shall be designed to be locked in the open or "*OFF*" position. **(T-0)**

12.9.2.1.2.9. Operator Protection. Cranes shall be designed to protect operators from falling objects, swinging loads and cable failures. **(T-0)** Cranes that are operated in inclement weather, shall protect the operator from the weather. **(T-0)**

12.9.2.1.2.10. Warning. An audible warning device shall be provided when hoisting operations or moving equipment might endanger personnel in the work area. **(T-0)** The device control shall be within easy reach of the operator. **(T-0)**

12.9.2.1.2.11. Warning Sign. A permanent sign shall be posted in the cab of the crane in full view of the operator. **(T-0)** This sign will read: "*DANGER HIGH VOLTAGE, Do Not Operate Within 10 Feet of Electric Power Lines.*" **(T-0)** If equipment is operated in the vicinity of power lines, installation of a proximity device shall be considered. **(T-0)**

12.9.2.1.2.12. Night Operations. Cranes operated during darkness shall have

clearance lights installed. **(T-0)** Working areas shall be illuminated so the designated signal person, loads, rigging, obstructions, etc., are readily visible. **(T-0)**

12.9.2.1.2.13. Man-Rated Cranes. Man-rated cranes shall be approved prior to acquisition or use. **(T-0)** Users will coordinate purchase with the installation safety staff and submit the following for review (see 29 CFR 1926.1400, *Cranes and Derricks in Construction*, for additional information): **(T-0)**

12.9.2.1.2.13.1. Crane make, model, year and present modifications if applicable. **(T-0)**

12.9.2.1.2.13.2. Present safety devices, limit switches, dead-man controls, control lowering capabilities, outriggers if applicable, etc. **(T-0)**

12.9.2.1.2.13.3. Past major overhaul or repairs and dates of rated load tests. **(T-0)**

12.9.2.1.2.13.4. Proposed method of use and working environment. **(T-0)**

12.9.2.1.2.13.5. Proposed work cage or basket, attachment points and methods of attachment for personnel. **(T-0)**

12.9.2.1.2.13.6. If necessary, illustrated drawings or photographs.

12.9.2.2. Qualification of Operators. Mobile cranes shall be operated only by designated, qualified operators with a valid AF Form 483, *Certificate of Competency*, or by persons in training under the direct supervision of a designated operator. **(T-0) Exception:** Operators of Air Force special purpose vehicle/truck cranes shall be licensed IAW AFI 24-301, in lieu of AF Form 483. **(T-1)** No other personnel will enter a crane cab except for oilers, supervisors and qualified inspectors whose duties require cab entry. **(T-1)** A list of qualified crane operators shall be kept by the using organization and appropriate entries shall be made in the individual's training records. **(T-1)**

12.9.2.2.1. Crawler, Locomotive, Truck and Mobile Hydraulic Cranes.

12.9.2.2.1.1. Prospective operators shall pass a written examination containing the safety requirements of this chapter and a practical operating examination, developed by the using activity, to demonstrate task-qualification to operate the crane safely. **(T-0)**

12.9.2.2.1.2. Operators shall meet the following minimum physical qualifications of American Society of Mechanical Engineers/American Society of Mechanical Engineers B30.5 and these physical qualifications must be clearly identified by the supervisor to the examining AF physician:

12.9.2.2.1.2.1. Have vision of at least 20/30 in one eye, and 20/50 in the other, with or without corrective lenses. **(T-0)**

12.9.2.2.1.2.2. Be able to distinguish red, green and yellow, regardless of position of colors, if color differentiation is required for operation. **(T-0)**

12.9.2.2.1.2.3. Test for ordinary conversation in one ear, with or without a hearing aid, to ensure hearing is adequate for a specific operation. **(T-0)**

12.9.2.2.1.2.4. Have sufficient strength, endurance, agility, coordination and speed of reaction to meet the demands of equipment operation. **(T-0)**

12.9.2.2.1.2.5. Evidence of physical defect, or emotional instability which could render the operator a hazard to herself, or himself or others, or, in the opinion of the examiner or supervisor, could interfere with the operator's safe performance, may be sufficient cause for disqualification. **(T-0)** In such cases specialized clinical or medical judgments and tests may be required. Any medical condition that places the worker at risk of sudden incapacitation may be sufficient reason for medical disqualification in the interest of safety, e.g., a history of epilepsy or a disabling heart condition.

12.9.2.2.1.2.6. Operator trainees shall have good depth perception, field of vision, reaction time, manual dexterity or coordination and no tendencies to dizziness or similar undesirable characteristics. **(T-0)** Physical defects such as loss of arm, hand, leg, foot or gross loss of function thereof may be considered as cause for denial of entry into a crane training program.

12.9.2.3. Safe Operating Practices.

12.9.2.3.1. If operators must divert their attention while operating the crane, they shall stop the crane. **(T-1)**

12.9.2.3.2. The operator shall respond to signals only from the designated signal person, but will obey an emergency stop signal from anyone at any time. **(T-1)**

12.9.2.3.3. Operators are responsible for operations under their direct control. Whenever there is any doubt as to safety, the operator will stop and refuse to handle loads until safety has been ensured. **(T-1)**

12.9.2.3.4. The operator will sound or give an audible warning signal each time before traveling (backing), and when approaching workers or other congested areas. **(T-1)** The signal may be mechanical (automatic) or oral.

12.9.2.3.5. Before leaving the crane unattended, the operator will:

12.9.2.3.5.1. Lower any suspended load, bucket, lifting magnet, or other device to the ground. **(T-0)**

12.9.2.3.5.2. Disengage clutch. **(T-1)**

12.9.2.3.5.3. Set travel, swing, boom brakes, and other locking devices. **(T-1)**

12.9.2.3.5.4. Put controls in the "*OFF*" or neutral position. **(T-1)**

12.9.2.3.5.5. Stop the engine. **(T-1)**

12.9.2.3.5.6. Secure crane, e.g., chocks, brakes, etc., against accidental travel. **(T-1)**

12.9.2.3.6. During periods of non-use, high winds, or weather alerts, the operator will lower the boom to ground level, a resting platform or otherwise ensure the boom is secure against movement from wind or other forces. **(T-1)**

12.9.2.3.7. Operators will not close a switch or start the engine until any warning tag or lock has been removed by the supervisor or person who originally attached the device. **(T-1)**

12.9.2.3.8. Operators will ensure all controls are in the "*OFF*" position and all personnel are clear of the crane before closing a switch or starting the engine. **(T-1)**

12.9.2.3.9. If power fails during operation, operators will:

12.9.2.3.9.1. If practical, lower the suspended load to the ground under brake control. **(T-1)** If not practical to land the load, shut down the crane and completely rope off or barricade the area around the suspended load. **(T-1)**

12.9.2.3.9.2. Set all brakes and locking devices. **(T-1)**

12.9.2.3.9.3. Move all clutch or other power controls to the "*OFF*" position. **(T-1)**

12.9.2.3.10. Operators shall be familiar with the equipment and its proper care. **(T-0)** If adjustments or repairs are necessary or any damage is known, the operator will report them promptly to the supervisor and record them on AFTO Form 244, AFTO Form 95, or MAJCOM or locally devised paper or automated system IAW paragraph **12.1.1,** as appropriate. **(T-1)**

12.9.2.3.11. All controls shall be tested by the operator at the start of a new shift. **(T-0)** Controls that do not operate properly shall be adjusted or repaired before continuing operation. **(T-0)**

12.9.2.3.12. Booms being assembled or disassembled on the ground, with or without support of the boom harness, shall be securely blocked to prevent dropping the boom and boom sections. **(T-1)**

12.9.2.3.13. To prevent injury to personnel, booms being manually telescoped shall be carefully repositioned prior to pinning. **(T-1)**

12.9.2.3.14. No crane shall be loaded beyond its rated capacity, except for test purposes IAW paragraph **12.9.2.6** **(T-0)** Weight of all loads shall be determined before lifting. **(T-1)**

12.9.2.3.15. When attaching the load, the hoist rope shall not be wrapped around the load, but shall be attached to the hook by slings or other approved devices of proper capacity. **(T-1)**

12.9.2.3.16. When moving the load, the supervisor directing the lift will ensure:

12.9.2.3.16.1. The crane is level and, where necessary, outriggers are in place and blocked IAW paragraph **12.9.2.3.24** **(T-1)**

12.9.2.3.16.2. The load is well secured and properly balanced in the sling or lifting device before hoisted more than a few inches. **(T-1)**

12.9.2.3.17. Before lifting, the operator will ensure:

12.9.2.3.17.1. The hoist rope is not kinked; **(T-1)**

12.9.2.3.17.2. Multiple part lines are not twisted around each other; **(T-1)**

12.9.2.3.17.3. The hook is brought over the load in a manner to prevent swinging;

and **(T-1)**

12.9.2.3.17.4. If there is a slack rope condition, the rope is properly seated on the drum and in the sheaves as the load is applied. **(T-1)**

12.9.2.3.18. During lifting, the operator will ensure there is no sudden acceleration or deceleration of the moving load; and the load and boom do not contact any obstructions. **(T-1)**

12.9.2.3.19. Side loading of booms shall be limited to freely suspended loads. Cranes shall not be used for dragging loads sideways. **(T-1)**

12.9.2.3.20. The crane shall not be operated while anyone is on the load or hook. **(T-1)** MAJCOM, DRU, or FOA approved man-rated cranes and work cages are permitted. Refer to paragraph **12.9.2.3.50** for hoisting and lowering personnel requirements.

12.9.2.3.21. The operator shall not carry or swing load over personnel. **(T-0)**

12.9.2.3.22. On truck mounted cranes, loads shall not be lifted over the front area of the truck unless specifically allowed by manufacturer's operating instructions. **(T-1)**

12.9.2.3.23. The operator will test the brakes each time a load is handled by raising the load a few inches and applying brakes. **(T-1)**

12.9.2.3.24. Outriggers shall be used when the load at a particular radius exceeds the rated load without outriggers as given by the crane manufacturer. **(T-1)** When floats are used, they shall be securely attached to outriggers. **(T-1)** Wood blocks used to support outriggers shall be strong enough to prevent crushing, free of defects and of sufficient size to prevent shifting or toppling of the crane under load. **(T-1)**

12.9.2.3.25. Neither the load nor boom shall be lowered to less than two (2) full wraps of rope on their respective drums. **(T-11)**

12.9.2.3.26. When two (2) or more cranes are used to lift one load, one designated person shall be responsible for the operation. **(T-0)** He or she will analyze the operation and instruct all personnel involved in proper positioning, rigging the load, and movements to be made. **(T-0)**

12.9.2.3.27. Before any crane is moved to a new job site, the route of travel shall be checked to determine that adequate clearances exist along the entire route. **(T-0)** This survey shall be conducted by the vehicle heavy equipment supervisor and crane operator. The empty hook shall be secured to prohibit swinging, and the boom shall be lowered to the boom rest or travel position. **(T-0)** A red cloth or warning flag, at least 12 inches square, or a warning light shall be carried at the end of any boom that extends more than 4 feet beyond the truck platform. **(T-0)** At night or during periods of reduced visibility, a warning light shall be used. **(T-0)** The superstructure shall be secured to prohibit rotation except when there is an operator in the cab to ensure proper boom clearances around tight spots and corners. **(T-0)** Additional vehicles shall be used to warn other motorists if the crane boom or wide load poses a hazard to the front or rear. **(T-0)**

12.9.2.3.28. A designated supervisor shall be responsible for determining and controlling safety before traveling a crane with a load. **(T-0)** Decisions such as position

of load, boom location, ground support, travel route and speed of movement shall be IAW his/her determination. **(T-0)** Specified tire pressures shall be maintained. **(T-0)** The boom shall be carried in line with the direction of motion, sudden starts and stops shall be avoided and tag or restraint lines shall be used to minimize swinging of the load. **(T-0)**

12.9.2.3.29. A crane shall never travel with the boom so high that it may bounce back over the cab. Consult the manufacturer's operation manual.

12.9.2.3.30. Avoid sudden starts and stops when rotating the crane. **(T-0)** Rotational speed shall be such that the load can be controlled. **(T-0)** A tag line shall be used when rotation of the load is hazardous. **(T-0)**

12.9.2.3.31. The boom hoist pawl or other positive locking device shall be engaged on rope supported booms if the crane is operated at a fixed radius. **(T-0)**

12.9.2.3.32. Ropes shall not be handled on a winch head without knowledge of the operator. **(T-0)** The operator shall be within convenient reach of the power unit control lever while a winch head is being used. **(T-0)**

12.9.2.3.33. On cranes having a powered telescoping boom, the hook is drawn closer to the boom head when hoisting, extending the boom or lowering a boom on machines where the winch is mounted stationary to the rear of the boom hinge. If the machine is not equipped with a "two-blocking preventive feature," rope shall be let-out from the load hoist mechanism so the hook will not be jammed (two-blocked) against the boom head. **(T-0)** The jammed condition may cause overload and result in rope or other component failure.

12.9.2.3.34. Telescoping boom sections shall be telescoped in the manner and sequence specified by the manufacturer. **(T-0)**

12.9.2.3.35. While holding the load:

12.9.2.3.35.1. The operator shall not leave his/her position at the controls while load is suspended.

12.9.2.3.35.2. No person shall be permitted to stand or pass under a suspended load. **(T-1)**

12.9.2.3.35.3. If the load hoist mechanism is not equipped to hold the drum from rotating in the lowering direction, without further action by the operator, loads shall not remain suspended for a considerable length of time.

12.9.2.3.36. Standard hand signals to the operator shall be utilized, unless voice communication equipment is used. The operator shall not respond to any signal unless he or she clearly understands it.

12.9.2.3.37. If necessary to give instructions to the operator, other than those provided herein, all crane motions shall be stopped. **(T-1)**

12.9.2.3.38. All crane controls shall be placed in the "*OFF*" position and the main switch opened when equipment is not in use. **(T-0)**

12.9.2.3.39. When operating near electric power lines, refer to 29 CFR 1926.1400, *Cranes and Derricks in Construction*, and: **(T-0)**

12.9.2.3.39.1. Overhead power lines shall be considered energized unless definitely known by the operator and supervisor that lines are not energized. **(T-0)**

12.9.2.3.39.2. No part of a crane or its load shall be permitted within 10 feet of any energized electrical power line. **(T-0)** When this is impractical, the power line shall be de-energized and visibly grounded, or a different route of travel used. **(T-0)**

12.9.2.3.39.3. For lines rated over 50 kilovolts (kV), minimum clearance shall be 10 feet plus 0.4 inch for each kV over 50 kV, or twice the length of the line insulator, but never less than 10 feet. **(T-0)**

12.9.2.3.39.4. A permanent sign shall be posted in the cab of the equipment in full view of the operator. **(T-0)** This sign will read: "*DANGER -- HIGH VOLTAGE, Do Not Operate Within 10 Feet of Electric Power Lines*." **(T-0)**

12.9.2.3.39.5. A dielectric boom shield and insulated link installed in the lifting line at the hook provide some protection against electric shock if the crane accidentally contacts energized electric lines. Proximity warning devices are not fail safe and shall be used in addition to, not as a replacement for, other controls. **(T-0)** Even though shields, insulated hooks and proximity warning devices are used, clearance criteria in paragraphs **12.9.2.3.39.2** and **12.9.2.3.39.3** shall be followed. **(T-0)**

12.9.2.3.39.6. If the boom of a rubber-tired crane contacts an electric power line, it is probable the entire crane may be energized since the rubber tires may insulate the crane from the ground. When this happens, operators shall not attempt to leave the crane until they are certain that the line is clear of the crane or the line is de-energized. To make such an attempt might result in electrocution since the operator's body would complete the circuit to ground as he or she climbed or stepped from the crane. If the fuel tank ignites, or if it is impossible for the operator to remain on the crane, he or she shall jump, after first making sure all body parts are clear of the crane before their feet touch the ground. **(T-1)**

12.9.2.3.40. Where motorized or pedestrian traffic is anticipated or encountered, the working area shall be blocked off or controlled to keep people and vehicles away. **(T-0) Note:** Operators of mobile cranes will stay clear of walls, overhead trestles, columns and other structures that pose electrical, crushing, burn hazards, etc. **(T-0)**

12.9.2.3.41. Personal Protective Equipment (PPE). Appropriate head protection shall be worn by crane crew personnel to protect against falling objects or impact type hazards. **(T-0)** Safety-toe shoes shall be worn by all materials handling and construction personnel involved in crane operations. **(T-0)** Refer to **Chapter 14** for additional guidance.

12.9.2.3.42. Rail clamps shall not be used to restrain tipping of a locomotive crane. Load weight shall be kept within the limit of the crane without using these clamps. **(T-0)**

12.9.2.3.43. Cranes shall not be operated without the full amount of ballast or counterweight in place, unless specifically authorized by the manufacturer's instructions.

12.9.2.3.44. Clothing and personal belongings shall be kept away from operator controls. **(T-0)** Tools, oil cans, extra fuses and other necessary articles shall be stored in the tool box and not permitted to lie loose in or about the cab. **(T-0)**

12.9.2.3.45. Firm, level (within one percent grade) footing under the crane is essential to prevent tipping or sinking as loads are lifted and swung. Where necessary, this footing shall be provided by timbers, cribbing or other structural material sufficient to distribute the load and provide a level surface. **(T-0)** Outriggers (on cranes so equipped) shall be fully extended per manufacturer's specifications. **(T-0)**

12.9.2.3.46. When small, portable containers are used to refuel engines, they shall be approved safety containers with an automatic closing cap and flame arrester. **(T-0)** The crane shall not be refueled when engine is running or hot.

12.9.2.3.47. A fire extinguisher rated for Class B and C fires shall be provided at the operator's station. **(T-0)** Operating and maintenance personnel shall be familiar with the care and use of the extinguisher. **(T-0)**

12.9.2.3.48. Locomotive cranes shall cease operation when railway cars on adjacent tracks are in motion. **(T-0)**

12.9.2.3.49. All hooks and hook blocks shall be permanently marked with the manufacturer's identification. **(T-0)** Load hooks shall be equipped with safety latches. **(T-0)**

12.9.2.3.50. The use of a crane or derrick to hoist workers on a personnel platform is prohibited except when conventional means of reaching the worksite, such as a personnel hoist, ladder, stair-way, aerial lift, elevating work platform or scaffold, would be more hazardous or is not possible. **(T-0)** Refer to paragraph **12.11.7** for additional guidance.

12.9.2.3.51. The area in the rear, in which someone could be struck or caught by the rotating super-structure, shall be barricaded. **(T-0)** Refer to 29 CFR 1926.1400, *Cranes and Derricks in Construction,* for additional guidance.

12.9.2.3.52. Refer to paragraph **12.11.2** for information on wire rope inspection, replacement and maintenance.

12.9.2.4. Inspections.

12.9.2.4.1. Frequent Inspections. Frequent inspections will include:

12.9.2.4.1.1. Checking hydraulic hoses, fittings and tubing, particularly hydraulic hoses which flex in normal operation. **(T-0)** The following are reasons for repair or replacement:

12.9.2.4.1.1.1. Evidence of hydraulic oil leakage at the surface of the flexible hose or excessive leakage at its junction with metal end couplings.

12.9.2.4.1.1.2. Blistering or abnormal deformation to the outer covering of

hydraulic hose.

12.9.2.4.1.1.3. Hydraulic oil leakage at any threaded or clamped joint that cannot be eliminated by normal tightening or recommended procedures.

12.9.2.4.1.1.4. Evidence of excessive abrasion or scrubbing on outer surface of a hose, rigid tube or hydraulic fitting. Action shall be taken immediately to eliminate or correct the cause or otherwise protect the components from additional damage.

12.9.2.4.1.2. Checking pumps and motors. The following are reasons for replacement or repair:

12.9.2.4.1.2.1. Loose bolts or fasteners.

12.9.2.4.1.2.2. Leaks at joints between sections.

12.9.2.4.1.2.3. Shaft seal leaks.

12.9.2.4.1.2.4. Unusual noises or vibration.

12.9.2.4.1.2.5. Loss of operating speed.

12.9.2.4.1.2.6. Suspected overheating of hydraulic oil.

12.9.2.4.1.2.7. Inability to hold proper pressure.

12.9.2.4.1.3. Checking valves. The following are reasons for replacement or repair:

12.9.2.4.1.3.1. Cracks in valve housing.

12.9.2.4.1.3.2. Improper return of spool to neutral position.

12.9.2.4.1.3.3. Leaks at spools or joints.

12.9.2.4.1.3.4. Sticking spools.

12.9.2.4.1.3.5. Failure of relief valves to attain correct pressure setting specified by manufacturer.

12.9.2.4.1.4. Checking cylinders. The following are reasons for replacement or repair:

12.9.2.4.1.4.1. Drifting caused by oil leaking across piston.

12.9.2.4.1.4.2. Rod seals leaking.

12.9.2.4.1.4.3. Leaks at welded joints.

12.9.2.4.1.4.4. Scored, nicked or dented cylinder rods.

12.9.2.4.1.4.5. Dented case (barrel).

12.9.2.4.1.4.6. Loose or deformed rod eyes or connecting joints.

12.9.2.4.1.5. Checking filters. Rubber particles on the filter element may indicate hose, “O” ring or other rubber component deterioration. Metal chips or pieces on the filter may denote failure in pumps, motors or cylinders. Further checking shall be done as necessary to determine origin of the problem before corrective action is taken. **(T-0)**

12.9.2.4.1.6. Checking control mechanisms for maladjustment.

12.9.2.4.2. Periodic. The periodic inspection will include inspecting items in paragraph **12.9.2.4.1** and the following: **(T-0)**

12.9.2.4.2.1. Vehicle control mechanisms for excessive wear of components and contamination by lubricants or other foreign matter. **(T-0)**

12.9.2.4.2.2. Installed safety devices for proper operation. **(T-0)**

12.9.2.4.2.3. Crane load hooks if cracked, have any visibly apparent bend or twist from the plane of the unbent hook (original manufacturer or baseline measurements), any distortion causing an increase in throat opening of five (5) percent, not to exceed ¼ inch (or as recommended by the manufacturer), or any wear exceeding 10 percent (or as recommended by the hook manufacturer) of the original manufacturer or baseline section dimension of the hook. **(T-0)** Refer to paragraphs **12.9.2.5.2.4** and **12.11.5.1** for additional guidance.

12.9.2.4.2.4. Rope reeving for compliance with crane manufacturer's recommendation. **(T-0)**

12.9.2.4.2.5. Electrical apparatus for malfunctions, signs of excessive deterioration or dirt and moisture accumulation. **(T-0)**

12.9.2.4.2.6. Deformed, cracked or corroded members in crane structure and boom. **(T-0)**

12.9.2.4.2.7. Loose bolts or rivets. **(T-0)**

12.9.2.4.2.8. Cracked or worn sheaves and drums. **(T-0)**

12.9.2.4.2.9. Worn, cracked or distorted parts such as pins, bearings, shafts, gears, rollers and locking devices. **(T-0)**

12.9.2.4.2.10. Excessive wear on brake and clutch system parts, linings, pawls and ratchets. **(T-0)**

12.9.2.4.2.11. Any inaccuracies of load and check boom angle indicators and other indicators over their full range. **(T-0)**

12.9.2.4.2.12. Proper performance of gasoline, diesel, electric or other power plants. **(T-0)**

12.9.2.4.2.13. Excessive wear of chain-drive sprockets and excessive chain stretch. **(T-0)**

12.9.2.4.2.14. Cracks in hooks by magnetic particle or other crack detecting process. **(T-0)**

12.9.2.4.2.15. Proper operation of travel steering, braking and locking devices. **(T-0)**

12.9.2.4.2.16. Worn or damaged tires. **(T-0)**

12.9.2.4.2.17. Rust on hydraulic rods and control valves. **(T-0)**

12.9.2.4.2.18. Cleanliness of oil filters and oil strainers. **(T-0)**

12.9.2.4.2.19. For nuclear-certified mobile hydraulic cranes, also see paragraph **12.9.2.6.2.2**

12.9.2.4.3. Inspection Records. Inspection records shall be maintained IAW AFI 24-302, *Vehicle Management*, or other appropriate directives. Location of inspection records shall be determined by the user. **(T-1)**

12.9.2.5. Maintenance.

12.9.2.5.1. Maintenance Procedure. The Vehicle Fleet Manager or Vehicle Management Superintendent shall establish a preventive maintenance program based on this standard and crane manufacturers' recommendations. **(T-1)** Crane maintenance records shall be maintained IAW AFI 24-302 or other appropriate directives. **(T-1)**

12.9.2.5.1.1. The following precautions shall be taken before making adjustments and repairs on a crane:

12.9.2.5.1.1.1. Position the crane where it will cause the least interference with other equipment or operations. **(T-1)**

12.9.2.5.1.1.2. Use appropriate lockout/tagout procedures on crane energy controls as prescribed by **Chapter 21**. **(T-1)**

12.9.2.5.1.1.3. Lower the boom to the ground if possible or secure it against dropping. **(T-1)**

12.9.2.5.1.1.4. Lower the lower load block to ground or secure it against dropping. **(T-1)**

12.9.2.5.1.1.5. Stop the power plant. **(T-1)**

12.9.2.5.1.1.6. Disengage and lockout all starting controls. **(T-1)**

12.9.2.5.1.1.7. Turn off all controls and engage the pawls. **(T-1)**

12.9.2.5.1.1.8. Relieve hydraulic oil pressure from all hydraulic systems before loosening or removing hydraulic components. **(T-1)**

12.9.2.5.1.1.9. Retract all hydraulic cylinders used for boom hoisting and boom telescoping. **(T-1)**

12.9.2.5.1.2. Warning tags and locks shall only be placed or removed by the maintenance supervisor or his/her representative. **(T-0)**

12.9.2.5.2. Adjustments and Repairs: After adjustments and repairs have been made, the crane shall not be operated until all guards have been reinstalled, trapped air removed from hydraulic system, safety devices reactivated and maintenance equipment removed.

12.9.2.5.2.1. Any unsafe conditions disclosed by inspection IAW paragraph **12.9.2.4** shall be corrected before the crane is operated again. **(T-0)** Adjustments and repairs shall be done only by qualified personnel. **(T-0)**

12.9.2.5.2.2. Adjustments to operating mechanisms, safety devices, control systems and power plants shall be maintained to ensure correct functioning. **(T-1)**

12.9.2.5.2.3. All critical parts of operating mechanisms or crane structures that are

cracked, broken, bent, corroded or excessively worn shall be repaired or promptly replaced to ensure safe operation. **(T-1)**

12.9.2.5.2.4. Crane hooks showing defects described in paragraph **12.9.2.4.2** or **12.11.5.1** will be removed from service and repaired or replaced. **(T-0)** Repairs by welding or reshaping are not recommended. If such repairs are attempted, they shall only be done by a qualified person and the hook shall be load tested IAW paragraph **12.9.2.6.1** before further use. **(T-0) Note 1:** Hooks repaired by welding or reshaping are not authorized on nuclear-certified hoists or lifting equipment used to lift critical loads. **Note 2:** Painted hooks shall not be used on nuclear-certified hoists or lifting equipment or equipment used to lift critical loads.

12.9.2.5.2.5. All replacement parts or repairs shall have at least the original manufacturer's design safety factor. **(T-0)**

12.9.2.5.3. Lubrication:

12.9.2.5.3.1. All moving parts of the crane, where lubrication is specified, shall be regularly lubricated IAW manufacturer's recommendations or TO procedures as to points and frequency of lubrication, maintenance of lubricant levels and types of lubricant. **(T-0)**

12.9.2.5.3.2. Cranes not equipped for automatic or remote lubrication shall be stationary when lubricated, with all controls in the "*OFF*" position, the main power control switch, if equipped, locked out or "*OFF*" and pawls applied. **(T-0)**

12.9.2.6. Testing.

12.9.2.6.1. Operational Tests.

12.9.2.6.1.1. Prior to initial use, all new cranes shall be tested by the manufacturer and verified by the Vehicle Management Flight Commander or Vehicle Fleet Manager to ensure compliance with operational requirements of this paragraph, including the following functions: **(T-0)**

12.9.2.6.1.1.1. Load lifting and lowering mechanisms. **(T-0)**

12.9.2.6.1.1.2. Boom lifting and lowering mechanisms. **(T-0)**

12.9.2.6.1.1.3. Boom extension and retraction mechanism. **(T-0)**

12.9.2.6.1.1.4. Swinging mechanism. **(T-0)**

12.9.2.6.1.1.5. Travel mechanism. **(T-0)**

12.9.2.6.1.1.6. Safety devices. **(T-0)**

12.9.2.6.1.2. Where the crane is not supplied by a single manufacturer, operational tests shall be conducted by a qualified person at final assembly. **(T-0)**

12.9.2.6.2. Load Tests.

12.9.2.6.2.1. Prior to being returned to service and initial use, extensively repaired or modified cranes shall be load tested, by a qualified person, at not less than 100 percent or more than 110 percent of rated capacity, unless otherwise recommended by the manufacturer. **(T-0)** When complete, stencil the load test date on the lower

boom assembly per 29 CFR 1926.1400. **(T-0)**

12.9.2.6.2.2. For nuclear-certified hydraulic mobile cranes, perform an annual load test at not less than 100 percent or more than 110 percent of the rated capacity. **(T-0)** Perform this test in con-junction with the annual inspection. **(T-0)** When complete, stencil the load test date on the lower boom assembly as per TO 36-1-191, *Technical and Managerial Reference for Motor Vehicle Maintenance.* **(T-0)**

12.9.2.6.2.3. Test loads shall not exceed 110 percent of the rated capacity at any selected working radius. **(T-0)**

12.9.2.6.2.4. If re-rating is necessary, crawler, truck and wheel-mounted mobile cranes shall be tested IAW Society of Automotive Engineers, Inc.'s *Recommended Practices, Crane Load Stability Test Code J76*5. **(T-0)** Locomotive cranes shall be re-rated IAW manufacturers' specifications. **(T-0)** A copy of the re-rating test report shall be provided to Vehicle Management and Analysis and a copy posted in the crane cab. **(T-1)**

12.9.2.6.2.5. Cranes shall not be re-rated in excess of original load ratings unless such rating changes are approved by the crane manufacturer. **(T-0)**

12.9.2.6.2.6. Test weights for load testing shall be tagged or adequately marked indicating total weight in pounds and owner or agency identification number. **(T-0)** Rebar steel shall not be used for test weight lift points.

12.9.2.6.3. A record of all tests shall be maintained indefinitely at a location determined by the user. **(T-1)**

12.10. Inspection, Maintenance and Testing of Derricks.

12.10.1. Inspections.

12.10.1.1. Frequent Inspections. Frequent inspections will include checking:

12.10.1.1.1. All control mechanisms — adjustment, wear and lubrication. **(T-0)**

12.10.1.1.2. All chords and lacing. **(T-0)**

12.10.1.1.3. Tension in guys. **(T-0)**

12.10.1.1.4. Plumb of the mast. **(T-0)**

12.10.1.1.5. Leakage of air or deterioration of hoses, seals and rams of hydraulic systems. **(T-0)**

12.10.1.1.6. Derrick hooks—cracks and bends, wear and deformations, etc. **(T-0)** Hooks with cracks or distortion of more than 5 percent of normal throat opening, not to exceed ¼ inch (or as recommended by the manufacturer), or with any apparent bend or twist from the plane from the original baseline measurements shall be removed from service and repaired or replaced. **(T-0)** Refer to paragraph **12.11.5.1.1**

12.10.1.1.7. Rope reeving — noncompliance with derrick manufacturer's recommendations. **(T-0)**

12.10.1.1.8. Hoist brakes, clutches and operating levers — proper functioning before beginning operations. **(T-0)**

12.10.1.1.9. Electrical apparatus — malfunction and signs of excessive deterioration, dirt and moisture accumulation. **(T-0)**

12.10.1.2. Periodic. The inspection will include items from paragraph **12.10.1.1** and the following:

12.10.1.2.1. Structural members, for deformations, cracks and corrosion. **(T-0)**

12.10.1.2.2. Bolts or rivets, for tightness. **(T-0)**

12.10.1.2.3. Parts such as pins, bearings, shafts, gears, sheaves, drums, rollers and locking and clamping devices for wear, cracks and distortion. **(T-0)**

12.10.1.2.4. Gudgeon pin, for cracks, wear and distortion each time derrick is erected. **(T-0)**

12.10.1.2.5. Power plants, for proper performance and compliance with applicable safety requirements. **(T-0)**

12.10.1.2.6. Hooks, for cracks and bends, wear and deformations, etc. **(T-0)** Hooks having more than 5 percent of normal throat opening or any apparent bend or twist from the plane from the original baseline measurements shall be replaced. **(T-0)** Refer to paragraph **12.11.5.1.1** for additional guidance.

12.10.1.2.7. Foundation or supports, for continued ability to sustain imposed loads. **(T-0)**

12.10.1.2.8. Derrick electrical pendant and control box, for proper grounding. **(T-0)**

12.10.2. Testing.

12.10.2.1. All new derricks shall have the manufacturer's certification that all required testing has been accomplished. **(T-0)** Prior to initial use, all modified and altered derricks shall be operationally tested to ensure compliance with this standard, including:

12.10.2.1.1. Load hoisting and lowering. **(T-0)**

12.10.2.1.2. Boom up and down. **(T-0)**

12.10.2.1.3. Swing. **(T-0)**

12.10.2.1.4. Operation of clutches and brakes of hoist. **(T-0)**

12.10.2.2. All anchorages shall be approved by the appointed personnel. **(T-0)** Rock and hairpin anchorages may require special testing.

12.10.3. Maintenance.

12.10.3.1. Preventive Maintenance.

12.10.3.1.1. A preventive maintenance program based on the derrick manufacturer's recommendations shall be established. **(T-0)** Dated and detailed records shall be readily available. **(T-0)**

12.10.3.1.2. Replacement parts shall be obtained from the original equipment manufacturer. **(T-0)**

12.10.3.2. Maintenance Procedure.

12.10.3.2.1. The following precautions shall be taken before adjustments and repairs are started on a derrick: **(T-0)**

12.10.3.2.1.1. The derrick to be repaired shall be arranged so it will cause the least interference with other equipment and operations in the area. **(T-0)**

12.10.3.2.1.2. All hoist drum dogs shall be engaged. **(T-0)**

12.10.3.2.1.3. The main or emergency switch shall be locked in the open (off) position if an electric hoist is used. **(T-0)** Refer to **Chapter 21** for additional lockout/tagout requirements.

12.10.3.2.1.4. Warning signs shall be placed on the derrick and hoist. **(T-0)**

12.10.3.2.1.5. Boom repairs on derricks shall be made when booms are lowered and adequately supported or when safely tied off. **(T-0)**

12.10.3.2.1.6. A good communication system shall be set up between the hoist operator and the appointed individual in charge of derrick operations before any work on the equipment is started. **(T-0)**

12.10.3.2.2. Welding repairs shall be approved by a qualified person. **(T-0)**

12.10.3.2.3. After adjustments and repairs have been made, the derrick shall not be operated until all guards have been reinstalled, safety devices reactivated, maintenance equipment removed and derrick electrical pendant and control box checked for proper grounding.

12.10.4. Adjustments and Repairs.

12.10.4.1. Any unsafe conditions disclosed by the inspection and requirements of paragraphs **12.10.2** and **12.10.3** shall be corrected before derrick operation is resumed. **(T-0)** Adjustments shall be maintained to assure correct functioning of components, including:

12.10.4.1.1. All functional operating mechanisms. **(T-0)**

12.10.4.1.2. Tie-downs or anchorages. **(T-0)**

12.10.4.1.3. Signal system. **(T-0)**

12.10.4.1.4. Brakes and clutches. **(T-0)**

12.10.4.1.5. Power plants. **(T-0)**

12.10.4.1.6. Guy lines. **(T-0)**

12.10.4.2. Repairs or replacement parts shall be provided promptly as needed for safe operation. **(T-0)** All replacement and repair parts shall have at least the original safety factor. **(T-0)**

12.10.4.2.1. Hooks showing defects described in paragraph **12.11.5**, shall be discarded. **(T-0)** Repairs by welding or reshaping are not recommended. If such repairs are attempted, they shall only be done by a qualified person, and the hook tested to load requirements of paragraph **12.10.2.1** before further use. **(T-0)**

12.10.4.2.2. All critical parts which are cracked, broken, bent, or excessively worn shall be replaced. **(T-0)**

12.10.4.2.3. Pitted or burned electrical contacts shall be corrected only by replacement and in sets. **(T-0)** Controller parts shall be lubricated as recommended by the manufacturer. **(T-0)**

12.10.5. Lubrication.

12.10.5.1. All moving parts of the derrick and hoist, for which lubrication is specified (including rope and chain), shall be regularly lubricated. **(T-0)** Lubricating systems shall be checked for proper delivery of lubricant. **(T-0)** Follow manufacturer's recommendations as to points and frequency of lubrication and maintenance of lubricant used. **(T-0)**

12.10.5.2. Machinery shall be stationary while lubricants are being applied unless it is equipped for automatic lubrication. **(T-0)**

12.10.6. Rope Inspection, Replacement and Maintenance. Follow criteria outlined in paragraph **12.11.2** For rotation-resistant rope, follow rope or equipment manufacturer's recommendations.

12.11. Related Hoisting Equipment.

12.11.1. Wire ropes, chains and hooks associated with overhead and gantry cranes shall be thoroughly inspected monthly. **(T-0)** Wire ropes, chains, hooks and related hoisting equipment shall be inspected prior to initial use and when repaired IAW applicable paragraphs of this chapter. **(T-0)** Inspections for each item shall be documented on the AFTO Form -95, or other appropriate inspection and maintenance form or automated system, and maintained on file for one (1) year. **(T-1)** Refer to paragraph **12.1.1** Documentation will include the date of the monthly inspection, signature of the inspector, an identifier for the equipment inspected, and condition of the equipment. **(T-0) Note:** A frequent inspection may also be used to document the thorough monthly inspection of hooks, chains and wire ropes associated with overhead and gantry cranes, provided it includes applicable requirements above and from paragraphs **12.11.2**, **12.11.3** and **12.11.5**

12.11.2. Wire Ropes.

12.11.2.1. Use and Attachment Considerations.

12.11.2.1.1. The rope or crane manufacturer's recommendation shall be followed when hoisting ropes are used. **(T-0)**

12.11.2.1.2. Socketing shall be done as specified by the assembly manufacturer. **(T-0)**

12.11.2.1.3. Swaged or compressed fittings shall be applied as recommended by the rope or crane manufacturer. **(T-0)**

12.11.2.1.4. Rope shall be secured to the drum as follows: **(T-0)**

12.11.2.1.4.1. Not less than two (2) wraps of rope will remain on the drum when the hook is in its extreme lowest position.

12.11.2.1.4.2. The rope end shall be anchored by a clamp securely attached to the drum or by a socket arrangement approved by the crane or rope manufacturer. **(T-0)**

12.11.2.1.4.3. If the crane is dual-reeved with the rope terminated at the equalizer, the termination fitting shall be rated to develop 100 percent of the rope strength.

(T-0)

12.11.2.1.5. Rope clips attached with U-bolts shall have the U-bolts on the dead or short end of the rope. Spacing and number of clips shall follow the clip manufacturer's recommendation or **Table 12.4** **(T-0)** Clips shall be drop-forged steel in all sizes manufactured commercially. **(T-0)** When a newly installed rope has been in operation for an hour, all nuts on the clip bolts shall be retightened. **(T-0)** Refer to **Table 12.4** for additional guidance.

12.11.2.2. Inspections.

12.11.2.2.1. Frequent Inspections. All running ropes in service shall be visually inspected daily or prior to use. **(T-0)** The inspection shall be documented on AFTO Form 244 or MAJCOM or locally devised paper or automated systems, which includes date of inspection, signature of inspector, an identifier for ropes inspected and rope condition. **(T-0)** Inspection shall be kept on file by the supervisor for a minimum of one year and made readily available. **(T-1)** Sections of rope normally hidden or difficult to see during inspection or maintenance procedures, such as parts passing over equalizer sheaves, shall be given close inspection, as these are points most likely to fail. **(T-0)** Any degradation in conditions described below could result in loss of original strength, shall be carefully noted and shall be considered for rejection: **(T-0)**

12.11.2.2.1.1. Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion or wear of outside wires. **(T-0)** Rope calipers and micrometers are normally used to determine changes in wire rope diameters. **(T-0)**

12.11.2.2.1.2. Broken outside wires and the degree of distribution or connection of such broken wires. **(T-0)**

12.11.2.2.1.3. Worn outside wires. **(T-0)**

12.11.2.2.1.4. Corroded or broken wires at end connections. **(T-0)**

12.11.2.2.1.5. Corroded, cracked, bent, worn or improperly applied end connections. **(T-0)**

12.11.2.2.1.6. Severe kinking, crushing, cutting or unstranding. **(T-0)**

12.11.2.2.2. Periodic Inspection. Recommended interval of periodic inspections shall be determined by a qualified person, based on such factors as expected rope life as determined by experience on the particular installation or similar installations, severity of environment, percentage of capacity lifts, frequency rates of operation, and exposure to shock loads. **(T-0)** Inspections need not be at equal calendar intervals and shall be more frequent as the rope approaches the end of its useful life. **(T-0)** This inspection shall cover the rope's entire length and requirements of paragraph **12.11.2.2.1** Inspections shall be documented on the AFTO Form 95 or MAJCOM or locally devised paper or automated systems, as outlined in paragraph **12.6.3.8** **(T-0)** Refer to paragraph **12.1.1** for additional guidance. The inspection record shall include the date of the inspection, signature of the inspector, an identifier for the rope inspected and rope condition. **(T-0)** The inspection record shall be kept on file by the user for a minimum of one year and made readily available. **(T-0)** **Note:** When the rope's periodic

inspection schedule falls within the periodic inspection schedule of the hoist, the rope inspection shall be recorded on the periodic inspection documentation specified in paragraphs **12.6.3.5.2** and **12.1.1** **(T-0)**

12.11.2.2.3. All rope idle for a month or more due to shutdown or storage of a hoist on which it is installed shall be given a thorough inspection before placed in service. **(T-0)** Refer to paragraph **12.11.2.4.3** for additional guidance.

12.11.2.3. Maintenance.

12.11.2.3.1. Rope shall be stored and handled in a manner which prevents damage or deterioration. **(T-0)**

12.11.2.3.2. Unreeling or uncoiling of rope shall be done as recommended by rope manufacturer and with extreme care to avoid kinking or inducing twist. **(T-0)**

12.11.2.3.3. Before cutting a rope, seizings shall be placed on each side of where the rope is to be cut to prevent unlaying of the strands. **(T-0)**

12.11.2.3.4. During installation, avoid dragging the rope in dirt or around objects which will scrape, nick, crush or induce sharp bends in the rope. **(T-0)**

12.11.2.3.5. Rope shall be maintained in a well-lubricated condition. **(T-0)** The object of rope lubrication is to reduce internal friction and to prevent corrosion. Lubricant applied as part of a maintenance program shall be compatible with the original lubricant. **(T-0)** The rope manufacturer's technical guidance/instructions shall be consulted. **(T-0)** Lubricant applied shall not hinder visual inspection. **(T-0)** Sections of rope located over sheaves or difficult to see during inspection and maintenance procedures require special attention when lubricating the rope. **Exception:** When used in clean rooms, factory lubricant may be removed from stainless steel ropes to prevent contamination.

12.11.2.3.6. An independent wire-rope or wire-strand core, or other temperature-damage resistant core, shall be used wherever there is exposure to temperatures at which fiber cores would be damaged. **(T-0)**

12.11.2.3.7. Replacement rope shall be the same size, grade, and construction as the original rope furnished by the crane manufacturer, unless otherwise recommended by a wire rope manufacturer due to actual working conditions. **(T-0)** Refer to paragraphs **12.11.2.3.4** and **12.11.2.4.4** for additional guidance.

12.11.2.4. Replacement:

12.11.2.4.1. Ropes shall be removed from service and replaced when any of the following conditions exist:

12.11.2.4.1.1. In running ropes, six (6) randomly distributed broken wires in one lay or three (3) broken wires in one strand in one lay. **(T-0)**

12.11.2.4.1.2. One outer wire broken at the contact point with the core of the rope, which has worked its way out of the rope structure and protrudes or loops out from the rope structure. **(T-0)**

12.11.2.4.1.3. Wear or scraping of 1/3 the original diameter of outside individual

wires. **(T-0)**

12.11.2.4.1.4. Kinking, crushing, bird caging, or any other damage resulting in distortion of the rope structure. **(T-0)**

12.11.2.4.1.5. Evidence of any heat damage or corrosion. **(T-0)**

12.11.2.4.1.6. Reductions from nominal diameter of more than: **(T-0)**

12.11.2.4.1.6.1. One-sixty-fourth (1/64) inch for diameters up to and including 5/16 inch. **(T-0)**

12.11.2.4.1.6.2. One-thirty-second (1/32) inch for diameters 3/8 inch to and including one-half inch. **(T-0)**

12.11.2.4.1.6.3. Three-sixty-fourths (3/64) inch for diameters 9/16 inch to and including three-fourths inch. **(T-0)**

12.11.2.4.1.6.4. One-sixteenth (1/16) inch for diameters 7/8 inch to and including one and one-eighth inch. **(T-0)**

12.11.2.4.1.6.5. Three-thirty-seconds (3/32) inch for diameters one and 1/4 inch to and including one and one-half inch. **(T-0)**

12.11.2.4.1.6.6. In standing ropes, more than two (2) broken wires in one lay in sections beyond end connections or more than one broken wire at an end **(T-0)** connection.

12.11.2.4.2. Special attention shall be given to the end fastenings. **(T-0)** Ropes shall be examined at socketed fittings and when two (2) broken wires are found next to this point, the rope shall be re-socketed. **(T-0)** Portions of the rope subjected to reverse bends and operation over small diameter sheaves or drums shall be given close attention.

12.11.2.4.3. A rope which has been in service, but idle for one month or more, shall be thoroughly examined before being put back into service. **(T-0)** This examination shall be for all types of deterioration, particularly corrosion, and shall be performed by a designated person, whose approval shall be required for further use of the rope. **(T-0)** The inspection shall be documented on an AFTO Form 95 or MAJCOM or locally devised paper or automated systems, which includes date of inspection, signature of inspector, an identifier for ropes inspected and rope condition. **(T-0)** The inspection shall be kept on file by the user for a minimum of one year and made readily available. **(T-1)**

12.11.2.4.4. All replacement rope shall be of proper size, grade and construction for its particular function on the machine. **(T-0) Note:** Discarded or repaired rope shall not be used for slings.

12.11.2.4.5. A continuing inspection record shall be maintained to establish a basis for judging when to replace wire rope. **(T-0)** This record shall cover points of deterioration listed in paragraphs **12.11.2.4.1** and **12.11.2.4.2** **(T-0)**

12.11.3. Chains.

12.11.3.1. Welded Link Chain Inspection.

12.11.3.1.1. Test hoist under load in hoisting and lowering directions and observe operation of the chain and sprockets. **(T-0)** Ensure chain feeds smoothly into and away from sprockets. **(T-0)**

12.11.3.1.2. If chain binds, jumps or is noisy, ensure it is clean and properly lubricated. **(T-0)** If the trouble persists, inspect chain and mating parts for wear, distortion or other damage. **(T-0)**

12.11.3.1.3. Clean the chain for inspection. Examine visually for gouges, nicks, weld splatter, corrosion and distorted links. **(T-0)** Slacken the chain and move adjacent links to one side to inspect for wear at the contact points. If wear is observed, or if stretching is suspected, measure the chain according to the hoist manufacturer's instructions. **(T-0)** If instructions are not available, proceed as follows:

12.11.3.1.3.1. Select an unworn, unstretched length of the chain from the slack end. **(T-0)**

12.11.3.1.3.2. Suspend chain vertically under tension and, using a caliper type gauge, measure outside length of any convenient number of links, approximately 12 to 14 inches overall. **(T-0)**

12.11.3.1.3.3. Measure the same number of links in the used sections and calculate percentage increase in length. **(T-0)** If the used chain exceeds the hoist manufacturer's recommended length, (or, in the absence of such a recommendation, if the chain is 1.5 percent longer than unused chain) replace the chain. **(T-0)** Do not repair load chain by welding or any other means; this repair is only accomplished by the chain manufacturer.

12.11.3.1.3.4. Install load chain links which pass over hoist load sprocket on edge (alternate to those which lie flat in the pockets) with welds away from center of the sprocket. **(T-0)**

12.11.3.1.4. Inspect hoist chains, including end connections, for excessive wear, twist and distorted links interfering with proper function or stretched beyond manufacturer's recommendations. **(T-0)** Hoist chains inspection intervals and requirements shall follow paragraphs **12.6.3.5.1** and **12.6.3.5.2** **(T-1)** A thorough inspection of all hoist chains shall be made at least once each month. **(T-1)** A written report which includes the date of the monthly inspection, the signature of the inspector, an identifier for the chains inspected and chain condition shall be kept on file by the user for a minimum of one year and made readily available. **(T-1)**

12.11.3.1.5. When chain is replaced, mating parts (chain sprockets, guides, stripper) shall be disassembled and inspected for wear and replaced if necessary. **(T-0)**

12.11.3.1.6. For non-load bearing drive (slack) chains, inspect for cracks, weld splatter, burrs or other damage. Repair or replace as required. **(T-0)**

12.11.3.2. Roller Link Chain Inspection:

12.11.3.2.1. Test hoist under load in hoisting and lowering directions and observe operation of chain and sprockets. **(T-0)** Ensure chain feeds smoothly into and away from sprockets. **(T-0)**

12.11.3.2.2. If chain binds, jumps or is noisy, ensure it is clean and properly lubricated. **(T-0)** If the trouble persists, inspect chain and mating parts for wear, distortion or other damage. **(T-0)** Hook shall be tested to the load requirements of paragraph **12.9.2.6.1** before further use. **(T-0)** Compliance should not preclude the possibility of consulting a qualified person when: the equipment has been altered, repaired or modified; the manuals or documents supplied by the manufacturer are no longer available; or the manufacturer or a successor is no longer in business and the manuals are no longer available. However, the purpose of consulting a qualified person shall not be to avoid contacting the manufacturer and obtaining the information supplied by the manufacturer. If manufacturer's data is not available and a qualified person has not determined the hook to be safe, the hook shall be removed from service. **(T-0) Note 1:** Hooks repaired by welding or reshaping are not authorized on nuclear-certified hoists or lifting equipment or equipment used to lift critical loads. **Note 2:** Painted hooks shall not be used on nuclear-certified hoists or lifting equipment. **(T-0) Note 3:** The manufacturer's original specifications shall be used as the baseline. **(T-0)** If the original specifications cannot be obtained through the manufacturer or item manager, the hook can continue to be used, provided the hook has been determined safe for use by a qualified individual IAW American Society of Mechanical Engineers B30.10, *Hooks*.

12.11.3.2.3. If possible, inspect roller link chain while in the hoist. With hoist suspended in normal position, apply a light load of approximately 50 pounds. **(T-0)**

12.11.3.2.3.1. Check chain for elongation following hoist manufacturer's instruction. **(T-0)** In absence of specific instructions, check the chain by determining the nominal pitch and measuring a 12-inch section of chain that normally travels over the chain sprocket. **(T-0)** Using a vernier caliper, check the dimension from the edge of one chain pin to the corresponding edge of another pin for the number of pitches per foot. **(T-0)** If elongation exceeds 1/4 inch in 12 inches, replace the chain. For example, a 3/4 inch pitch chain should measure 12 inches over 16 pitches. Reject chain if measurement over 16 pitches exceeds 12.25 inches. **(T-0)**

12.11.3.2.3.2. Check chain for twist. **(T-0)** Replace the chain if the twist in any 5-foot section exceeds 15 degrees. **(T-0)**

12.11.3.2.3.3. Check for camber. **(T-0)** Replace chain which has a side bow exceeding 1/4 inch in any 5-foot section. **(T-0)**

12.11.3.2.4. Inspect the chain more thoroughly by removing chain from hoist and cleaning it thoroughly in an acid-free solvent. **(T-0)** Then check for the following deficiencies:

12.11.3.2.4.1. Pins turned from their original position.

12.11.3.2.4.2. Rollers that do not turn freely with light finger pressure.

12.11.3.2.4.3. Joints that cannot be flexed by easy hand pressure.

12.11.3.2.4.4. Link plates that are spread open. A visual check of the pin extension at free end of chain can determine the amount of spread and the condition of the chain.

12.11.3.2.4.5. Corrosion, pitting or discoloration of chain, which is generally indicative of serious impairment.

12.11.3.2.4.6. Gouges, nicks or weld spatter.

12.11.3.3. Maintenance. All chain shall be kept clean and free from rust or any coating deposit build up and any change in dimensions or reduced flexibility. **(T-0)** Excessively dirty chain shall be soaked in a clean acid-free solvent and agitated to ensure all joints are free from grit and foreign matter. **(T-0)** Hand chain normally needs no lubricant. Roller and load chain shall be lubricated according to the hoist manufacturer's recommendations. **(T-0)** In absence of recommendations, the chain may be lubricated with a good grade of Society of Automobile Engineers (SAE) 20 or SAE 30 automotive motor oil. **(T-1)** Grease shall never be applied to a chain. **(T-0)**

12.11.4. Sheaves and Equalizers.

12.11.4.1. Sheaves.

12.11.4.1.1. Sheave grooves shall be smooth and free from surface defects which could cause rope damage. **(T-0)**

12.11.4.1.2. Sheave-carrying ropes, which can be momentarily unloaded, shall be provided with close-fitting guards or other suitable devices to guide the rope back into the groove when the load is applied again. **(T-0) Note:** Equalizers where ropes are terminated shall be specified to have sufficient adjustment space for block leveling as the rope stretches. **(T-0)**

12.11.4.1.3. Sheaves in the bottom block shall be equipped with close-fitting guards to prevent ropes from fouling when the block is lying on the ground with loose ropes. **(T-0)**

12.11.4.1.4. Pockets and flanges of sheaves used with hoist chains shall be sized so the chain does not catch or bind during operation. **(T-0)**

12.11.4.1.5. All running sheaves shall be equipped with means for lubrication. **(T-0)** Permanently lubricated, sealed bearings meet this requirement.

12.11.4.1.6. When chain is replaced, mating parts (chain sprockets, guides, stripper) shall be disassembled, inspected for wear and replaced if necessary. **(T-0)**

12.11.4.2. Equalizers.

12.11.4.2.1. If a load is supported by more than one part of rope, the tension in the parts shall be equalized. **(T-0)**

12.11.4.2.2. Equalizers shall be readily accessible for maintenance, lubrication and inspection. **(T-0)**

12.11.5. Hooks.

12.11.5.1. Inspection.

12.11.5.1.1. Hooks that are cracked, have any visibly apparent bend or twist from the plane of the unbent hook (original manufacturer or baseline measurements), any distortion causing an increase in throat opening of five (5) percent, not to exceed ¼

inch (or as recommended by the manufacturer), or any wear exceeding 10 percent (or as recommended by the hook manufacturer) of the original manufacturer or baseline section dimension of the hook shall be removed from service and repaired or replaced. **(T-0)** Repairs by welding or reshaping are not recommended as a standard practice. If such repairs are attempted, they shall be done by a qualified person and the exceed ¼ inch (or as recommended by the manufacturer).

12.11.5.1.2. Hooks shall be examined for the following:

12.11.5.1.2.1. Distortion such as bending, twisting or increased throat opening.

12.11.5.1.2.1.1. Any apparent bend or twist from the plane from the original measurements.

12.11.5.1.2.1.2. Any wear exceeding 10 percent (or as recommended by the manufacturer) of the original section dimension of the hook or its load pin.

12.11.5.1.2.1.3. Any distortion causing an increase in throat opening of five (5) percent, not to exceed ¼ inch (or as recommended by the manufacturer).

12.11.5.1.2.2. Cracks, severe nicks or gouges.

12.11.5.1.2.3. Safety latch engagement and damaged or malfunctioning latch, e.g., any self-locking latch that does not lock or any latch that does not close the hook's throat.

12.11.5.1.2.4. Hook attachment and securing means. Hook retaining nuts on collar and pins, welds or riveting shall be used to secure the retaining member.

12.11.5.1.2.5. Lubrication of swivel point.

12.11.5.1.2.6. Repairs by welding or reshaping are not recommended as a standard practice. If such repairs are attempted, they shall only be accomplished by a qualified person, and the hook shall be tested to the load requirements of the specific equipment in use. **(T-0) Note:** Hooks repaired by welding or reshaping are not authorized on nuclear-certified hoists or lifting equipment.

12.11.5.1.3. Intervals of Inspections. All hooks in service shall be visually inspected daily or prior to use. **(T-0)** The inspection shall be documented on AFTO Form 244 or MAJCOM or locally devised paper or automated system, which includes date of inspection, signature of inspector, an identifier for the hooks inspected and hook condition. **(T-1)** The inspection shall be kept on file by the user for a minimum of one year and made readily available. **(T-1)** Refer to paragraph **12.1.5.3** for additional guidance. **Note:** If the hook is part of a hoist, the frequent inspection shall be recorded on the hoist inspection documentation IAW paragraph **12.6.3.5.1**

12.11.5.1.4. For nuclear-certified hoist hooks and hooks used in lifting critical loads, perform a dye penetrant, magnetic particle, or other suitable nondestructive inspection (NDI) on the hook annually, in addition to the above. **(T-0)** For nuclear-certified hoist hooks, perform the annual NDI in conjunction with one of the two scheduled semiannual hoist and crane inspections. **(T-0)** Refer to paragraphs **12.6.3.5.2** and **12.8.3.5.2** for specific guidance. Refer to paragraph **12.6.3.7.4** for additional guidance on critical loads. **Note:** If the hook retaining nut is welded to the hook shank, removal

of the hook for inspection is not required. In this case, a visual inspection of the inside of the block assembly shall be performed. **(T-0)** If the block is designed such that disassembly is not feasible, this inspection is not required. **Warning:** If hook is removed from hoist for NDI, verify that the hook is properly reinstalled before use. **(T-0)**

12.11.5.2. Rated Capacity. Rated capacity for a hook, when used as intended, shall be equal to other suspension members to which it is attached. **(T-0)** When this is not feasible, special precautions shall be taken to ensure the hook's rated capacity is not exceeded. **(T-0)**

12.11.5.3. Hooks shall not be painted. **(T-0)** Unless specifically permitted by TO or other technical guidance, Air Force-users are not authorized to paint hooks. Hooks (including hooks on slings) received painted by the manufacturer may be used in applications not requiring them to be non-destructively inspected. Painted hooks removed from service shall be replaced. **(T-0) Note 1:** Painted hooks shall not be used on nuclear-certified hoists or lifting equipment or equipment used to lift critical loads. **Note 2:** Hooks with protective coatings applied by the manufacturer that do not affect or interfere with NDI may be used in applications requiring hook NDI. **Note 3:** Existing painted hooks may have the paint removed for NDI but may not be repainted unless authorized above.

12.11.5.4. Removable Hooks and Lifting Fixtures. Where operations require removal or replacement of hooks and/or lifting fixtures, the lifting capacity of the hooks/lifting fixtures shall be marked on the hook/lifting fixture and readily identifiable to the hoist/crane operator to prevent overloading the crane or hook/lifting fixture when load capacities are different. **(T-0)**

12.11.6. Hydra sets and Load Cells. These devices allow precision placement of heavy loads during mating and demating operations. These precision positioners are especially valuable when handling critical high value items such as spacecraft payloads or astronautical optics. Users of these types of materials handling equipment will develop inspection and testing procedures based upon the type of materials lifted. **(T-0)**

12.11.7. Personnel Hoists and Suspended Personnel Platforms. Using a crane or derrick to hoist workers on a personnel platform is prohibited except when conventional means of reaching the worksite, such as personnel hoist, ladder, stairway, aerial lift, elevating work platform or scaffold, would be more hazardous or is not possible. When absolutely necessary to hoist personnel, the following shall apply:

12.11.7.1. Cranes used for personnel hoisting shall have an anti-two blocking device incorporated into its design and shall have a power controlled lowering system capable of handling rated loads and speeds as specified by the manufacturer. **(T-0)** Refer to 29 CFR 1926.1400 for additional information.

12.11.7.2. Platforms used to suspend personnel shall be designed and used IAW 29 CFR 1926.1400 and as follows: **(T-0)**

12.11.7.2.1. Be capable of supporting at least five (5) times the maximum intended load (workers and their tools and equipment). **(T-0)**

12.11.7.2.2. Be equipped with a guardrail system including a top rail of 42 inches, a midrail and a toe-board and shall be enclosed at least from the toeboard to the midrail. **(T-0)** The guardrails shall be able to withstand at least 200 pounds applied in any direction. **(T-0)** A grab rail shall be installed inside the entire perimeter of the platform. **(T-0)**

12.11.7.2.3. Will permit a maximum of four (4) workers to be lifted, and provide room for tools and equipment. **(T-0)** Each worker shall be considered to weigh 250 pounds. **(T-0)**

12.11.7.2.4. Shall not be used during high winds, thunderstorms or any other adverse weather condition which could endanger the workers on the platform. **(T-0)**

12.11.7.3. The lifting bridle, used to suspend the working platform from the crane, shall normally consist of four (4) legs attached to ensure stability of the platform. **(T-0)** The lifting bridle shall be attached by a hook, closed and locked or secured by a shackle with a bolt, nut and retaining pin. **(T-0)** These bridles and associated rigging shall not be used for other purposes when not hoisting personnel. **(T-0)**

12.11.7.4. The total weight of the loaded personnel platform and related rigging (to include the load block, ball and wire rope) shall not exceed 50 percent of the rated capacity for the radius and configuration of the crane or derrick. **(T-0)**

12.11.7.5. The crane shall be uniformly level within one percent of level grade and located on firm footing. **(T-0)** If equipped, outriggers shall be fully deployed IAW manufacturer's specifications. **(T-0)**

12.11.7.6. Requirements for trial lift, inspection and load tests per 29 CFR 1926.1400 and the following:

12.11.7.6.1. Trial lifts are required immediately before personnel are lifted. **(T-0)** A new trial lift shall be performed any time the location or route of the planned lift changes. **(T-0)** The platform shall be inspected after the trial lift and before lifting personnel. **(T-0)**

12.11.7.6.2. The platform and rigging shall be load tested to 125 percent of the platform's rated capacity prior to lifting personnel at each job location and after any modifications or repairs. **(T-0)**

12.11.7.7. Personnel Safe Work Practices.

12.11.7.7.1. Workers shall keep all body parts inside the platform during lifts and, except when over water, shall wear and secure a safety harness with lanyard to an approved attach point within the platform. **(T-0)** The safety harness lanyard system must prevent a fall of over six (6) feet and the attach point must be capable of supporting the fall impact of the worker. **(T-0)** Refer to paragraph **13.4.6** for additional fall protection guidance.

12.11.7.7.2. The crane or derrick operator shall remain at the controls when personnel are suspended and shall terminate hoisting of personnel at the first sign of a potentially dangerous condition. **(T-0)**

12.11.8. Portable Automobile Lifting Devices.

12.11.8.1. Each portable automotive lifting devices shall be provided with operator's instructions. **(T-0)** The instructions shall specify the proper operating procedures and basic function of the components. **(T-0)** The instructions shall contain the recommended replacement fluid, maintenance and inspection procedures and intervals, as applicable. **(T-0)**

12.11.8.2. Maintenance. The portable automotive lifting devices shall be maintained IAW the product instructions.

12.11.8.3. Inspection.

12.11.8.3.1. Visual inspection shall be made before each use of the portable automotive lifting devices by checking for abnormal conditions, such as cracked welds, leaks and damaged, loose or missing parts. **(T-0)**

12.11.8.3.2. Other inspections shall be made per product operating instructions. **(T-0)**

12.11.8.3.3. Each portable automotive lifting devices shall be inspected immediately if the lift is believed to have been subjected to abnormal load or shock. **(T-0)** It is recommended that this inspection be made by qualified personnel or a manufacturer's or supplier's authorized repair facility.

12.12. Portable Automotive Lifting Devices and Related Equipment.

12.12.1. Requirements. All personnel shall observe all safety precautions in this chapter and those recommended by the manufacturers of the portable automotive lifting devices. **(T-1)** Always read the owner's manual before operating the portable automotive lifting devices. **(T-1)** The owner's manual/instructions spell out the proper operating procedures and basic function of the components, which includes the recommended replacement fluid, maintenance and inspection procedures and intervals as applicable.

12.12.2. Maintenance and Inspection.

12.12.2.1. Maintenance. The portable automotive lifting devices shall be maintained IAW the product instructions. **(T-0)**

12.12.2.2. Inspection.

12.12.2.2.1. Visual inspection shall be made before each use of the portable automotive lifting devices by checking for abnormal conditions, such as cracked welds, leaks and damaged, loose or missing parts. **(T-1)**

12.12.2.2.2. Other inspections shall be made per product operating instructions. **(T-1)**

12.12.2.2.3. Each portable automotive lifting devices shall be inspected immediately if the lift is believed to have been subjected to abnormal load or shock. **(T-1)** It is recommended that this inspection be made by a manufacturer's or supplier's authorized repair facility.

12.12.2.2.4. Owners and/or operators should be aware that repair of this equipment may require specialized knowledge and facilities. It is recommended that an annual inspection of the portable automotive lifting devices be made by a manufacturer's or supplier's repair facility and that any defective parts, decals or safety labels or signs are

replace with manufacturer's or supplier's specified parts. A list of repair facilities is available from the manufacturer or supplier.

Table 12.1. Synthetic Web Slings. 1,000 Pounds per Inch of Width – Single Ply (Rated in capacity in pounds)

Sling Body Width (inches)	Triangle -- Choker slings, type I Triangle -- Triangle slings, type II Eye and eye with flat eye slings, type III: Eye and eye with twisted eye slings, type IV					
	Vertical	**Choker**	**Vertical Basket**	**30° Basket**	**45° Basket**	**60° Basket**
1	1,000	750	2,000	1,700	1,400	1,000
2	2,000	1,500	4,000	3,500	2,800	2,000
3	3,000	2,200	6,000	5,200	4,200	3,000
4	4,000	3,000	8,000	6,900	5,700	4,000
5	5,000	3,700	10,000	8,700	7,100	5,000
6	6,000	4,500	12,000	10,400	8,500	6,000
Sling Body Width (inches)	**Endless Slings, type V**					
	Vertical	**Choker**	**Vertical Basket**	**30° Basket**	**45° Basket**	**60° Basket**
1	1,600	1,300	3,200	2,800	2,300	1,600
2	3,200	2,600	6,400	5,500	4,500	3,200
3	4,800	3,800	9,600	8,300	6,800	4,800
4	6,400	5,100	12,800	11,100	9,000	6,400
5	8,000	6,400	16,000	13,900	11,300	8,000
6	9,600	7,700	19,200	16,600	13,600	9,600
Sling Body Width (inches)	**Return Eye Slings, type VI**					
	Vertical	**Choker**	**Vertical Basket**	**30° Basket**	**45° Basket**	**60° Basket**
1	800	650	1,600	1,400	1,150	800
2	1,600	1,300	3,200	2,800	2,300	1,600
3	2,400	1,950	4,800	4,150	3,400	2,400
4	3,200	2,600	6,400	5,500	4,500	3,200
5	4,000	3,250	8,000	6,900	5,650	4,000
6	4,800	3,800	9,600	8,300	6,800	4,800

Notes:

1. All angles shown are measured from the vertical.
2. Capacities for intermediate widths not shown may be obtained by interpolation.

Table 12.2. Synthetic Web Slings. 1,200 Pounds per Inch of Width – Single Ply (Rated capacity in pounds)

Sling Body Width (inches)	Triangle -- Choker slings, type I Triangle -- Triangle slings, type II Eye and eye with flat eye slings, type III: Eye and eye with twisted eye slings, type IV

	Vertical	Choker	Vertical Basket	30° Basket	45° Basket	60° Basket
1	1,200	900	2,400	2,100	1,700	1,200
2	2,400	1,800	4,800	4,200	3,400	2,400
3	3,600	2,700	7,200	6,200	5,100	3,600
4	4,800	3,600	9,600	8,300	6,800	4,800
5	6,000	4,500	12,000	10,400	8,500	6,000
6	7,200	5,400	14,400	12,500	10,200	7,200
Sling Body Width (inches)	**Endless Slings, type V**					
	Vertical	**Choker**	**Vertical Basket**	**30° Basket**	**45° Basket**	**60° Basket**
1	1,900	1,500	3,800	3,300	2,700	1,900
2	3,800	3,000	7,600	6,600	5,400	3,800
3	5,800	4,600	11,600	10,000	8,200	5,800
4	7,700	6,200	15,400	13,300	10,900	7,700
5	9,600	7,700	19,200	16,600	13,600	9,600
6	11,500	9,200	23,000	19,900	16,300	11,500
Sling Body Width (inches)	**Return Eye Slings, type VI**					
	Vertical	**Choker**	**Vertical Basket**	**30° Basket**	**45° Basket**	**60° Basket**
1	950	750	1,900	1,650	1,350	950
2	1,900	1,500	3,800	3,300	2,700	1,900
3	2,850	2,250	5,700	4,950	4,050	2,850
4	3,800	3,000	7,600	6,600	5,400	3,800
5	4,750	3,750	9,500	8,250	6,750	4,750
6	5,800	4,600	11,600	10,000	8,200	5,800

Notes:

1. All angles shown are measured from the vertical.
2. Capacities for intermediate widths not shown may be obtained by interpolation.

Table 12.3. Synthetic Web Slings. 1,600 Pounds per Inch of Width – Single Ply (Rated capacity in pounds)

Sling Body Width (inches)	**Triangle -- Choker slings, type I** **Triangle -- Triangle slings, type II** **Eye and eye with flat eye slings, type III:** **Eye and eye with twisted eye slings, type IV**					
	Vertical	**Choker**	**Vertical Basket**	**30° Basket**	**45° Basket**	**60° Basket**
1	1,600	1,200	3,200	2,800	2,300	1,600
2	3,200	2,400	6,400	5,500	4,500	3,200
3	4,800	3,600	9,600	8,300	6,800	4,800
4	6,400	4,800	12,800	11,100	9,000	6,400
5	8,000	6,000	16,000	13,800	11,300	8,000
6	9,600	7,200	19,200	16,600	13,600	9,600
	Endless Slings, type V					

Sling Body Width (inches)	Vertical	Choker	Vertical Basket	30° Basket	45° Basket	60° Basket
1	2,600	2,100	5,200	4,500	3,700	2,600
2	5,100	4,100	10,200	8,800	7,200	5,100
3	7,700	6,200	15,400	13,300	10,900	7,700
4	10,100	8,200	20,400	17,700	14,400	10,200
5	12,800	10,200	25,600	22,200	18,100	12,800
6	15,400	12,300	30,800	26,700	21,800	15,400
Sling Body Width (inches)	**Return Eye Slings, type VI**					
	Vertical	**Choker**	**Vertical Basket**	**30° Basket**	**45° Basket**	**60° Basket**
1	1,050	1,050	2,600	2,250	1,850	1,300
2	2,600	2,100	5,200	4,500	3,700	2,600
3	3,900	3,150	7,800	6,750	5,500	3,900
4	5,100	4,100	10,200	8,800	7,200	5,100
5	6,400	5,150	12,800	11,050	9,050	6,400
6	7,700	6,200	15,400	13,300	10,900	7,700

Notes:

1. All angles shown are measured from the vertical.
2. Capacities for intermediate widths not shown may be obtained by interpolation.

Table 12.4. Number of Spacing of Clips for Ropes of Various Sizes. (If manufacturer's recommendations are not available)

Rope Diameter (inches)	Minimum Number Of Drop Forged Clips	Amount of Rope to Turn Back (inches)	Torque in Ft. Lbs	Minimum Spacing (inches)
1/8	3	3-1/4	4.5	3
1/4	3	4-3/4	15	3
1/2	3	11-1/2	65	3
5/8	3	12	95	3-3/4
3/4	4	18	130	4-1/2
7/8	4	19	225	5-1/4
1	5	26	225	6
1-1/8	6	34	225	6-3/4
1-1/4	6	44	360	7-1/2
1-3/8	7	44	360	8-1/4
1-1/2	7	54	360	9
1-5/8	8	58	430	
1-3/4	8	61	590	
2	8	71	750	
2-1/4	8	73	750	

Notes:
1. Apply the initial load and retighten nuts to the recommended torque. The rope will stretch and shrink in diameter when loads are applied inspect periodically and retighten.
2. The efficiency rating of a properly prepared termination for clip sizes 1/8 to 7/8 in. is approximately 80 percent and for sizes 1 to 3 in. is approximately 90 percent. This rating is based on the catalog breaking strength of wire rope. If a pulley is used in place of a thimble for turning back the rope, add one additional clip.
3. 1 in. = 2.54 cm. / 1 ft-lb = 1.36 Newton-meter.
4. The number of clips shown is based upon using right regular or Lang lay wire rope, 6 x 19 class or 6 x 37 class, fiber core or Independent Wire Rope Core, Improved Plow Steel or Extra Improved Plow Steel. If Seale construction or similar large outer wire type construction in the 6 x 19 class is used for sizes 1 in. (2.5 cm) and larger, add one additional clip.
5. The number of clips shown also applies to right regular lay wire rope, 8 x 19 class, fiber core, Improved Plow Steel, nominal sizes 1-1/2 in. and smaller; and right regular lay wire rope, 18 x 7 class, fiber core, Improved Plow Steel or Extra Improved Steel, nominal sizes 1-3/4 in. and smaller.
6. For other classes4 of wire rope not mentioned above, it may be necessary to add additional clips to the number shown.
7. Turn back the specified amount of rope from the thimble. Apply the first clip one base width from the dead end of the wire rope (U-bolt over dead end — live end rests in clip saddle). Tighten nuts evenly to recommended torque.
8. Apply the next clip as near the loop as possible. Turn on nuts firm but do not tighten. Space additional clips, if required, equally between the first two. Turn on nuts — take up rope slack — tighten all nuts evenly on all clips to recommended torque.

Table 12.5. Testing and Inspection Requirements for Materials Handling and Storage Equipment.
Note: This table provides a general overview of requirements outlined in this standard. Refer to specific paragraphs identified in parenthesis for more detailed information. See **Table 12.6** for additional testing and inspection requirements for hoisting equipment used for critical and nuclear loads.

	Load Tests		**Inspections**		
Type of Equipment	**Initial (Generally Manufacturer)**	**Following Repair, Modifications, etc.**	**Daily or Prior to Use**	**Periodic**	**Specialized Operator Qualifications**
Manual Hoisting Devices	Yes 100% – 125% **(12.5.2.5.2.1)**	Yes 100% – 125% **(12.5.2.5.2.2)**	Yes **(12.5.2.3.1)**	Annually **(12.5.2.3.2)**	No
Powered Industrial Trucks	No	No	Yes **(12.3.6)**	No	Yes **(12.3.3)**
Conveyors	No	No	Yes **(12.4.2.4)**	No	Yes **(12.4.2.2)**
Hoists	Yes 100% – 125% **(12.6.3.7.2.)**	Yes 100% – 125% **(12.6.3.7.2.)**	Yes **(12.6.3.5.1.)**	Yes **(12.6.3.5.2.)** Other **(12.6.3.5.3.)**	Yes **(12.6.3.3.)**

Slings	Yes 100% – 200% **(12.7.2.4.3)**	Yes 100% – 200% **(12.7.3.1.1)**	Yes **(12.7.2.3)**	Yes **(12.7.2.3.2.)**	No
Mobile and Locomotive Cranes	Yes 100% – 125% **(12.9.2.6.1.1)**	Yes 100% – 125% **(12.9.2.6.2)**	Yes **(12.9.2.4)**	Yes **(12.9.2.4.2)**	Yes **(12.9.2.2)**
Overhead Gantry, and Underhung Cranes and Monorail Systems	No	Yes 100% – 110% **(12.8.2.7.1)**	Yes **(12.8.2.5.1)**	Monthly **(12.8.2.5.2)**	Yes **(12.8.2.3)**
Related Hoisting Equipment (Chain, Wire, Rope, Hook, Personnel Platforms)	Yes **(12.11.7.6)**	Yes 100% – 110% **(12.11.7.6)**	Yes **(12.11.2.2.1)**	Yes **(12.11.2.2.2)**	No
Derricks	Yes **(12.10.2.1.)**	No	Yes **(12.10.1.1)**	Yes **(12.10.1.2)**	No

Table 12.6. Additional Testing and Inspection Requirements for Materials Handling and Equipment Used for Critical and Nuclear Loads.

Note: This table provides a general overview of requirements outlined in this standard. Refer to specific paragraphs identified in parenthesis for more detailed information. Requirements outlined in this table are additional requirements to those outlined in **Table 12.5**

Type of Equipment	Annual Load Test	Periodic Inspection
Hoists		
Nuclear Load	Yes Not less than 100% or more than 125% of the rated capacity **(12.6.3.7.3)**	Semiannually **(12.6.3.5.2)**
Critical Load	Yes Not less than 100% or more than 125% of the rated capacity **(12.6.3.7.4)**	
Slings		
Nuclear Load	Yes Per 11N Series TOs **(12.7.2.4)**	Yes Per 11N Series TOs **(12.7.2.3)**
Mobile and Locomotive Cranes		
Nuclear Load	Yes Not less than 100% or more than 110% **(12.9.2.6.2.2)**	

Related Hoisting		
Equipment **Critical and Nuclear Load**	NDI Hook – Yes (Annually)	

Chapter 13

FALL PROTECTION

13.1. Scope. This chapter applies to all workplaces. It covers all walking-working surfaces unless specifically covered by another chapter or industry.

13.1.1. General Industry Requirements IAW 29 CFR 1910. Fall protection shall be provided whenever workers can fall four (4) feet or more. **(T-0)** This four (4) foot rule applies to all walking and working surfaces and includes open-sided floors and platforms, wall openings and window wall openings at a stairway landing, floor, platform or balcony with a drop of four (4) feet or more. Refer to paragraph **13.2.2** for types of fall protection.

13.1.2. Construction Operations IAW 29 CFR 1926. Fall protection shall be provided when workers can fall six (6) feet or more during construction operations. **(T-0)** This six (6) foot rule applies to all walking and working surfaces, including roofs, open-sided floors and platforms, wall openings and window wall openings at a stairway landing, floor, platform or balcony with a drop of six (6) feet or more. Refer to 29 CFR Subpart M for additional requirements.

13.1.3. Aircraft Flightline Operations. Refer to **Chapter 24**, *Aircraft Flightline – Ground Operations and Activities*.

13.1.4. Portable ladders and Scaffolding. Refer to **Chapter 7**, *Walking - Working Surfaces*, **Chapter 17**, *Scaffolding*, 29 CFR 1910.23, *Ladders*, and 29 CFR 1910.27, *Scaffolds and Rope Descent Systems*.

13.1.5. Powered platforms and aerial lifts. Refer to **Chapter 16,** *Mobile Elevating Work Platforms*, 29 CFR 1910.66(j) and 1910.67(c)(2)(v).

13.1.6. This chapter does not apply to the following:

13.1.6.1. Fall protection is not required for fall hazards presented by the exposed perimeters of entertainment stages and the exposed perimeters of rail-station platforms. Refer to 29 CFR 1910.28, *Duty to have Fall Protection and Falling Object Protection*.

13.1.6.2. Inspections, Investigations or Assessments. IAW 29 CFR 1910.28(a)(2)(ii), fall protection is not required during inspections, investigations or assessments of workplace conditions or work to be performed prior to the start of work or after all work has been completed. **Note:** If fall protections systems or equipment meeting the requirements of 29 CFR 1910.29, *Fall Protection Systems and Falling Object Protection—Criteria and Practices*, have been installed, fall protection is required. A JHA and/or risk assessment shall be developed for tasks exposing workers to falls four (4) feet or more and not adequately covered in the applicable item TO. **(T-0)**

13.2. General Information.

13.2.1. Refer to AFI 91-202, *USAF Mishap Prevention Program*, for employee safety and health training requirements and **Chapter 2**, *General Work Procedures*, and **Chapter 14**, *Personal Protective Equipment (PPE)*, of this AFI for additional guidance on workplace hazards and proper PPE. **(T-1)**

13.2.2. Types of Fall Protection.

13.2.2.1. Active. Active fall protection, such as positioning and restraint systems, ladder climbing devices and personal fall arrest systems, require the worker to wear a harness and attach himself/herself to an anchorage or lifeline. Positioning and restraint systems prevent a worker from falling while a personal fall arrest systems permits a worker to fall, but limits arresting loads to generally safe levels.

13.2.2.1.1. Positioning and restraint systems. Fall restraint systems, also referred to as work positioning systems, are similar to a personal fall arrest system; however, fall restraint systems restrict a worker's range of movement so the individual cannot fall to the surface below.

13.2.2.1.2. Refer to paragraphs **13.4.6** and **13.5** for additional guidance on personal fall arrest systems.

13.2.2.2. Passive. Passive fall protection, such as guardrails, work stands and platforms (aircraft maintenance stands, e.g., B-1, B-4, B-5, etc.), nets, ladder cages and other devices can prevent a worker from falling, but are not directly connected to the worker. If passive fall protection is not feasible, active fall protection is the preferred option. **Note:** Nets do not prevent a worker from falling, but does prevent a worker from hitting the next level.

13.2.2.3. Fall Protection Plans. Fall protection plans, such as using TO designated aircraft surfaces, are the least preferred method of fall protection, but may be considered when it is demonstrated that active and/or passive measures are ineffective, would create a greater hazard or are not feasible. Refer to 29 CFR 1910.28 for additional requirements. A fall protection plan must meet the requirements of 29 CFR 1926.502(k) and shall be documented in a JHA coordinated with the installation Occupational Safety office before the plan and its procedural controls are used. **(T-0)** Training for the fall protection plan must meet the requirements of 29 CFR 1926.503(a) and (c). **(T-0) Note:** Consistent with OSHA guidelines, cost shall not be a consideration for selecting the fall protection plan's procedural controls.

13.2.2.3.1. A JHA shall be performed where the fall protection plan's procedural controls are the only practical means of providing fall protection. **(T-1)** The JHA, and any changes, shall be prepared by a qualified person, as defined in **Attachment 1, Terms,** and developed specifically for the worksite. **(T-1)** JHAs shall be kept up to date and maintained at the work center for the work site, e.g., maintenance supervisor or superintendent, flight chief or supervisor office, etc. **(T-1)** Implementation of the JHA shall be under the supervision of a competent person, as defined in **Attachment 1, Terms. (T-1)** Refer to **Chapter 1** for additional guidance on JHAs. 13.2.2.3.2. Procedures and equipment identified in the JHA shall be considered the minimum mandatory requirements for operations covered in the JHA, and shall include:

13.2.2.3.2.1. An assessment of the operation and fall hazard. **(T-0)**

13.2.2.3.2.2. Why active and passive fall protection systems (e.g., guardrails, personal fall arrest systems or net systems) are not feasible or would create a greater hazard? **(T-0)**

13.2.2.3.2.3. Description of the fall protection measures available and each location where conventional fall protection methods cannot be used (these will become controlled access zones). **(T-0)**

13.2.2.3.2.4. A corrective action plan describing planned upgrades (equipment, cost and timetable, prioritized by the shop) and appropriate Risk Assessment Codes, to partially or totally eliminate need for procedural controls. **(T-1)**

13.2.3. Air Force item managers (Depot) shall perform the necessary functions, e.g., describing planned upgrades, costs, timetables and prioritization for Air Force equipment not meeting fall protection standards. **(T-1)**

13.3. Training. Before any workers are exposed to a fall hazard, training IAW 29 CFR 1910.30, *Training Requirements*, shall be completed. **(T-0)** Training shall include methods of use, application, inspection and storage, as well as any manufacturer‘s recommendations; application limits, proper anchoring and tie-off techniques, estimation of free fall, deceleration and total fall distance to prevent striking a lower level; applicable fall protection, fall prevention, rescue and evacuation plans. **(T-0)** Recurring training shall be conducted annually, when work conditions change or new fall arrest systems are introduced, and documented IAW AFI 91-202. **(T-1)**

13.4. Fall Protection Equipment.

13.4.1. Railings. Refer to **Chapter 15,** *Training Systems*, and 29 CFR 1910.28 for information on railings.

13.4.2. Fixed Work Platforms. Refer to **Chapter 15**, for additional guidance.

13.4.3. Mobile Work Platforms. Vehicle-mounted elevating and rotating work platforms, manual and self-propelled mobile work platforms or similar equipment may be used to protect workers provided guards, railings, a personal fall arrest system or other similar devices are incorporated in the platform design. Refer to **Chapter 15**, and 29 CFR 1910.23, 29 CFR 1910.27, 29 CFR 1910.67, *Vehicle-Mounted Elevating and Rotating Work Platforms*, and 29 CFR 1910.140, *Personal Fall Protection Systems*, for additional information.

13.4.4. Safety Nets. Nets may be used when workers are more than 25 feet above ground, water or other surfaces where ladders, catch platforms, temporary floors, fixed or mobile work platforms or personal fall arrest systems are impractical. Refer to 29 CFR 1910.29, *Fall Protection Systems and Falling Object Protection—Criteria and Practices*, and 29 CFR part 1926, Subpart M, for safety net systems requirements.

13.4.5. Ladder Safety Devices. Refer to 29 CFR 1910.28 and 29 CFR 1910.29 for ladder safety devices requirements.

13.4.6. Personal Fall Arrest Systems. Personal fall arrest systems require an anchorage point, connecting means, lanyard and shock absorber. Refer to 29 CFR 1910.29 and 29 CFR 1910.140 for additional information. **Note:** To prevent worker injury or death, personal fall arrest systems shall not be used without a rescue plan. Refer to paragraph **13.7** for additional guidance on rescue plans.

13.4.6.1. Selection. Personal fall arrest systems shall be selected by a qualified person, match the particular work situation and minimize free fall distance (not to exceed six [6] feet). **(T-0)** personal fall arrest systems equipment shall meet or exceed requirements in American National Standards Institute Z359.1, *The Fall Protection Code*. **(T-0)** Only commercially manufactured fall arrest equipment shall be used. **(T-0)**

13.4.6.2. Personal fall arrest systems equipment shall have the manufacturer‘s name or logo; part number and model designation; capacity rating; warning to follow the

manufacturer's instructions included with the equipment at time of shipment from the manufacturer stamped on the equipment or permanently attached tag and shall be marked to indicate compliance with American National Standards Institute Z359.1. **(T-0)**

13.4.6.2.1. The service life of fall protection equipment manufactured of synthetic fiber shall be specified by the manufacturer, or sooner if determined unserviceable per paragraph **13.5.1** **(T-0)** The service life begins once the equipment is put in service, assuming the new unused equipment is stored in a climate-controlled location, i.e., in a plastic bag not exposed to vapors, and in a cool location out of direct sunlight.

13.4.6.3. Horizontal lifelines (Skylines), commonly used in aircraft hangars, wash racks, corrosion control or other aircraft maintenance areas, shall be designed by a qualified person as defined in 29 CFR 1910.66, *Personal Fall Arrest System*, and 29 CFR 1910.140. **(T-0)** The number of workers attached to the lifeline at any time shall not exceed lifeline/anchorage point design limits.

13.4.6.4. Full body harness.

13.4.6.4.1. Only a full body harness shall be used with a personal fall arrest systems. **(T-0)** It shall provide support across the lower chest, over the shoulders and around the thighs and, when properly fitted and used, shall prevent the worker falling out of the harness should a fall occur. **(T-0)** While working on or near exposed energized electrical equipment operating at 50 volts or more the safety harness worn over arc flash rated protective clothing shall be arc flash rated IAW UFC 3-560-01, *Operation and Maintenance: Electrical Safety,* and American Society for Testing Materials F887, *Standard Specifications for Personal Climbing Equipment*. **(T-0)** **Warning:** Body belts may not be used.

13.4.6.4.2. The lanyard attachment point shall be located in the center of the wearer's back near shoulder level or above the wearer's head. **(T-0)**

13.4.6.4.3. Harness load bearing straps shall have a minimum width of 1-5/8 inch and be finished to prevent fraying. **(T-0)**

13.4.6.5. Lanyards. Lanyards of synthetic materials shall have free ends lightly seared to prevent unraveling. **(T-0)** Knots weaken a lanyard and shall not be used in lanyard end terminations. Lanyards (and shock absorbers) subjected to impact loading from a falling person or weight test shall be removed from service and replaced. **(T-0)** Refer to paragraphs **13.5.2.8** and **13.6.8.4** for additional guidance. **Warning:** Wire rope or rope covered wire lanyards, some plastics (such as nylon) and wet lanyards are conductive and shall not be used near electrical hazards.

13.4.6.6. Energy (Shock) Absorber Components. Each personal fall arrest system may include a shock absorber. Shock absorbers shall be designed so activation is obvious, e.g., ripped stitches, telltale strips visible, etc. **(T-0)** Shock absorbers with any signs of activation shall be removed from service. **(T-0)**

13.4.6.7. Anchorage. Anchorages for lifelines and lanyards shall support at least a 5,000 pound load for each person connected to the anchorage. **(T-0)** Anchorages not meeting this rating can be used as part of a complete personal fall arrest system which maintains a safety factor of at least two (2) and is under the supervision of a qualified person. Only one

personal fall arrest system shall be connected to an anchorage point unless specifically certified for more. **(T-0)**

13.4.6.8. Connectors. personal fall arrest system connectors (hardware used to connect a system together such as a carabiner, D-ring, O-ring, oval ring, snap-hook, etc.) shall be drop forged, pressed or formed steel or made of equivalent materials and purchased new with a clean finish, free of rust, scale or foreign matter. **(T-0)**

13.4.6.8.1. Snaphooks and carabineers shall be self-closing, self-locking, designed to take 2 consecutive and deliberate actions (double locking) to open and load rated for at least 5,000 pounds. **(T-0)**

13.4.6.8.2. Connectors shall withstand a 5,000 pound load multiplied by the maximum number of personal fall arrest systems attached to the connector and shall not be exposed to sharp edges, abrasive surfaces or physical hazards, such as thermal, electrical or chemical sources. **(T-0)**

13.4.6.9. Fall arrester components. Fall arresters, as in self-retracting lifelines, shall be automatic in their locking (fall stopping) function. **(T-0)** Workers shall follow manufacturer's instructions to test the locking mechanism after connection to their harness/lanyard. **(T-0)** Self- retracting lifeline systems will be positioned over the worker as the worker moves. **(T-0)** Pulling on the lifeline cable to provide more slack without moving the overhead carrier (trolley) will result in a pendulum swing should the worker fall. Energy shock absorbers will not be used in conjunction with deceleration devices (self-retracting lifelines).

13.4.7. Electricians. Fall protection equipment for electricians shall be arc thermal performance value rated IAW UFC 3-560-01. **(T-0)**

13.4.8. Equipment For Un-stepped Communications Poles. All communications-electronic field technicians required to climb un-stepped communications poles will use the squeeze pole fall protector (pole choker) arrest system. **(T-1)** 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)** Refer to **Chapter 30**, *Communication Cable, Antenna and Communication System*, for additional guidance.

13.5. Inspections and Maintenance

13.5.1. Personal Fall Arrest Systems Inspection. (**Note:** Inspections shall be documented IAW TO 00-25-245. **(T-1)**

13.5.1.1. Personal fall arrest systems users shall comply with TO 00-25-245 and manufacturer's instructions for inspection, maintenance, cleaning and storage. **(T-0)** If defects or damage to equipment or inadequate maintenance of equipment is found, the equipment shall be immediately tagged "unserviceable" and removed from service. **(T-0)** Unserviceable personal fall arrest systems will be destroyed to prevent further use. **(T-0)**

13.5.1.2. Workers shall inspect their personal fall arrest systems prior to the first use of the day and/or shift for mildew, wear, damage and other deterioration. **(T-0)**

13.5.1.3. Supervisors shall ensure all personal fall arrest systems components receive a thorough inspection at least quarterly. **(T-1)** This inspection shall be documented and maintained for at least one year. **(T-1)**

13.5.1.4. Supervisors shall maintain manufacturer's instructions and performance testing information for personal fall arrest systems used by their workers. **(T-1)**

13.5.1.5. Personal fall arrest systems components requiring removal from service:

13.5.1.5.1. Components with illegible or absent markings.

13.5.1.5.2. Absence of any element which affects equipment form, fit or function.

13.5.1.5.3. Defective or damaged hardware elements including distorted hooks or faulty hook springs, tongues unfitted to shoulder buckles, loose or damaged mountings, non-functioning parts, cracks, sharp edges, deformation, corrosion, chemical attack, excessive heating, alteration, deterioration, contact with acids or other corrosives and excessive wear.

13.5.1.5.4. Defects or damage to straps or ropes including fraying, unsplicing, unlaying, kinking, knotting, roping, broken or pulled stitches, excessive elongation, chemical attack, excessive soiling, cuts, tears, abrasions, mold, undue stretching, alteration, needed or excessive lubrication, excessive aging, contact with heat, fire or corrosives, internal or external deterioration and excessive wear.

13.5.1.5.5. Lanyards after an impact load and shock absorbers with any signs of activation.

13.5.2. Personal Fall Arrest Systems Use, Maintenance and Storage Requirements.

13.5.2.1. Equipment shall be stored and maintained IAW the manufacturer's instructions. **(T-0)** Unique issues, due to local conditions, shall be addressed with the manufacturer. **(T-0)**

13.5.2.2. Equipment shall be stored to preclude damage from environmental factors such as heat, light, excessive moisture, dirt, oil, chemicals and their vapors or other degrading elements. **(T-0)**

13.5.2.3. Rope, synthetic materials and rope-covered lanyards shall not be used while welding, cutting or in areas with sharp edges, open flames or excessive heat.

13.5.2.4. Lanyards, connectors and lifelines subject to damage by work operations such as welding, chemical cleaning and sandblasting, shall be protected or other securing systems used. **(T-0)**

13.5.2.5. Lanyards shall be kept as short as practical to minimize free fall distance, shall not permit a vertical fall of more than six (6) feet as specified in 29 CFR 1910.140, nor allow the worker to contact any lower level or obstruction. **(T-0)** Lanyards shall not be attached to a dropline, lifeline or fixed anchorage point in a manner that reduces lanyard strength.

13.5.2.6. It is common practice to interchange lanyards, connectors, lifelines, deceleration devices and body harnesses; however, components from different manufacturers may not

be safely interchangeable. Always check with the manufacturer(s) before mixing components.

13.5.2.7. Only use personal fall arrest systems components for their designed purposes.

13.5.2.8. Personal fall arrest systems components subjected to impact loading shall be immediately removed from service and replaced. **(T-0)**

13.6. Operations. Fall protection is required for workers working in elevated locations on open-sided floors and platforms and near floor and wall openings.

13.6.1. Fall prevention and protection must be considered for maintenance work or storing of equipment at heights. **(T-0)** At the planning and design phase of a project, fall hazards shall be considered and eliminated whenever possible. **(T-1)** When elimination or prevention of fall hazards is not feasible, the design must include certified and labeled anchorages IAW 29 CFR 1910.28 and American National Standards Institute Z359.1. **(T-0)** Where fall protection is required near weight handling equipment, care must be taken to prevent potential conflicts between the weight handling equipment and fall protection measures. **(T-1)**

13.6.2. Erecting or Dismantling Fall Protection. Workers shall be provided with a safe means for erecting or dismantling fall protection systems and features. **(T-0)**

13.6.3. Dangerous Equipment and Machinery. Regardless of the fall distance, fall protection must be provided when working over dangerous equipment and machinery unless it is less than four feet and covered or guarded to eliminate the hazard. **(T-0)**

13.6.4. Low-slope Roofs

13.6.4.1. Work performed less than six (6) feet from the roof edge requires that each employee is protected from falling by a guardrail system, safety net system, travel restraint system, or personal fall arrest system

13.6.4.2. Work performed at least 6 feet but less than 15 feet from the roof edge requires that each employee is protected from falling by using a guardrail system, safety net system, travel restraint system, or personal fall arrest system. **Note:** A designated area may be used when performing work that is both infrequent and temporary.

13.6.4.3. Work performed 15 feet or more from the roof edge, requires:

13.6.4.3.1. That each employee is protected from falling by a guardrail system, safety net system, travel restraint system, or personal fall arrest system or a designated area. The employer is not required to provide any fall protection, provided the work is both infrequent and temporary; and

13.6.4.3.2. A work rule is implemented/enforced prohibiting employees from going within 15 feet of the roof edge without using fall protection IAW with paragraphs **13.6.4.1** and **13.6.4.2**

13.6.5. A supervisor, who is designated in writing, shall be responsible for procurement of fall protection/fall arrest systems required by the organization or shop. **(T-1)** The supervisor shall be familiar with the shop's typical work assignments and fall protection/fall arrest systems required for each operation. **(T-1)** The supervisor shall ensure each worker/qualified person/competent person using a fall protection/fall arrest system is trained and evaluated on proper use, application and inspection of fall protection/fall arrest systems. **(T-0)**

13.6.6. Worker fall protection requires an in-depth evaluation of risks. The supervisor shall:

13.6.6.1. Conduct JHA, as required. **(T-1)** A JHA is not required if existing guidance covers all safety requirements of an operation or process. Supervisors will refer to **Chapter 1** and AFI 91-202 for additional guidance on JHAs and job safety lesson plans. **(T-1)**

13.6.6.2. Prepare, review, approve and modify rescue plans and training lesson plans for fall protection activities. **(T-1)**

13.6.6.3. Ensure initial and recurring training and training evaluations are provided to shop personnel on fall protection/fall arrest systems prior to initial use. Refer to paragraph **13.3** for additional guidance. **(T-1)**

13.6.6.4. Ensure appropriate design, selection, certification, evaluation and analysis of fall protection/fall arrest systems and equipment. **(T-1)**

13.6.6.5. Prepare and accomplish self-inspection checklist annually IAW TO 00-25-245. Checklist shall include all relevant information on fall protection/fall arrest systems, e.g., proper care, maintaining and inspection of fall protection/fall arrest systems equipment, training program, etc. **(T-1)** The self-inspection shall be documented and maintained until the next self-inspection is performed. **(T-1)**

13.6.6.6. Conduct fall protection/fall arrest system inspections and support accident investigations. **(T-1)**

13.6.7. A qualified person, typically an engineer, shall:

13.6.7.1. Identify and certify anchorage points on facilities and structures. **(T-0)**

13.6.7.2. Assist supervisors and competent persons in selecting fall protection systems. **(T-0)**

13.6.7.3. Develop and evaluate fall protection plans, as defined in paragraph **13.2.2.3**, that may be used for: **(T-1)**

13.6.7.3.1. General industry activities, e.g., TO designated aircraft surfaces, rolling stock/motor vehicles not positioned inside of or contiguous to a building or other structure where the installation of fall protection is feasible, etc.

13.6.7.3.2. Construction activities, e.g., leading edge work, precast concrete erection work, or residential construction work, as defined by 29 CFR 1926.501(b)(2), (b)(12) and (b)(13). **(T-0)**

13.6.8. A competent person, typically an experienced worker, shall:

13.6.8.1. Assist supervisors and qualified persons in determining feasibility and safety of fall protection for workers and selecting appropriate fall protection systems. **(T-1)**

13.6.8.2. Perform on site observations of job work conditions, use of fall protection systems and correct application of the fall protection plan for general industry activities. **(T-1)**

13.6.8.3. Identify hazardous conditions and suspend work tasks until hazards are corrected. **(T-1)**

13.6.8.4. Inspect personal fall arrest systems equipment to determine if components subjected to impact loading are undamaged. If damaged, remove and replace. **(T-1)**

13.7. Rescue

13.7.1. Rescue Plan. Rescue plans will be developed for fall protection activities. **(T-1)** Personal fall arrest systems use shall not be allowed if a means to rescue a fallen worker is not available. The rescue plans shall include the following elements at a minimum:

13.7.1.1. Type of rescue system, e.g., ladder, aerial lift, FES Flight, outside agency. **(T-1)**

13.7.1.1.1. If relying on FES Flight or contracted agency, notification prior to fall protection activities commencing is required.

13.7.1.1.2. If FES Flight or contracted agency is unavailable work will not commence.

13.7.1.2. Location of rescue anchorage.

13.7.1.3. Equipment needed.

13.7.1.4. Attachment to fallen worker's harness.

13.7.1.5. Required training.

13.7.1.6. Specific actions to achieve successful rescue.

13.7.2. Supervisors shall ensure workers using a personal fall arrest system can be properly rescued or can rescue themselves should a fall occur. **(T-0)** Availability of rescue personnel, ladders or other rescue equipment shall be determined prior to using a fall arrest system. **(T-0)**

13.7.3. Self-rescue by a fallen worker may be possible, depending on location and work conditions. However, the supervisor shall ensure a rescue plan is in place to rescue workers should they be injured or unable to self-rescue. **(T-0)**

13.7.4. Workers suspended in a full body harness often lose consciousness after a fall. This is caused by restrictions in blood flow to the extremities caused by the harness. The rescue plan must ensure a rescue can be affected very quickly to prevent permanent injury or death. **(T-1)** **Warning:** Hanging in a harness for an extended period of time can be fatal. IAW American National Standards Institute Z359.4, *Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components*, prompt rescue means getting to the subject within six (6) minutes after an accidental fall.

13.7.5. When potential for serious injury exists due to a fall and no threat requires immediate movement of the fallen worker, the worker should remain in place and encouraged to remain still while emergency services personnel are called to assist.

13.7.6. Additional Rescue Guidance. Where non-Air Force professional rescue agencies cannot promptly rescue a fallen AF worker, the installation Occupational Safety office and FES Flight may establish training for fire protection workers and adequate installation personnel as authorized or competent rescuers. Training shall be documented IAW AFI 91-202. **(T-1)** Coordination with the installation Fire Chief is required to determine if the FES Flight is able to support a fall rescue operation.

Chapter 14

PERSONAL PROTECTIVE EQUIPMENT (PPE)

14.1. Scope. This chapter covers the use, selection, care and maintenance for protective equipment for eyes, face, head and extremities, protective clothing, respiratory devices and protective shields/barriers. For issues involving Radio Frequency or laser radiation, refer to AFI 48-109 *Electromagnetic Field Radiation (EMFR) Occupational and environmental health Program*, AFI 48-139, *Laser and Optical Radiation Protection Program*, and AFI 48-148, *Ionizing Radiation Protection.*

14.2. Hazards. The best means of worker protection is to engineer hazards out of the job so the worker is not exposed. If this is not possible, PPE may be required. A documented job hazard analysis (JHA) shall be conducted to determine if hazards are present and take actions necessary to protect workers from injury, illness or death IAW 29 CFR 1910.132, *Personal Protective Equipment – General Requirements*. **(T-1)** Refer to paragraph **1.5** and AFI 91-202 for additional guidance on JHA.

14.2.1. An employee can be exposed to many hazards, to include:

14.2.1.1. Physical Hazards, e.g., electricity, radiation, high exposures to sunlight/ultraviolet rays, temperature extremes, noise, flying or falling particles, sharp edges, etc.

14.2.1.2. Chemical and Dust Hazards, e.g., cleaning products, paints, acids, solvents, welding fumes, gases, flammable materials, pesticides, etc.

14.2.1.3. Biological Hazards, e.g., blood/other body fluids, fungi/mold, bacteria, viruses, plants, insect bites, animal/bird droppings, etc.

14.2.1.4. Ergonomic Hazards, e.g., vibration.

14.2.2. Commanders and/or Functional Managers shall ensure all work centers conduct and document hazard assessments to determine if hazards are present and take actions necessary to protect workers from injury, illness or death IAW 29 CFR 1910.132. **(T-0)** Only after engineering controls (e.g., placing foam around aircraft) have been applied to the maximum extent practicable, or until controls can be installed, will PPE (e.g., bump caps) be the primary means to protect personnel against hazards. **Note:** If PPE is required for the performance of a task, then it shall be provided by the commander and/or functional manager. **(T-0)** Subordinates are not responsible for providing their own PPE.

14.2.3. Supervisors shall:

14.2.3.1. Conduct and document hazard assessments in each workplace where their employees are performing duties IAW 29 CFR 1910.132. **(T-0)** If PPE is required, the supervisor shall ensure that PPE is provided, used and maintained in a sanitary serviceable condition. **(T-0)**

14.2.3.2. Contact BE and Environmental Management when workplace operations change to schedule appropriate evaluation when new hazardous materials are introduced, processed or procedures are changed, or engineering controls are modified or added. **(T-1)**

14.2.4. Air Force personnel shall promptly report safety, fire and health hazards to supervision or management. **(T-0)**

14.3. Training.

14.3.1. Training shall be provided to each affected employee who is required to use PPE when accomplishing any work activity. (T-0) Supervisors shall train each employee to know, at a minimum, the following:

14.3.1.1. When PPE is necessary.

14.3.1.2. The right PPE for the work activity. **(T-0)**

14.3.1.3. How to properly don, doff, adjust, and wear PPE. **(T-0)**

14.3.1.4. Limitations/Hazards of specific PPE. **(T-0)**

14.3.1.5. Pre-use inspections, proper care, maintenance, useful life and disposal of the PPE. **(T-0)**

14.3.2. Manufacturer's instructions shall be consulted for specific PPE training requirements. **(T-0)** Specific respiratory protection PPE training can also be found in 29 CFR 1910.134, *Respiratory Protection.*

14.3.3. Supervisor shall document training IAW paragraph **1.7** **(T-1)**

14.3.4. Respiratory Training Documentation. IAW AFI 48-137, *Respiratory Protection Program*, document respiratory training.

14.4. Personal Protective Equipment (PPE).

14.4.1. PPE shall be used whenever there are hazards that can do bodily harm through absorption, inhalation or physical contact. **(T-0)** This equipment includes respiratory protective devices, special clothing and protective devices for the eyes, face, head, torso and extremities. All PPE shall be approved for the work performed and shall be maintained in satisfactory condition. **(T-0)** Units should consult the installation Occupational Safety office and BE if they have questions regarding PPE. BE is responsible for selecting respirator and filter types, and fit testing for users requiring respiratory protection. Supervisors shall instruct personnel in the use and care of this equipment. **(T-0)** Training shall be documented IAW AFI 91-202. **(T-1)** Refer to 29 CFR 1910.133., *Eye and Face Protection*, and AFI 48-137, and AFI 48-127, *Occupational Noise and Hearing Conservation Program*, for additional guidance and information. Protective equipment must meet the following minimum requirements:

14.4.1.1. Provide adequate protection against the particular hazards for which they are designed. **(T-0)**

14.4.1.2. Be reasonably comfortable when worn under designated conditions. **(T-0)**

14.4.1.3. Fit snugly without interfering with movement of wearer. **(T-0)**

14.4.1.4. Be durable. **(T-0)**

14.4.1.5. Be capable of being disinfected (unless disposable items are used). **(T-0)**

14.4.1.6. Be easily cleaned. **(T-0)**

14.4.1.7. Be kept clean and in good repair. **(T-0)**

14.4.2. Supervisors are responsible for maintaining discipline with regard to personnel wearing properly fitted PPE, when required, and shall consult the installation Occupational Safety office and BE concerning the selection and use of PPE. **(T-1) Note:** All personnel must have job safety training. **(T-0)** Supervisors shall document job safety training for all personnel. **(T-1)** Refer to AFI 91-202 for further information.

14.4.3. Air Force personnel shall:

14.4.3.1. Comply with PPE requirements. **(T-0)**

14.4.3.2. Ensure provided PPE is used when required, adjusted to properly fit and maintained in a sanitary and serviceable condition. **(T-0)**

14.4.3.3. Notify supervisors of any changes in medical status which might impair their ability to safely wear PPE (e.g., weight changes, facial scarring, dental changes, disfigurement, etc.). **(T-1)**

14.4.4. Eye and Face Protection. (**Note:** Only protective eye and face devices IAW American National Standards Institute/International Safety Equipment Association Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices,* will be used.) (**T-0**) Personnel shall be provided and use appropriate eye or face protection, as directed by applicable technical data or as determined by an appropriate risk assessment, when exposed to hazards (or potential hazards) from flying or falling particles, molten metal, liquid chemicals, corrosives, caustics, chemical gases, vapors or ionizing and non-ionizing radiation. **(T-0)** This requirement also applies to management, supervisors and visitors within the hazardous area. Selection shall be based on the kind and degree of hazard present. **(T-0) Note 1:** Eye protection is required to protect against small particles of falling debris whenever a task is above eye level and the worker must look up into the area being worked on. **(T-0) Note 2:** Face shields are considered face protection only and must be worn with appropriate eye protection at all times. **(T-0)** In the case of primary protection, other protective devices such as safety goggles shall be worn. **(T-0)** Refer to 29 CFR 1910.133, for additional information.

14.4.4.1. Supervisors shall ensure eye and face protection properly fits their employees before use in hazardous area. **(T-0)**

14.4.4.2. Eye and face protection must have the manufacturer‘s identification clearly marked on the equipment. **(T-0)** Etching is not allowed on the lenses of safety glasses. Safety glasses from manufacturers already meet American National Standards Institute/International Safety Equipment Association Z87.1 requirements. If not, return to manufacturer prior to use.

14.4.4.3. When limitations or precautions are indicated by the manufacturer, they shall be transmitted to the user and strictly observed. **(T-0)**

14.4.4.4. Metal framed glasses shall be secured with a cord or strap to prevent them from falling into energized circuitry. **(T-0)**

14.4.4.5. Safety spectacles are designed with special sturdy frames. Normal street frames with safety lenses are not acceptable substitutes and shall not be worn as a substitute for safety spectacles.

14.4.4.6. Prescription safety spectacles shall only be fitted by qualified optical personnel. **(T-1)**

14.4.4.7. Employees who wear prescription lenses shall be provided eye protection that incorporates the prescription in its design and protects against the hazard, or shall wear eye protection that can be worn over the prescription lenses. **(T-0)** The protective equipment must not interfere with the wearer's vision or proper position of the protective equipment. **(T-0)**

14.4.4.8. Contact lenses alone do not provide eye protection and shall not be worn in eye hazard work environments without the use of appropriate safety eyewear. **(T-0)** Employees who wear contact lenses will notify their supervisors. **(T-1)** This information is vital to emergency medical personnel who may need to remove a lens from the individual's eye.

14.4.4.8.1. If an individual who must wear corrective lenses uses spectacle inserts with a full-face piece respirator, the spectacle inserts for the respirator shall be purchased by the government using a prescription provided by the user. **(T-0)**

14.4.4.8.2. If an individual who must wear corrective lenses elects to wear contact lenses with any respirator, the contact lenses shall be purchased by the individual. **(T-0)**

14.4.4.8.3. Some vapors and gases can penetrate contact lenses, and possibly get trapped between the lens and eye, and cause serious harm to the worker. Supervisor and worker should contact BE to evaluate the potential hazards associated with the assigned task and make a decision on the appropriate eyewear.

14.4.4.9. When working with potentially injurious light radiation, affected employees shall wear PPE with filtered lenses that have a shade number appropriate to the protection required. **(T-0)** Refer to **Chapter 27,** *Welding, Cutting and Brazing,* for additional information.

14.4.5. Head Protection. Personnel working in areas where there is a potential for injury from falling or flying objects, bumping head against a fixed object or electrical shock or burns shall be provided and use protective helmets. **(T-0)** Typical examples of these areas are construction sites and warehouses. Protective helmets must comply with American National Standards Institute/International Safety Equipment Association Z89.1, *Industrial Head Protection,* and 29 CFR 1910.112, *Head Protection.* **(T-0) Note:** Protective helmets that contain the American National Standards Institute/International Safety Equipment Association Z89.1 marking meet the requirements of American National Standards Institute/International Safety Equipment Association Z89.1.

14.4.5.1. Safety Helmets (Hard Hats). Commanders, supervisors and team members shall ensure all those working on or near underground or aerial installation, construction and certain maintenance-related jobs wear an approved hard hat at all times. **(T-0)** Specifically, it shall be worn while working construction, all Red Horse-type building construction, working on or around poles, overhead structures, vaults, manholes, excavations, demolitions, and tower and antenna construction jobs. **(T-0)** The chinstrap shall be worn during work aloft. **(T-1)** Refer to paragraph **14.4.5.2** for additional guidance on chinstraps. These safety helmets (hard hats) provide protection from impact and penetration of falling objects and from high-voltage electric shock and burns. Main helmet components consist of a protective shell, inside suspension system designed to act as an energy-absorbing mechanism and a chinstrap to secure the helmet to the head. The crown strap shall form a

cradle to support the helmet on the wearer's head. The distance between the top of the head and the underside of the shell shall be adjusted to the manufacturer's requirement for the particular helmet being used. **(T-0)** Any part of the helmet that comes into contact with the wearer's head must not irritate the skin.

14.4.5.1.1. American National Standards Institute Safety Helmet Classification.

14.4.5.1.1.1. Type I (Impact Type). Type I helmets reduce the force of impact from a blow to the top of the head.

14.4.5.1.1.2. Type II (Impact Type). Type II helmets reduce the force of impact from a blow received off center or to the top of the head.

14.4.5.1.1.3. Class G (Electrical – General). Class G helmets reduce the danger of contact exposure to low voltage conductors.

14.4.5.1.1.4. Class E (Electrical). Class E helmets are intended to reduce the danger of exposure to high voltage conductors.

14.4.5.1.1.5. Class C (Conductive). Class C helmets do not provide protection against contact with electrical conductors.

14.4.5.1.2. Color Identification. Safety helmets shall not be painted, as certain paints may hide cracks or defects in the outer shell and destroy or degrade the insulating characteristics of the shell. Helmets are manufactured in a wide variety of colors and units shall purchase helmets manufactured in a color that meets their particular requirement rather than painting them. **(T-1)** Colored helmets shall meet the requirements of American National Standards Institute/International Safety Equipment Association Z89.1. **(T-0) Note:** Protective helmets that contain the American National Standards Institute/International Safety Equipment Association Z89.1 marking meet the requirements of American National Standards Institute/International Safety Equipment Association Z89.1.

14.4.5.1.3. Identification Markers. Affix identification markers on shells without making holes through the shell and without the use of any metal parts or metallic labels. (Holes could cause the helmet to fail the electrical insulation test and degrade the impact design of the helmet.) **Note:** Helmet markings shall allow the wearer to identify the type of helmet by looking inside the shell for the manufacturer, American National Standards Institute designation, and class. **(T-0)** For example: Manufacturer's Name, American National Standards Institute/International Safety Equipment Association Z89.1, and Applicable Type and Class designations.

14.4.5.1.4. Use of Decals. Decals on safety helmets are only authorized if approved by the unit's MAJCOM, DRU or FOA, and with the following restrictions:

14.4.5.1.4.1. Decals shall be limited to unit or MAJCOM emblems and the individual's name. **(T-2) Note:** Decals may also possess a composite took kit identification/tracking number.

14.4.5.1.4.2. Decals or emblems shall be stick-on type only, no more than three (3) inches in nominal diameter. **(T-1)**

14.4.5.1.4.3. Names shall be stick-on with each letter no more than 1/2 inch by 1/2

inch. **(T-1)**

14.4.5.2. Chinstraps. Chinstraps shall be made of nonconductive material not less than 12.7 mm (1/2 inch) in width. **(T-1)** An adjustable chinstrap is designed to fit under the chin to secure the helmet to the head. Safety helmets are of little use if they do not fit securely on the head and remain in place when impacted by a falling object. The chinstrap shall be used when working on elevated surfaces where there is a possibility of the hard hat falling off and impacting workers on the lower level. **(T-0)**

14.4.5.3. Bump Caps. Bump caps are constructed of lightweight materials and provide minimal protection against bumps or lacerations to the head. They do not afford adequate protection from high impact forces or penetration by flying or falling objects and shall not be used as a substitute for hard hats. Their use shall be determined by the supervisor's hazard assessment, in conjunction with the installation Occupational Safety office. **(T-0)** Refer to paragraph **14.2** for additional information on hazard assessments.

14.4.5.4. Hair Protection.

14.4.5.4.1. Men and women who work around chains, belts, rotating devices, suction devices, blowers, etc., shall cover their hair, especially long hair, to prevent it being caught in moving equipment. **(T-0)** While such equipment is normally guarded, long hair can fit between the mesh of guards and be drawn into the moving parts.

14.4.5.4.2. The length of hair which poses a hazard varies with the operation performed and the control measures used.

14.4.5.4.3. The supervisor, being most knowledgeable of the operation, shall determine what constitutes an acceptable hair length. **(T-1)** Normally, hair longer than four inches and in close proximity to moving components shall be considered hazardous. **(T-1)** However, the supervisor may contact the installation Occupational Safety office for assistance.

14.4.5.4.4. Bandannas, disposable caps, hairnets and turbans may be used, providing they cover the hair completely and do not themselves present a hazard to the wearer. **Note 1:** The effect of long hair shall be considered when conducting a workplace JHA. **(T-0) Note 2:** Flightline excluded, i.e., these items cannot be worn on the flightline due to a potential foreign object damage (FOD) hazard.

14.4.6. Hearing Protection. Exposure to high noise levels can cause hearing loss or impairment, in addition to physical and psychological stress. Specifically designed protection may be required, depending on the type of noise encountered and the auditory condition of the employee. AFI 48-127 is the primary Air Force directive on hazardous noise exposure policies, responsibilities and procedures, including hearing protective device information. Contact BE for information on the Air Force Hearing Protection Program. Refer to AFI 48-127 for additional guidance and information.

14.4.7. Respiratory Protection. IAW AFI 48-137, BE, as the OPR for the Air Force Respiratory Protection Program, recommends/approves all respiratory protection devices and shall be consulted on respiratory protection required for specific shop activities and job site(s), if required. **(T-1)** AFI 48-137 and 29 CFR 1910.134 provides guidance on control of occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes,

mists, gases, smokes, sprays, vapors or in oxygen-deficient environments. Operations that generate hazardous dusts, such as those that contain lead, cadmium, beryllium and asbestos, may require use of protective clothing to prevent injury and spread of contamination. At locations where neither BE nor occupational or environmental health personnel are readily available, supervisors shall contact the support medical facility or the next higher headquarters for assistance with respiratory protection guidance. **(T-1)** OSHA has expanded standards for many of these chemicals and they direct strict workplace compliance to include identifying regulated areas. Consult with BE on any operation that generates dust to include aircraft and parts sanding.

14.4.8. Torso Protection. The torso is the largest exposed area of the body. A variety of protective clothing is available to protect personnel from heat, hot metals, liquids, impacts, cuts, corrosives, caustics and radiation. Items such as vests, jackets, aprons, coveralls and full body suits have been specifically designed for this purpose. Supervisors must consider the hazards involved with an operation before selecting the proper protective equipment, which may be a combination of several different pieces of PPE. **(T-0)** For example, cloth coveralls protect wood workers against minor cuts and abrasions; however, coveralls alone would be inappropriate for operating a table saw. The addition of a leather apron and eye protection would be more appropriate. **Note:** A back support belt is designed to provide lower lumbar and abdominal muscle support when lifting. However, there is no definitive proof that back support belts serve any protective function; therefore, the Air Force does not recognize back support belts as PPE. Back support belts are only worn with supervisory approval and proper training of safe lifting techniques. They shall not be relied upon solely to protect the back from injury. Back support belts should be unfastened when the individual is not presently involved in a lifting motion, to prevent the possibility of muscle atrophy from prolonged usage.

14.4.9. Hand and Arm Protection. When an employee's hands or arms are exposed to hazards, such as skin absorption of harmful substances, severe cuts, lacerations, abrasions, punctures, chemical burns or harmful temperature extremes, appropriate hand or arm protection shall be provided and used. **(T-0)** Sleeves, padded arm protectors, hand pads and other items shall be worn to protect the hands and arms when hot or sharp materials are handled. **(T-0)** There is a wide assortment of gloves, hand pads, sleeves and wristlets for protection against various hazardous situations. Before purchasing any protective equipment, contact BE, who will evaluate the hazard and provide the necessary specifications such as material type, thickness and coverage area, then ensure the manufacturer's recommended use for the glove matches the particular application and anticipated hazards involved. Supervisors shall select appropriate hand protection based on the characteristics required for the task to be performed, dexterity required, conditions present, duration of use, frequency, physical stresses, limitations of protective clothing and degree of exposure to identified hazards. **(T-0)**

14.4.9.1. Multi-Use Gloves. These gloves are generally worn to protect the hands from injuries caused by handling sharp or jagged objects, wood or similar hazard-producing materials. These gloves are usually made of cloth material, such as cotton flannel, with chrome leather palms and fingers or synthetic coating. All-leather gloves are also acceptable. **Note:** Supervisors unable to find appropriate glove(s) in the Air Force inventory, must use proper Air Force channels to procure PPE from outside sources. **(T-1)** Before purchasing gloves or any protective clothing (outside Air Force sources), the

supervisor shall obtain manufacturer documentation which indicates the equipment meets the appropriate test standards for the hazards anticipated. **(T-1)**

14.4.9.2. Selection of Gloves for Protection against Chemical Hazards. Chemical protective gloves shall be worn by personnel working in battery shops or where acids, alkalis, organic solvents and other harmful chemicals are handled. **(T-0)** Refer to the TO, JHA and BE evaluation for assistance in selecting the proper glove.

14.4.9.2.1. Toxic properties of the chemicals used must be determined and taken into consideration when selecting the proper protective gloves. **(T-0) Example:** Some chemicals cause local effects on the skin or pass through the skin and cause systemic effects.

14.4.9.2.2. A glove shall be selected on the basis of the chemical component with the shortest breakthrough time, since it is possible for solvents to carry active ingredients through polymeric materials. **(T-0)**

14.4.9.2.3. Chemical-resistant gloves can be used for most dry powders.

14.4.9.2.4. Employees must be able to remove gloves in such a manner as to prevent skin contamination. **(T-0)**

14.4.10. Electrical Workers' Clothing and Equipment (Refer to AFI 32-1064, *Electrical Safety Practices).*

14.4.10.1. Insulated Protective Equipment. Personnel who work on energized high voltage circuits or power supply lines shall wear electrical workers' nonconductive rubber gloves (with leather outer gloves) as prescribed by TOs, manufacturer's manuals or other safety directives. **(T-0)** Other insulating clothing and equipment, such as blankets, hoods, sleeves, matting and line tools designed for the voltage levels encountered, shall be used as required. **(T-0)**

14.4.10.1.1. Each item shall be clearly marked with proper Class number and Type (I or II). **(T-0)** The Class numbers identify the design requirements of gloves, blankets and sleeves made of rubber. Refer to 29 CFR 1910.137, *Electrical Protective Equipment,* Table I-4 for the rubber insulating voltage requirement for each class. Material used for non-ozone-resistant equipment (gloves) other than matting shall be marked Type I. **(T-0)** Material used for ozone-resistant equipment (gloves) other than matting shall be marked Type II. **(T-0)**

14.4.10.1.2. Maximum use voltages shall conform to those listed in 29 CFR 1910.137, Table I-4. **(T-0)**

14.4.10.2. Arc flash protection shall be provided for all Air Force operations exposing personnel performing duties on or in proximity of energized parts operating at 50 volts or more. (T-1) Protective clothing required, if any, shall be based on the procedures outlined in UFC 3-560-01, *Operation and Maintenance: Electrical* Safety, National Fire Protection Association 70E, *Standard for Electrical Safety in the Workplace,* and AFI 32-1064. **(T-1)**

14.4.10.3. Selection of Gloves for Protection against Electrical Shock or Burn. Electrical workers' gloves are designed to insulate workers from shock, burns and other electrical hazards. These gloves shall not be the only protection provided and shall never be used

with voltages higher than the insulation rating of the gloves. Workers shall ensure gloves being used have been tested IAW this standard. **(T-0)**

14.4.10.3.1. Rubber protective gloves shall never be used without leather outer protective gloves, also referred to as leather gauntlets.

14.4.10.3.2. Only seamless rubber insulating gloves shall be used. **(T-0)**

14.4.10.3.3. Gloves shall be marked clearly and permanently on the cuff portion with the name of the manufacturer or supplier, type, size, voltage class and class color. **(T-0)**

14.4.10.3.4. Markings shall be non-conducting and not impair the insulating qualities of the glove. **(T-0)**

14.4.10.3.5. Type II material (gloves, blankets and sleeves) is equipment other than matting which has been designed to be ozone-resistant. Material used for Type II insulating equipment shall be capable of withstanding an ozone test with no visible effects. **(T-0)** The ozone test shall reliably indicate that the material will resist ozone exposure in actual use. **(T-0)** Any visible signs of ozone deterioration of the material, such as checking, cracking, breaks or pitting, is evidence of failure to meet the requirements for ozone-resistant material.

14.4.10.3.6. Gloves shall be capable of withstanding the alternating current (AC) proof test voltage specified in 29CFR 1910.137, Table I-1 after a 16-hour water soak. **(T-0)**

14.4.10.4. Insulating Matting. Insulating matting shall be used near electrical apparatus or circuits in high voltage maintenance areas as an additional safety measure to protect personnel. **(T-0)** Insulating matting protects against accidental shock only and shall not be depended upon for protection when handling energized wires and circuits. TOs 00-25-232, *Control and Use of Insulating Matting for High-Voltage Application*, and 00-25-234, *General Shop Practice Requirements for Repair, Maintenance, and Test of Electrical Equipment (ATOS)*, and MIL-DTL-15562G, *Matting or Sheet, Floor Covering Insulating for High Voltage Application*, provide information and instructions for control, use and marking of insulating matting. Approved electrical insulating matting is permanently marked IAW MIL-DTL-15562G.

14.4.10.4.1. Upon request, the supervisor, with the assistance of the installation Occupational Safety office, shall inspect areas with electrical facilities and determine if insulating matting is required for worker protection. **(T-1)** Typical examples of areas where insulating matting is required include locations where potential shock hazards exist and additional resistance is required, floor resistance is lowered due to dampness, high voltages (greater than 600 volts, nominal) may be encountered, such as high voltage consoles, and areas with electrical repair or test benches (shops), motors or equipment and control panels.

14.4.10.4.2. Insulating matting on floors in front of and around electrical workbenches, high voltage cabinets, switch panels, etc., shall be of one continuous length or strip. **(T-0)** Where possible, the matting shall continue 24 inches beyond the end of the equipment. Overlapping at corners is not required if it produces a tripping hazard. If

more than one run or strip of matting is required, the activity supervisor shall determine the amount needed. **(T-1)**

14.4.10.4.3. Insulating matting shall be seamless and markings shall be non-conducting and not impair the insulating qualities of the equipment. **(T-0)**

14.4.10.4.4. Matting shall be capable of withstanding the alternating current proof test voltage specified in 29 CFR 1910.137, Table I-4. **(T-0)**

14.4.10.4.5. Insulating matting shall not be used for nonskid applications such as walkways, hall runners, in front of workbenches (non-electric) or on work and test benches, etc. For these applications, general purpose matting shall be used. **(T-1)** This is a low-cost matting and is satisfactory for use in areas where shock protection is not required. No certification for use of general purpose matting is required.

14.4.10.5. Rubber insulating equipment meeting the following national consensus standards are deemed to be in compliance with this standard.

14.4.10.5.1. American Society of Testing Materials D120, *Standard Specification for Rubber Insulating Gloves*.

14.4.10.5.2. American Society of Testing Materials D178, *Standard Specification for Rubber Insulating Matting*.

14.4.10.5.3. American Society of Testing Materials D1051, *Standard Specification for Rubber Insulating Sleeves*. **Note:** These standards contain specifications for conducting AC and direct current (DC) proof tests, breakdown test, water soak procedure and the ozone test mentioned in this standard.

14.4.11. Foot and Leg Protection—Safety Shoes, Toe Caps, Leggings, etc. Protective footwear shall be provided and worn when there is a reasonable possibility of foot injuries from heavy or sharp objects and electrical and/or static electricity. (T-0) Use appropriate foot guards, safety shoes or boots and leggings for protection of feet and legs from falling or rolling objects, sharp objects, molten metal, hot surfaces and wet slippery surfaces. Leggings protect the lower leg and feet from molten metal or welding sparks. Safety snaps permit their rapid removal.

14.4.11.1. Supervisors shall identify those areas, operations and occupations which require protective leg or footwear. **(T-1)** All individually issued safety footwear used in Air Force operations shall meet the requirements of American Society of Testing Materials F2412, *Standard Test Methods for Foot Protection,* and American Society of Testing Materials F2413, *Standard Specification for Performance Requirements for Protective (Safety) Toe Cap Footwear.* **(T-0)**

14.4.11.2. Safety shoes shall be sturdy and have an impact-resistant toe. **(T-0)** Only shoes meeting or exceeding the American National Standards Institute Class 75 impact standard are approved for the Air Force. Refer to 29 CFR 1910.136., *Foot Protection,* for additional information. Metal insoles in shoes protect against puncture wounds. Additional protection, such as metatarsal guards, may be necessary for some job tasks. Nonskid shoes shall be worn where floors may be wet or slippery. **(T-0)** Electrical hazard shoes are not designed to be a replacement for electrically rated matting in high voltage situations. These shoes are designed to be used when working on low voltage circuits and as a secondary

means of protection. **Note:** When exposed to cold temperatures and foot crushing hazards, if cold weather footwear which also provides crushing protection is not available, personnel shall be issued footwear which protects against the possibility of frostbite. **(T-0)**

14.4.12. Chemical Protective Clothing. The purpose of chemical protective clothing and equipment is to shield or isolate individuals from chemical, physical and biological hazards encountered during hazardous materials operations. Many chemicals pose invisible hazards and offer no warning properties. It is important for employees to realize that no single protective clothing item can protect against all hazards. Other protective methods, such as engineering or administrative controls, shall be used to limit chemical contact before considering use of PPE. **(T-0)**

14.4.12.1. Chemical Protective Clothing Selection. Workplace supervisors shall contact BE to determine the appropriate PPE for all processes. **(T-1)**

14.4.12.2. Ensemble Selection Factors:

14.4.12.2.1. Hazard Consideration. Chemicals present a variety of hazards such as toxicity, corrosiveness, flammability, reactivity and oxygen deficiency, or a combination of hazards may be present.

14.4.12.2.2. Requirements. The proper type of chemical protective clothing or equipment depends on job requirements, and includes requirements from TOs, SDSs and manufacturer‘s recommendations.

14.4.12.2.2.1. Check with BE before purchasing chemical protective clothing or equipment.

14.4.12.2.2.2. Some chemicals require PPE made out of specific materials. Ensure PPE is made from specific materials designed to protect against specific chemicals for the duration of exposure.

14.4.12.3. Chemical Protective Clothing—Breakthrough Time (see **Attachment 1, Terms**). Chemicals allowed to remain on protective clothing or equipment can diffuse through the material, even if it is in storage. Chemical protective clothing that is reused must be cleaned before storage. **(T-0)** In some cases it may be more cost effective to select chemical protective clothing with a relatively short breakthrough time and discard it after use.

14.4.12.3.1. Duration of Exposure. Maximum duration of exposure to a chemical shall be considered when selecting chemical protective clothing. **(T-0)**

14.4.12.3.2. Performance Characteristics.

14.4.12.3.2.1. Resistance to abrasions, cuts, heat, ozone and punctures or tears shall be considered to maintain the integrity of the material. **(T-0)**

14.4.12.3.2.2. Flexibility may be an important factor if inflexible equipment interferes with the worker’s ability to successfully accomplish his or her task.

14.4.13. Knee Protection. Knee pads may be used by workers who are required to kneel while performing most of their work or by workers with known knee problems that could be compounded by working in a kneeling position.

14.4.14. Welding, Cutting and Brazing Specific PPE. Key portions of 29 CFR 1910.252., *Welding, Cutting and Brazing – General Requirements*, covering protective equipment, are included here. Workers engaged in or exposed to welding, cutting or brazing activities shall be provided the proper PPE. **(T-0)** The appropriate protective clothing required for specific welding operations varies with the size, nature and location of the work performed. Refer to 29 CFR 1910.132 and AFI 48-137 for additional guidance.

14.4.14.1. Personal protective clothing may interfere with the body's heat dissipation, especially during hot weather or in confined spaces. Workers may need frequent breaks.

14.4.14.2. Leg Protection. For heavy work, flame-resistant leggings or other equivalent means shall be used to provide additional protection for the legs. **(T-0)**

14.4.14.3. Hand and Arm Protection.

14.4.14.3.1. All welders and cutters shall wear protective flame-resistant gloves. **(T-0)** All gloves shall be in good repair, dry and capable of providing protection from electric shock by welding equipment. **(T-0)** Insulated linings shall be used to protect areas exposed to high radiant energy. **(T-0)**

14.4.14.3.2. Cape sleeves or shoulder covers with bibs made of leather or other flame-resistant materials shall be worn during overhead welding, cutting or other operations, when necessary. **(T-0)**

14.4.14.4. Torso Protection.

14.4.14.4.1. Clothing shall provide sufficient coverage and be made of suitable materials to minimize skin burns caused by sparks, spatter, ultra violet radiation or electrical shock. **(T-0)**

14.4.14.4.2. All outer clothing, such as coveralls, shall be reasonably free from oil and grease. **(T-0)**

14.4.14.4.3. Front pockets and upturned sleeves or cuffs shall be prohibited. **(T-0)** Sleeves and collars shall be kept buttoned to prevent hot metal slag and sparks from contacting the skin. **(T-0)**

14.4.14.4.4. Durable flame-resistant aprons made of leather or suitable materials shall be used to protect the front of the body when additional protection against sparks and radiant energy is needed. **(T-0)**

14.4.14.5. Eye and Face Protection requirements.

14.4.14.5.1. All welding helmets shall meet 29 CFR 1910.252 requirements. **(T-0)**

14.4.14.5.2. Eye and face protective equipment shall be inspected for serviceability prior to each use. **(T-0)** For sanitary purposes, eye and face protectors shall not be shared by other employees. Helmets shall be used during all arc-welding or arc-cutting operations, excluding submerged arc-welding. **(T-0)** Where the work permits, submerged arc-welders shall be enclosed in separate booths coated on the inside with non- reflective material. **(T-0)** When two or more welders are exposed to the hazards of each other's welding operations, goggles shall be worn under the welder's helmets to provide protection from harmful rays and flying debris. **(T-0)** Helpers or attendants shall be provided with the proper PPE, to include eye protection. **(T-0)**

14.4.14.5.3. Goggles or other suitable eye protection shall be used during all gas welding or oxygen cutting operations. **(T-0)**

14.4.14.5.4. All operators and attendants of resistance welding or brazing equipment, or while chipping slag, shall use transparent face shields or goggles, depending on the particular job, to protect their faces or eyes as required. **(T-0)**

14.4.14.5.5. Suitable tinted goggles or spectacles shall be provided for torch brazing operations or soldering operations. **(T-0)** Spectacles shall be equipped with side shields. **(T-0)**

14.4.14.6. Specifications for PPE.

14.4.14.6.1. Helmets and goggles shall be made of a material which is an insulator for heat and electricity. **(T-0)** Helmets, face shields and goggles shall not be readily flammable and shall be capable of withstanding sterilization. **(T-0)**

14.4.14.6.2. Helmets shall be arranged to protect the face, neck and ears from direct radiant energy from the arc. **(T-0)**

14.4.14.6.3. All parts shall be constructed of a material which will not readily corrode or discolor the skin. **(T-0)**

14.4.14.6.4. Goggles shall be ventilated to prevent fogging of the lenses as much as practicable. **(T-0)**

14.4.14.6.5. Easily removed filter and cover lenses or plates shall be provided to protect each helmet, goggle filter lens or plate. **(T-0)**

14.4.14.6.6. All glass for lenses shall be tempered and substantially free from striae/scratches, air bubbles, waves and other flaws. **(T-0)** Except when a lens is ground to provide proper optical correction for defective vision, the front and rear surfaces of lenses and windows shall be smooth and parallel. **(T-0)**

14.4.14.6.7. Lenses shall bear some permanent distinctive markings identifying the lens' source and shade. **(T-0)**

14.4.14.6.8. All filter lenses and plates shall meet the radiant energy transmission test prescribed in American National Standards Institute/International Safety Equipment Association Z87.1. **(T-0**)

14.4.14.6.9. Hand-held screens for shielding the face and eyes shall not be used since they may be inadvertently held in the wrong position and not provide the proper protection.

14.4.14.7. Hearing Protection. Refer to paragraph **2.2.2** for guidance.

14.4.14.8. Respiratory Protection. When mechanical or natural ventilation fails to reduce air contaminants to allowable levels or when implementation of such controls is not feasible, respiratory protective equipment shall be used to protect personnel from hazardous concentrations of airborne contaminants. **(T-0)** Only approved respirator equipment shall be used. **(T-0)** Consult BE and AFI 48-137 for additional guidance.

14.4.14.9. Head Protection. Caps made from flame resistant material shall be worn under helmets, when necessary, to prevent head burns. **(T-0)**

14.4.15. Light Reflective Products.

14.4.15.1. Light reflective and luminescent materials are particularly effective for reducing mishaps caused by poor visibility or darkness. Reflective coatings are available in the primary safety code colors so standard signs and markings can be made with these materials. Materials used must remain reflective when wet. **(T-0)**

14.4.15.2. Personnel exposed to a traffic environment or flightline operations during hours of darkness, periods of reduced visibility or as part of construction, shall be provided and use reflective vests/accessories or shall use organizational clothing with sewn-on reflective tape. **(T-3)** Security Forces performing flightline operations are exempt from this requirement per AFI 91-207, *The US Air Force Traffic Safety Program.* **Note:** Personnel whose job requires them to perform some function in the traffic/flightline environment shall be provided reflective equipment to enhance their visibility, except as previously stated for Security Forces. **(T-1)**

14.4.16. Heat Reflective and Protective Clothing. Radiant heat is a problem in operations such as heat treating of metals, foundry operations and heating plants. Heat reflective qualities of clothing and other surfaces are considerably affected by color and surface characteristics. Polished metallic aluminum is an effective surface to reflect radiant heat. Helmets, suits, gloves and boots with this type of surface are available and shall be used when necessary to prevent heat stress and physical injury. **(T-0)** Frequent breaks and drinking plenty of water are also critical to prevent heat-related injuries. **Note:** If metallic coating on heat reflective clothing is conductive, it shall not be worn where there is the possibility of electrical shock.

14.4.17. Cold-Testing and Clothing. Protective clothing used in cold-testing or cold storage areas must be adequate to protect workers from hazards involved with the task and cold temperatures. **(T-0)** Supervisors shall ensure JHAs conducted for this type operation identify protection for working in cold temperatures. **(T-0)** Frostbite can be avoided by wearing appropriate protective clothing and by taking frequent breaks to warm extremities. Supervisors shall ensure cold weather clothing is provided when needed for work in cold temperatures. **(T-0)**

14.4.18. Personal Fall Arrest Systems (Safety Harnesses, Lanyards, Lifelines, and Straps). See Chapter 13**,** *Fall Protection*.

14.5. Proper Care and Maintenance. Workers shall maintain all PPE IAW with manufacturer's instructions to include being kept clean and in good repair. **(T-0)** Previously used PPE shall be disinfected before reissue to another worker. **(T-0)** Contaminated PPE that cannot be decontaminated shall be disposed of in a manner that protects employees from exposure to hazards. **(T-0)** Functional managers shall ensure disposal of contaminated PPE is consistent with applicable environmental regulations. **(T-1)** Reusable PPE that can be decontaminated can be stored in sealed ziplock type bags.

14.5.1. Shop supervisors shall ensure shop personnel use the protective clothing and equipment that will protect them from work hazards. **(T-1)** It is the responsibility of workers to keep their PPE in a clean, sanitary state of repair and use the equipment when required.

14.5.2. Workers shall keep their hands and face clean, change clothes and wash skin contaminated with solvents, lubricants or fuels, and keep hands and soiled objects out of their mouth. **(T-0)** No food or drink shall be brought into or consumed in areas exposed to toxic

materials, chemicals or industrial shop contaminants nor shall drinking water sources such as water fountains be located in those areas. **(T-0) Note:** Cleaning supplies in a break room shall be stored in a storage locker or equivalent. **(T-1)** After exposure to any contaminant, shop personnel shall wash their hands before eating or smoking. **(T-0)** Safe drinking water shall be provided in or reasonably near all shops. **(T-0)** Waste food from the lunch area shall be kept in a receptacle that is tightly covered and kept clean. **(T-1)** Restrooms, provided with hot and cold running water, shall be kept clean and in a sanitary condition. **(T-0)** Shop personnel required to wear protective clothing shall be provided with change rooms equipped with clothing lockers having separate storage facilities for clean and soiled clothing. **(T-0)** Clothing used daily and issued by the shop shall be cleaned and stored in shop lockers or fenced areas within the building. **(T-1)** Clothing and protective equipment shall be inspected daily for satisfactory condition by using workers. **(T-0)** In addition, supervisors or a designated employee shall spot check equipment and clothing. **(T-1)** Refer to 29 CFR 1910.141, *Sanitation,* for additional information.

14.5.3. Shop supervisors shall provide on-site laundry and shower facilities IAW 29 CFR 1910.141 and 29 CFR 1910.1000 through 1910.1052. **(T-0)** Additionally, showers and laundry facilities shall be provided when the installation Occupational Safety office or BE determine an occupational hazard warrants them. **(T-0)**

14.5.4. Eye and Face Protection.

14.5.4.1. Pitted or scratched lenses that reduce visibility shall be removed from service and not used. **(T-0)**

14.5.4.2. Dirty lenses can reduce vision and contribute to a mishap. Workers shall clean lenses as frequently as necessary to maintain good vision. **(T-0)**

14.5.4.3. Eye goggle headbands that are slack, worn out, sweat soaked, knotted or twisted shall be replaced when they no longer hold the goggles in the proper position. **(T-0)**

14.5.5. Head Protection.

14.5.5.1. Do not place objects inside safety helmets between the shell and suspension device. This space is designed into the helmet so the impact force is not transmitted to the wearer's head.

14.5.5.2. Keep safety helmets/bump caps free of abrasions, scrapes and nicks, and do not deliberately drop, throw or otherwise abuse them because this causes them to lose their protective qualities. Do not store helmets in direct sunlight or where exposed to extreme heat as this may degrade the degree of protection offered. **Note:** Shells constructed of polymer plastics are susceptible to damage from ultraviolet light and gradual chemical degradation. This degradation first appears as a loss of surface gloss called chalking, and with further deterioration, the surface will begin to flake away.

14.5.5.3. Do not drill ventilation holes in safety helmets/bump caps.

14.5.5.4. Inspection. Inspect safety helmets/bump caps prior to each use. Any of the following defects is cause for immediate removal from service:

14.5.5.4.1. Safety helmets suspension systems with evidence of material cracking, tearing, fraying or other signs of deterioration.

14.5.5.4.2. Any cracks, perforations of brim or shell, deformation of shell or evidence of exposure to excessive heat, chemicals or radiation.

14.5.5.4.3. Any accumulation of conductive material on or inside the shell that cannot be removed prior to use. This applies to helmets used in electrical hazardous environments.

14.5.6. Electrical Workers' Clothing and Equipment (Refer to AFI 32-1064).

14.5.6.1. Insulating Equipment.

14.5.6.1.1. Insulating equipment shall be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of causing damage. **(T-0)** Insulating gloves shall be given an air test along with the inspection. **(T-0)**

14.5.6.1.2. Insulating equipment with any of the following defects will not be used:

14.5.6.1.2.1. A hole, tear, puncture or cut.

14.5.6.1.2.2. Ozone cutting or checking.

14.5.6.1.2.3. An embedded foreign object.

14.5.6.1.2.4. Any swelling, softening, hardening or sticky texture or loss of elasticity. Any other defect that damages the insulating properties.

14.5.6.1.3. Insulating equipment found to have defects that might affect its insulating properties shall be removed from service and returned for testing. **(T-0)** Insulating equipment shall be cleaned as needed to remove foreign substances. **(T-0)**

14.5.6.1.4. Insulating equipment shall be stored in a location and manner as to protect it from light, temperature extremes, excessive humidity, ozone and other injurious substances and conditions. **(T-0)**

14.5.6.2. Electrical Equipment/PPE.

14.5.6.2.1. Procedure for testing gloves.

14.5.6.2.1.1. Glove (right side out) shall be filled with tap water and immersed in water to a depth IAW instructions in 29 CFR 1910.137, Table I-3. **(T-0)**

14.5.6.2.1.2. Water shall be added to or removed from the glove, as necessary, so the water level is the same inside and outside the glove. **(T-0)**

14.5.6.2.1.3. When the AC test is used on gloves, the 60-hertz proof test current may not exceed the values specified in 29 CFR 1910.137, Table I-1 at any time during the test.

14.5.6.2.1.4. After the 16-hour water soak, the 60-hertz proof test current may exceed the values given in 29 CFR 1910.137, Table I-1 by not more than 2 milliamperes. **Note:** If gloves do not pass the proof test requirements of 29 CFR 1910.137, Table I-1, they shall not be used for electrical protection.

14.5.6.2.1.5. Rubber protective gloves shall be visually inspected prior to each use. **(T-0)** They shall be placed in glove bags and stored in a bin or locker away from tools and materials to prevent damage. **(T-0)**

14.5.6.2.2. Surface irregularities present on rubber goods from imperfections on forms or molds or inherent difficulties in the manufacturing process may appear as indentations, protuberances or imbedded foreign material and are acceptable under the following conditions:

14.5.6.2.2.1. The indentation or protuberance blends into a smooth slope when the material is stretched.

14.5.6.2.2.2. Foreign material remains in place when the insulating material is folded and stretches with the insulating material surrounding it.

14.5.6.2.3. Rubber insulating gloves in storage shall be dielectric tested every 12 months. **(T-0)** Rubber gloves that are removed from storage and issued to a worker are in active use and shall be tested before first issue and every six (6) months thereafter. **(T-0)** Refer to UFC 3-560-01 for additional requirements.

14.5.6.2.4. Rubber insulating sleeves shall be dielectric tested before first issue and every 12 months thereafter. **(T-0)**

14.5.6.2.5. The supervisor shall stamp the dates of the dielectric test and issue date on the gloves. **(T-0)** The supervisor shall maintain a record of all electrical equipment test dates and establish procedures to control its issue, inspection, testing and use. **(T-1)**

14.5.6.2.6. Rubber insulating matting shall be capable of withstanding the alternating current proof test voltage specified in 29CFR 1910.137, Table I-4. **(T-0)** The voltage test shall be applied continuously for one minute (1) on matting and applied continuously for three (3) minutes for equipment other than matting. **(T-0)**

14.5.6.2.7. Cleaning of rubber insulating matting shall be accomplished as often as necessary to prevent contamination, utilizing domestic cleaners such as carpet cleaner or any other locally approved cleaner required for special situations. **(T-0)**

14.5.6.2.8. Insulating matting shall be replaced when worn to one-half its original thickness or the manufacturer's suggested replacement requirements. **(T-0) Note:** Shoes with nails or metal scraps in soles shall not be worn on insulating matting.

14.5.7. Chemical Protective Clothing.

14.5.7.1. Pre-Use Inspection. Typical inspection procedures for chemical protective clothing shall include checks for imperfect seams and seals and discrepancies in the material coating, such as pinholes, rips and tears, surface cracks, malfunctioning closures and signs of deterioration. **(T-0)** Pinholes may be detected by holding the material up to a light in a dark room. Gloves can be checked by inflating the glove to see if the glove holds the pressure or emits bubbles under water. Manufacturer’s manuals shall be consulted for specific inspection recommendations. **(T-0)**

14.5.7.2. Cleaning. Chemical protective clothing that is reused shall be cleaned before storage. **(T-0)** Residual chemicals on chemical protective clothing can permeate the material during storage and reduce the useful life of the clothing. It can also contaminate the inside of the clothing.

14.5.7.3. Disposal. The supervisor shall ensure chemical protective clothing classified as hazardous waste is correctly discarded. **(T-0)** Refer to AFI 32-7042, *Waste Management*, and Environmental Management for the proper disposal of hazardous waste.

Chapter 15

TRAINING SYSTEMS

15.1. Scope. This chapter provides guidance on fire protection engineering criteria, fire prevention requirements and housekeeping procedures for the system safety and risk management of all training devices in AFI 36-2251, *Management of Air Force Training Systems.* It also applies to all training systems regardless of the stage of design, development or date of installation. Headquarters Air Force Civil Engineer Center (HQ AFCEC) shall determine the fire prevention requirements for trainers not covered in AFI 36-2251.

15.1.1. Hazards. Protective measures, such as grounding, conductive floors and benches, humidity control, antistatic packaging of spare components and other controls shall be used as needed to prevent electrostatic discharge. **(T-1)** Refer to paragraph **1.5** and/or **Chapter 2,** *General Work Procedures,* for guidance on hazards and human factors.

15.1.2. Fire, Injury and Equipment Damage Hazards. Refer to MIL-STD-1472G, *Design Criteria Standard: Human Engineering,* for additional guidance on damage to training systems equipment.

15.2. General Requirements.

15.2.1. Fire Extinguishers. Listed Class C carbon dioxide, clean agent or water mist fire extinguishers with a minimum rating of 10B:C located IAW National Fire Protection Association 10, *Standard for Portable Fire Extinguishers,* must be provided with all facility areas containing permanently installed electronic equipment such as motion bays, model boards, visual display rooms, computer bays, etc. **(T-0)** Simulator-type fire extinguishers may be provided in cockpit and/or other crew stations. Dry and wet chemical agent fire extinguishers are prohibited.

15.2.2. Fire and Emergency Procedures. The training system operator and/or instructor shall provide a fire safety briefing to trainees at the start of each training session. **(T-0)** Prompt action during a fire will protect personnel and minimize damage.

15.2.3. Housekeeping.

15.2.3.1. Combustible materials shall be disposed of in suitable noncombustible containers, conspicuously labeled as to contents and with self-closing lids. **(T-0)** These containers shall be emptied when full and at least at the end of each working shift. **(T-0)** Contact the installation Environmental Management office for disposal procedures for combustible hazardous waste. Refer to **Chapter 22,** *Flammables and Combustibles,* for additional guidance.

15.2.3.2. Building floors, especially raised floors, shall be kept smooth, clean and free of obstructions and slippery materials. **(T-0)**

15.2.3.3. Floors shall not be cleaned with flammable or combustible liquids. **(T-0)** Follow the manufacturer‘s and SDS guidelines when using cleaning agents for floors and facilities.

15.2.3.4. To prevent buildup of trash and foreign objects, sub-floors under raised floors shall be cleaned periodically, but not less than once every 60 days. **(T-1)** Sub-floors shall be inspected once each operational day to ensure no flooding or leaking is present, unless

the sub-floor area is provided with an automatic water leakage detection system. **(T-1)** **Note:** Any change in facility or room use requires reassessment of the cleaning schedule.

15.2.3.5. Utility trenches shall be kept clean of foreign objects and inspected at least every 60 days. **(T-1)** If cleaning history shows a longer period between cleanings is feasible, the Fire Protection Flight may allow extending the time between cleanings. **Note:** Any change in facility or room use requires reassessment of the cleaning schedule.

15.3. Facility Requirements.

15.3.1. Planning. Proper layout, spacing and arrangement of equipment and machinery are essential and can best be achieved in the planning stages by considering current and future uses of the facility. The installation Occupational Safety office, CE, Fire Protection Flight and BE shall coordinate on all plans. **(T-1)**

15.3.2. Location. Training systems shall be located in facilities complying with UFC 3-600-01, *Fire Protection Engineering for Facilities,* and Engineering Technical Letter 01-18, *Fire Protection Engineering Criteria – Electronic Equipment Installations.* **(T-0)** Training systems shall be considered as mission support equipment as defined in Engineering Technical Letter 01-18. **(T-0)** Facility fire protection shall be as follows:

15.3.2.1. Wheeled Vehicle Egress Assistance Trainers, such as the High Mobility Multipurpose Wheeled Vehicle (HMMWV) Egress Assistance Trainer. **(T-0)** These trainers shall be protected by an automatic sprinkler system or automatic fire detection system installed IAW UFC 3-600-01 when located inside a structure having a roof and three or more side walls, including tension membrane/fabric structures. **(T-0)**

15.3.2.2. Aircraft Fuselage Trainers (including aircraft loading/unloading trainers, patient transport trainers and other trainers utilizing an aircraft fuselage inside a facility). These units shall be completely protected with an automatic sprinkler system installed IAW UFC 3-600-01, including both inside and outside the fuselage. **(T-0)**

15.3.2.3. Aircraft Flight Training Devices and Similar High Value Training Devices.

15.3.2.3.1. The entire facility, including equipment and non-equipment spaces, shall be completely protected by an automatic sprinkler system installed IAW UFC 3-600-01, and maintained IAW requirements in UFC 3-601-02, *Operations and Maintenance: Inspection, Testing, and Maintenance of Fire Protection Systems.*

15.3.2.3.2. New and relocated aircraft flight training devices or similar high value training devices shall be located in spaces protected by ultra-sensitive smoke detection systems IAW Engineering Technical Letter 01-18. **(T-1)** Existing facilities housing training devices with internal fire detection and alarm systems do not require ultra-sensitive systems but shall be provided with a standard smoke detection system. **(T-1)** **Note:** An ultra-sensitive smoke detection system uses an aspirating air sampling-type smoke detector intended for detection of incipient fires, such as smoldering associated with overheating or low energy release rate fires.

15.3.2.3.3. Training system spaces shall be separated from other spaces and/or occupancies and operationally distinct adjacent equipment spaces in the facility by a minimum of 1-hour fire rated construction, extending from structural floor to structural ceiling and/or roof. **(T-0)**

15.3.2.3.4. Raised floor spaces shall be divided in the same manner as the equipment spaces above the area they serve. **(T-0)**

15.3.2.3.5. Raised floor spaces shall contain a standard or ultra-sensitive smoke detection system in the same manner as the equipment spaces above the area they serve. **(T-0)**

15.3.2.3.6. Raised floor systems shall be constructed of noncombustible materials.

15.3.2.3.7. If training system spaces are served by air handling equipment which also serves any other part of the facility, including an adjacent training system space, automatic smoke and fire dampers shall be provided to shut off the space from the remainder of the facility upon any facility fire alarm indication. **(T-0)** Activation of the facility fire detection system shall shut down the air handling system. **(T-0)** An air handling system which serves an individual training system does not have to be deactivated for facility fire alarm indications for conditions originating outside the training system space.

15.3.2.3.8. Communications and interconnecting cable and wiring in training system and raised floor spaces shall comply with the *National Electrical Code,* Article 645. **(T-0)** Communications and interconnecting cable and wiring in training system spaces and other areas of the facility or other facilities shall comply with *National Electrical Code,* Article 725. **(T-0)**

15.3.3. Electrical.

15.3.3.1. Surge protection shall be provided for all incoming power to the training system. **(T-0)** New training system facilities shall have surge protection for the entire facility. **(T-0)**

15.3.3.2. All power and distribution circuits shall comply with National Fire Protection Association 70 and UFC 3-520-01, *Interior Electrical Systems*. **(T-0)**

15.3.4. Drainage. Drainage shall be provided in utility trenches and motion bays. **(T-0)**

15.3.5. Hydraulic Pump Rooms. Hydraulic pump rooms shall be of 1-hour fire rated construction, except rooms which contain more than 250 gallons of hydraulic fluid, which shall be of 2-hour fire rated construction**(T-0)**.

15.3.6. Emergency Lighting. Emergency lighting shall be provided IAW National Fire Protection Association 101, *Life Safety Code.* **(T-0)**

15.4. Training Systems Requirements.

15.4.1. General Flammability Requirements. Only fire resistant and non-hazardous (when exposed to fire) materials shall be used in cockpits, seats, shrouds, cable ties, cable coverings and auxiliary insulation for heat, electrical, sound, etc. **(T-0)** The flame spread rating for these materials shall not exceed 75 and smoke development shall not exceed 100 when tested IAW American Society for Testing Materials E84, *Standard Test Method for Surface Burning Characteristics of Building Materials.* Alternately, materials shall be considered acceptable that meet one of the following: certification under California State Fire Marshall Title 19; listing under Underwriters Laboratories 94, *Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances;* or successful testing under National Fire

Protection Association 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*, Test Method 1. **(T-0)** Materials not meeting one of these requirements may only be used when the training device application is identical to the aircraft/wheeled vehicle configuration and material.

15.4.2. General Hydraulic System Features.

15.4.2.1. Hydraulic pump controls shall be designed to automatically shut down on sudden or excessive flow in the hydraulic lines when the fluid level is low or when excessive hydraulic fluid temperature is sensed. **(T-0)**

15.4.2.2. Flexible hoses shall be shielded to prevent leaking hydraulic fluid from spraying on potential ignition sources, trainees and staff personnel. **(T-1)** Braided shielding integral to the flexible hoses shall be used whenever the hoses are not located in covered trenches. **(T-1)**

15.4.2.3. Upon loss of power or shutdown of the hydraulic pumps, the training device shall automatically return to the rest position within 10 seconds. **(T-1)**

15.4.2.3.1. For wheeled vehicle egress assistance trainers, it is permitted to provide a manual hand crank feature, or equivalent method, to enable the instructor/operator to manually rotate the trainer to a position that allows safe egress by the trainees. **(T-1)**

15.4.2.3.2. For aircraft fuselage trainers, hydraulically operated doors are not required to be moveable upon loss of power or shutdown of the hydraulic pumps if exit doors are provided for trainee egress from the trainer. **(T-1)** The number of doors and locations shall comply with the requirements in National Fire Protection Association 101. **(T-0)**

15.4.2.3.3. For aircraft flight and similar high value training systems, access ramps shall automatically deploy after motion is stopped — even when power is removed. **(T-1)**

15.4.2.4. Hydraulic pump controls shall be designed so operation of the facility fire alarm or training system fire alarm system shuts down the pumps. **(T-1)** This feature is not required for wheeled vehicle egress assistance trainers.

15.4.3. Emergency Lighting. Emergency lighting shall be provided in all enclosed occupied training spaces IAW National Fire Protection Association 70, Article 700. **(T-0)**

15.5. Requirements of Wheeled Vehicle Egress Assistance Trainers.

15.5.1. Safety Zone. A safety zone shall be provided to keep observers at a safe distance when the unit is rotating. **(T-1)**

15.5.2. Head Strike Hazard. Projections inside the unit shall be padded and loose objects secured that could present a head strike hazard to trainees during unit rollover. **(T-0)** Padding shall comply with flammability requirements in paragraph **15.4.1** **(T-0)**

15.5.3. Walkways. Walkways shall be padded where the trainees egress to minimize the potential for injury to personnel should a trainee fall from the vehicle doors. **(T-1)** Padding shall comply with flammability requirements in paragraph **15.4.1** **(T-0)**

15.5.4. Fire Extinguisher. A portable fire extinguisher 2A-10BC (or greater) shall be located within immediate vicinity of the instructor/operator. **(T-1)**

15.5.5. Power Failure. A means shall be provided to manually-rotate the unit to a safe position for trainee egress in case of loss of power or failure of the powered rotation motor. **(T-1)**

15.5.6. Egress Procedures. Procedures shall be established to provide safe emergency occupant egress from the unit, such as when the unit fails to fully rotate to the design rollover position. **(T-1)**

15.5.7. Loading and Seating. Approved occupant seating and loading limits shall be posted in the immediate vicinity of the unit. **(T-1)** Prohibited seating arrangements shall also be posted, such as any unbalanced seating arrangements that could prevent manual rotation of the unit during an emergency. **(T-1)**

15.5.8. Retractor Mechanisms. Trainee shall not be assigned to any location in the trainer (such as the gunner's hatch in the roof of a HMMWV Egress Assistance Trainer unit) that requires completion of manual actions by the trainee or others to pull/move the trainee to a safe position during a rollover operation. **(T-1)** Automatic retractor mechanisms (such as gunner's restraint retractors) may be used only after they have been tested to successfully operate during all possible operational modes of the trainer, including failure to fully rotate to the design rollover position. **(T-1)**

15.6. Requirements for Aircraft Flight and Similar High Value Training Systems.

15.6.1. Fire Detection and Alarm Systems.

15.6.1.1. New or relocated training systems do not require an internal fire detection and alarm system when located in spaces protected by ultra-sensitive smoke detection IAW paragraph **15.3.2.3**

15.6.1.2. Existing training systems in spaces protected by a standard smoke detection system shall have an internal fire detection and alarm system. **(T-1)** This system shall interconnect all detection and annunciation devices with the various training system components (cabinets, instructor operator station, cockpit, motion base, etc.). **(T-1)** This system shall be either of the dual fixed-temperature type or the ultra-sensitive type. **(T-1)**

15.6.1.2.1. Dual fixed-temperature type fire detectors shall be installed in electrical, electronic, hydraulic and computer cabinets. **(T-1)** Activation of the first detector, i.e., the one calibrated to the lower activating temperature, shall produce a distinctive audible signal. **(T-1)** Activation of the second detector, i.e., the one calibrated to the higher activating temperature, shall activate the facility detection system through the training system fire alarm panel and de-energize the simulator and all peripheral equipment. **(T-1)**

15.6.1.2.2. Ultra-sensitive smoke detection systems shall be provided to protect electrical, electronic/and computer cabinets. **(T-1)** A minimum two-stage warning capability shall be provided. **(T-1)** The first, more sensitive stage shall produce a distinctive audible signal. **(T-1)** Activation of the second, less sensitive stage shall activate the facility detection system through the training system fire alarm panel and de-energize the simulator and all peripheral equipment. **(T-1)**

15.6.1.2.3. If detection equipment is located in an unoccupied area, e.g., computer rooms, a means shall be provided to positively alert operators at the instructor operator station. **(T-1)** If multiple unoccupied computer areas are present, then a means shall be provided to inform the instructor operator station which unoccupied area has the activated alarm. **(T-1)**

15.6.1.3. A fire alarm graphic annunciator or display panel, to identify training system fire detection systems signals, shall be installed IAW National Fire Protection Association 72, *National Fire Alarm and Signaling Code.* **(T-0)** Each detection device shall be identified by light emitting diodes, or other readily visible means, in the graphic annunciator or display panel. **(T-1)**

15.6.1.4. The fire detection system shall be powered by a dedicated circuit with backup battery power and connected to the facility electrical supply ahead of the training system disconnect switch. **(T-1)**

15.6.1.5. The fire detection system shall be capable of operating from both 50 and 60 hertz. **(T-1)**

15.6.1.6. The system fire detection and alarm control panel shall be designed to transmit both coded fire and trouble signals to the fire alarm and receiving center or other monitoring service (when not located on a DoD installation) IAW National Fire Protection Association 72. **(T-0)** This may be through the facility fire alarm transmitter or an independent fire alarm transmitter. Contact the installation Fire Protection Flight for fire alarm and receiving equipment requirements. **(T-1)**

15.6.1.7. Interface of Facility and Training System Fire Protection Systems.

15.6.1.7.1. Required functions upon activation of the facility fire alarm system (without activation of any suppression system in the facility):

15.6.1.7.1.1. Occupants in the training spaces shall be notified of the alarm condition through audible (siren, horn, bell, etc.) and visual (strobe) cues. **(T-1)** Occupants of the facility (including those in the training spaces) shall exit the facility immediately without delay, following the facility's preexisting emergency evacuation plan. **(T-1)**

15.6.1.7.1.2. For training systems meeting the requirements of paragraphs **15.3.2.3** and **15.4,** the instructor may place the training system in a standby mode, system freeze or other appropriate condition prior to evacuation. **(T-1)**

15.6.1.7.1.3. For existing facilities and training systems awaiting upgrade to comply with paragraphs **15.3.2.3** and **15.4,** the training system power source shall shut down. **(T-1)** This shutdown may be accompanied by an automatic emergency power off or by an automatic, rapid, sequenced shutdown. **(T-1)** Also see paragraph **15.7**

15.6.1.7.2. Required functions upon activation of the facility fire suppression system (without activation of a suppression system in any training system area):

15.6.1.7.2.1. Occupants in the training spaces shall be notified of the alarm condition through audible (siren, horn, bell, etc.) and visual (strobe) cues. **(T-1)** Occupants of the facility (including those in the training spaces) shall exit the

facility immediately without delay, following the facility's preexisting emergency evacuation plan. **(T-1)**

15.6.1.7.2.2. The training system power source shall shut down. **(T-1)** This shutdown may be accomplished by an automatic emergency power off or by an automatic, rapid, sequenced shutdown.

15.6.1.7.3. Required functions upon activation of a training system fire detection system only (without activation of any fire suppression system):

15.6.1.7.3.1. Training staff shall be notified upon activation of the first, less sensitive stage of ultra-sensitive smoke detection systems or upon activation of the first detector in dual fixed-temperature type systems. **(T-1)** For existing facilities and training systems awaiting upgrade to comply with paragraphs **15.3.2.3** and **15.4,** the training system power source shall emergency power off upon activation of the first detector. Also see paragraph **15.7** **(T-1)**

15.6.1.7.3.2. The training system shall automatically emergency power off upon activation of the second, less sensitive stage of ultra-sensitive smoke detection systems or upon activation of the second detector in dual fixed-temperature type systems for training systems meeting the requirements of paragraphs **15.3.2.3** and **15.4** **(T-1)**

15.6.1.7.4. Required functions upon activation of a training system fire suppression system — the training system power source shall automatically emergency power off. **(T-1)**

15.6.1.7.5. Training staff shall be provided with means to manually emergency power off whenever necessary for the safety of the staff, students or the equipment prior to exiting the facility. **(T-1)**

15.6.1.7.6. Following an emergency power off:

15.6.1.7.6.1. The training system fire alarm system shall notify occupants throughout the facility of the alarm condition through audible (siren, horn, bell, etc.) and visual (strobe) cues. **(T-1)**

15.6.1.7.6.2. All personnel throughout the facility, including those in training areas, shall exit the facility immediately without delay, following the facility's preexisting emergency evacuation plan. **(T-1)**

15.6.2. Fire Stops. All cable trays, utility trenches, etc., that connect to spaces outside training system spaces shall have fire stops installed every 25 feet. **(T-1)**

15.6.3. Air Handling Equipment. Training systems served by air handling equipment which also serves any other part of the facility, including any adjacent training system space, shall have automatic smoke and fire dampers to shut off the space from the remainder of the facility on any facility fire alarm indication. **(T-1)** Air handling systems dedicated to an individual training system need not be deactivated upon facility fire alarm indications unless originating within the training system.

15.6.4. Specifications for Cable and Wiring.

15.6.4.1. Polyvinyl chloride coated wire shall not be used in the cockpit areas of non-commercial-off-the-shelf hardware and/or training systems. **(T-1)** Plenum rated cable and wiring meeting the requirements of *National Electrical Code,* Article 300.22 shall be used. **(T-0) Note:** Polyvinyl chloride coated wire is allowed in the cockpit areas of commercial-off-the-shelf hardware and/or training systems per manufacturer's standard or commercial design practices provided the cockpit is not enclosed or, if enclosed, that smoke detectors are installed and the system design vents any smoke or gases to the exterior of the cockpit.

15.6.4.2. Communications and interconnecting cable and wiring between components within the training system space and raised floor space shall comply with *National Electrical Code,* Article 670, and those in the training system space and other areas of the facility or other facilities shall comply with *National Electrical Code,* Article 725. **(T-0)**

15.6.4.3. Power and signal cable groups in which heat cannot quickly dissipate shall contain a heat sensor wire or other heat sensing device. **(T-1)**

15.6.4.4. Cable and wiring for the training system fire alarm system shall comply with *National Electrical Code,* Article 760. **(T-0)**

15.6.5. Power Disconnect Means. A means to disconnect electrical power to the entire training system shall be provided at all instructor operator stations and at other key locations on the training system. **(T-1)**

15.6.6. Computer and/or Electronic Cabinets.

15.6.6.1. Self-contained air conditioning systems shall include a product of combustion detector capable of sounding an audible alarm and activating the facility detection system. **(T-1)**

15.6.6.2. Cabinets near a motion base water fog and/or spray deluge system shall be water resistant and/or shielded from water discharge. **(T-1)** Cabinets near a motion base wet pipe sprinkler system do not require special protection.

15.6.6.3. The acquiring authority may exempt "off-the-shelf" computer and/or electronic devices with internal thermally activated power disconnects from requirements for dual fixed-temperature type thermal fire detectors for computer and/or electronic cabinets. **(T-1)**

15.6.7. Instructor Operator Station.

15.6.7.1. A means to activate the facility fire detection system shall be provided in easy reach of the operators at the instructor operator station. **(T-1)** Normally, a standard manual fire alarm station shall be provided on the operator's console with provision to interconnect to the facility alarm and detection system, and to initiate a training system emergency power off. **(T-1)**

15.6.7.2. Smoke detection devices shall be provided in the instructor operator station when located in an enclosed container and/or space not part of the facility. **(T-1)** Activation of this system shall alert the training system occupants and the operators at the instructor operator station. **(T-1)**

15.6.7.3. A facility alarm annunciator shall be installed when the instructor operator station is located in an enclosed container and/or space not part of the facility. **(T-1)**

15.6.8. Cockpit and/or Other Crew Stations.

15.6.8.1. Single station smoke detection devices shall be provided in cockpits and other enclosed crew stations. **(T-1)** Battery powered detectors shall not be used.

15.6.8.2. The cockpit shall be designed to preclude or restrict passage of smoke and gases through the cockpit floor or sides. **(T-1)**

15.6.8.3. A means shall be provided to alert cockpit and/or other crew station occupants of a positive activation of the local and facility detection systems. **(T-1)**

15.6.8.4. Training station ventilation shall be shut down if the training system fire detection is activated. **(T-1)**

15.6.9. Motion Base.

15.6.9.1. The motion system shall return to the rest position within 10 seconds of activation of either the system fire detection system or the facility fire suppression system. **(T-1)** Access ramps shall automatically deploy after motion is stopped, even when power is removed. **(T-1)**

15.6.9.2. Hydraulically powered motion bases will comply with paragraphs **15.4.2** and the following:

15.6.9.2.1. Rate-compensated type thermal fire detection devices shall be provided under each motion platform. **(T-1)** These rate-compensated type thermal fire detection devices are not required when all the following conditions are met: the training system is located in a facility fully protected by a wet pipe sprinkler system meeting the requirements of paragraph **15.3.2.3.1;** flight training devices and associated controls are located in spaces protected by ultra-sensitive smoke detection systems as defined in Engineering Technical Letter 01-18 (also see paragraph **15.3.2.3.2**); and the cockpit/crew stations located on the motion base fully comply with the cockpit/crew station requirements listed in paragraph **15.6.8** **(T-1)**

15.6.9.2.2. A wet pipe sprinkler system (sprinkler heads and piping) shall be provided as part of each motion base. **(T-0)** This motion base sprinkler system is not required for training systems when all the following conditions are met: the training system is located in a facility fully protected by a wet pipe sprinkler system meeting the requirements of paragraph **15.3.2.3.1;** flight training devices and associated controls are located in spaces protected by ultra-sensitive smoke detection systems as defined in Engineering Technical Letter 01-18 (also see paragraph **15.3.2.3.2**); and the cockpit/crew stations located on the motion base fully comply with the cockpit/crew station requirements listed in paragraph **15.6.8** The exact position for each sprinkler and number of sprinklers shall be defined for each motion base to ensure complete coverage and prevent interference with each hydraulic actuator‘s range of motion. **(T-1)** The system shall deliver a minimum of 0.35 gallons per minute per square foot of area under the motion base. **(T-0)** Normally, sprinkler piping is interconnected with the facility sprinkler system, but a separate system riser with separate flow detection is acceptable.

15.6.9.2.3. A pre-action sprinkler system is permitted for the motion base in lieu of the wet pipe sprinkler system listed in paragraph **15.6.9.2.2** when approved in writing by

the MAJCOM Fire Protection office. The rate-compensated type thermal fire detection devices listed in paragraph **15.6.9.2.1** shall be used to activate the pre-action functions of the system. **(T-1) Note:** Increased procurement, operational and maintenance expenses are associated with the use of pre-action sprinkler systems.

15.7. Upgrade of Existing Aircraft Flight and Similar High Value Training Systems. Existing facilities and training systems may continue in use while awaiting upgrade to comply with paragraphs **15.3.2.3** and **15.4,** if they comply with all the following:

15.7.1. Facilities. No Category I or II fire safety deficiencies exist.

15.7.2. Training Systems. It is assumed existing training system deficiencies have been upgraded or are programmed to be upgraded to comply with previous (superseded) editions of AFOSH standards or previous (superseded) revisions of this AFI. Training systems currently identified to be upgraded to previous (superseded) editions of this AFI may be upgraded as programmed provided Halon 1301 or other gaseous agents are not part of the upgrade.

15.7.3. Maintenance. All installed fire protection features shall be regularly serviced and maintained in operational condition.

15.7.4. Halon. Existing Halon fire suppression systems shall be placed on manual activation and automatic discharge mechanisms disabled. **(T-1)** Existing Halon fire suppression systems shall not be re-serviced following discharge and the training device shall remain operational. **(T-1)** Training systems developed with Halon fire suppression systems shall transition to current standards during any major modification. **(T-1)**

Chapter 16

MOBILE ELEVATING WORK PLATFORMS

16.1. General Information. This chapter applies to vehicle-mounted elevating and rotating platforms, including work platforms, firefighting aerial devices and aircraft maintenance equipment used for elevating workers. It also applies to all manually-propelled and self-propelled mobile work platforms (including ladder stands) and rolling (mobile) scaffolds (towers). In some cases, the Air Force changes the design of commercially purchased mobile work platforms and scaffolds or builds this equipment; therefore, this chapter includes essential information on loads, rules and requirements for design, construction and use of mobile work platforms and scaffolds. Also refer to 29 CFR 1910.27.

16.2. Hazards.

16.2.1. Refer to paragraph **1.5** and AFI 91-202 for further information on job hazard analysis and the job safety lesson plan. **Note:** A job hazard analysis is not required when existing guidance adequately covers all safety requirements of an operation or process. Examples are TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding*.

16.2.2. Refer to **Chapter 2**, *General Work Procedures***,** and **Chapter 14**, *Personal Protective Equipment*, for additional guidance.

16.3. General Requirements. The potential for worker injury, death and property damage is reduced by proper platform and scaffold (tower) design, thorough operator training and inspections, good equipment maintenance and supervisor enforcement of safe work practices. Supervisors shall ensure workers are physically capable of work at high elevations. Workers, too, must be alert to signs or symptoms from co-workers such as decreased performance, change in attitude and/or physical changes, etc., which could lead to a mishap.

16.4. Vehicle-Mounted Elevating and Rotating Work Platforms.

16.4.1. Procurement. Commercial aerial devices procured for Air Force firefighting purposes shall conform to National Fire Protection Association 1901, *Standard for Automotive Fire Apparatus*. All other aerial devices, either commercially procured or constructed by the Air Force for mission specific needs, shall conform to American National Standards Institute A92.2., *Vehicle Mounted Elevating and Rotating Aerial Devices*. **(T-0)**

16.4.2. Modifications. Modifications shall conform to American National Standards Institute A92.2. and 29 CFR 1910.67., *Vehicle-Mounted Elevating and Rotating Work Platforms*, and shall be documented on the appropriate form. **(T-0)** Authorized modifications include temporary removal of installed equipment not needed for a particular mission or modification to provide a new or improved capability. **Warning:** Any modification which removes or defeats any safety device or feature on an aerial device is prohibited.

16.4.3. Clearances.

16.4.3.1. Electrical. Maintain the following clearances when operating aerial lifts under, over, by or near electric power lines.

16.4.3.1.1. For lines rated 50 kilovolts (kV) or less, the minimum clearance between lines and any part of the aerial lift shall be at least 10 feet (305 centimeter [cm]). **(T-0)**

16.4.3.1.2. For lines rated over 50 kilovolts (kV), the minimum clearance between lines and any part of the aerial lift shall be at least 10 feet (305 cm) plus 4 inches (10 cm) for each 10 kV over 50 kV. **(T-0)** Refer to 29 CFR 1910.269 for additional information.

16.4.3.2. **Exceptions:** Requirements in paragraph **16.4.3** do not apply if:

16.4.3.2.1. The aerial device is insulated for the work and work is performed by trained communications outside plant workers, line clearance tree-trimming workers or exterior electric linemen.

16.4.3.2.2. Electric power transmission or distribution lines have been de-energized and visibly grounded at point of work or where insulating barriers (not part of or attached to the aerial lift) have been erected to prevent physical contact with the lines.

16.4.3.2.3. Insulating barriers (rated for the voltage of lines being guarded and not part of or attached to the vehicle or its raised structure) are installed to prevent contact with lines. In this instance, the clearance may be reduced to a distance within the designed working dimensions of the insulating barrier. Refer to UFC 3-560-01, *Operation and Maintenance: Electrical Safety,* for additional information.

16.4.3.2.4. Aerial lift is insulated for voltage involved and work is performed by a qualified person. In this instance, the clearance between non-insulated parts of the aerial lift and power line may be reduced to the distance in UFC 3-560-01, Table 10-9.

16.4.3.2.5. An aerial lift or equipment contacts an electrical conductor. In this instance, the vehicle, equipment and attachments shall be considered energized. Personnel standing on the ground shall not contact any part of the lift unless using protective equipment rated for the voltage. Refer to **Chapter 30,** *Communications Cable, Antenna and Communications Systems,* for additional information.

16.4.3.3. Aircraft. When operating aerial lifts under, over, by or near aircraft, ensure adequate clearance is maintained to allow for slight movement of both the aircraft and aerial equipment caused by light winds. See paragraph **16.4.6.9**

16.4.4. Proximity Warning Devices. Proximity warning devices may be installed on aerial platforms but will not release the operator from assuring safe clearance IAW paragraph **16.4.3**

16.4.5. Inspection and Test Procedures.

16.4.5.1. Aerial ladders shall be inspected and tested annually or immediately following any activity when it is known, or suspected, to have been loaded beyond its maximum load capacity, or immediately following any repair of any ladder assembly structural or mechanical component. **(T-0)** Refer to National Fire Protection Association 1914, *Standard for Testing Fire Department Aerial Devices*, for inspection requirements. Inspections are the joint responsibility of the principal operator and vehicle mechanic qualified to perform annual inspections. Document inspections and tests IAW AFI 24-302, *Vehicle Management*. **(T-1) Note:** Aerial devices used for firefighting shall be inspected and tested at least annually IAW National Fire Protection Association 1914. **(T-0)** Qualified FES Flight personnel may perform many of the tests and inspection actions; however, it is recommended they be performed by a third-party testing company or the

aerial device manufacturer. A record of the inspection and tests shall be documented IAW AFI 24-302. **(T-1)**

16.4.5.2. Articulating and extendible boom platforms shall be inspected and tested annually. **(T-0)** Special inspections and tests shall be conducted immediately following any use where the work platform may have been loaded beyond the manufacturer‘s rated capacity, or immediately following any repair of a boom or work platform assembly structural or mechanical component. **(T-0)** Refer to the manufacturer’s manual for inspection requirements. Inspections shall be a joint effort by the principal operator and a vehicle mechanic qualified to perform annual inspections of the vehicle. **(T-1)** The inspection and test shall be documented IAW AFI 24-302. **(T-1)** When the personnel platform is attached to a telescoping derrick or crane with a rated capacity higher than that of the work platform, test procedures contained herein shall not apply and testing shall be accomplished IAW applicable technical orders (TOs) or manufacturer‘s maintenance manual. **(T-1)**

16.4.5.3. Refer to 29 CFR 1926.1400., *Cranes and Derricks in Construction,* for information on use of cranes or derricks to hoist personnel work platforms.

16.4.6. Operations.

16.4.6.1. American National Standards Institute A92.2. requires aerial device manufacturers provide manuals to dealers and direct sale purchasers. Air Force users shall ensure manuals are readily available (stored in weather resistant compartment provided by manufacturer) to workers. **(T-1)** These manuals shall contain:

16.4.6.1.1. Description, specifications and ratings of the aerial device. **(T-1)**

16.4.6.1.2. Operating instructions for aerial device and its auxiliary systems. **(T-1)**

16.4.6.1.3. Precautions relating to multiple configurations such as performing aerial work from a moving vehicle. **(T-1)**

16.4.6.1.4. Instructions regarding routine maintenance and frequency of recommended maintenance. **(T-1)**

16.4.6.1.5. Replacement part information. **(T-1)**

16.4.6.1.6. Instruction markings per paragraph **16.4.6.2** **(T-1)**

16.4.6.2. Each aerial device shall have a clearly visible plate or plates (located in a readily accessible area) stating:

16.4.6.2.1. Make, model and manufacturer’s serial number. **(T-0)**

16.4.6.2.2. Rated capacity. **(T-0)**

16.4.6.2.3. Platform height. **(T-0)**

16.4.6.2.4. Maximum recommended operating pressures of hydraulic and/or pneumatic systems. **(T-0)**

16.4.6.2.5. Hazards inherent in operation of an aerial device. **(T-0)**

16.4.6.2.6. Manufacturer’s marking which describes the function of each control. **(T-0)**

16.4.6.2.7. Insulated or non-insulated. **(T-0) Note:** Insulating aerial devices do not protect personnel from phase to phase or phase to ground contacts at the platform end.

16.4.6.2.8. Qualification voltage and date of test, if applicable. **(T-0)**

16.4.6.2.9. Year of manufacture. **(T-0)**

16.4.6.2.10. Number of platforms. **(T-0)**

16.4.6.2.11. Category of aerial device. **(T-0)**

16.4.6.2.12. Manufacturer's rated line voltage. **(T-0)** Where alternative configurations are possible, the plate will show by chart, schematic or scale the capacities of all combinations in their operating positions and cautions or restrictions, or both, for operation of all alternate or combinations of alternate configurations. These plates shall not be removed from the device, painted over or otherwise made unavailable for reference by the operator. **Note:** If an aerial device does not have a plate attached, contact the manufacturer and do not use the aerial lift until the plate is received. This plate shall not be removed or painted over.

16.4.6.3. Workers required to use vehicle-mounted elevating and rotating work platforms shall be thoroughly trained in all aspects of the job before using this equipment. **(T-0)** This shall include "hands-on-training" prior to actual "on-the-job" training tasks. Completion of operator training and specific qualification shall be documented in individual's training records (MIMICs, MIS or other data retrieval system). **(T-1) Note:** While these requirements relate to aerial lifts, a similar level of detail is required when developing training plans and training personnel on other powered or potentially hazardous equipment. **(T-1)**

16.4.6.4. Before a mobile unit is moved for travel, the aerial device shall be secured in the specified lower traveling position (to prevent rotation) by the use of cradles or locking devices IAW manufacturer's instructions. **(T-0)**

16.4.6.5. The unit shall be visually inspected and lift controls tested prior to each shift or day's work to determine the unit and controls are in safe working condition. **(T-0)** The override feature explained in paragraph **16.4.6.6** shall be tested at this time. **(T-0)** IAW American National Standards Institute A92.2, a record of this test shall only be documented if a discrepancy was found with the unit during the inspection. **(T-1)**

16.4.6.6. Articulating and extendible boom platforms, primarily designed as personnel carriers, shall have both platform (upper) and lower controls. **(T-0)** Upper controls shall be in or beside the platform within easy reach of the operator. **(T-0)** In order to prevent inadvertent actuation of the platform boom positioning controls, operation of an unlocking device shall precede use of the control itself and shall be maintained simultaneously during use of the controls. **(T-0)** The unlocking device may be incorporated into each control. Lower controls shall override upper controls. **(T-0)** Controls shall be plainly marked with their function. **(T-0)** The override mode shall prevent boom movement with the lower control station unattended. Lower level controls shall not be operated without permission from the employee in the lift, except in an emergency. Whenever a worker is in or on an elevated work platform, at least one person qualified to operate the equipment shall be stationed near the lower level control panel. **(T-0) Exception:** Personnel working in or on

an elevated boom without a qualified person near the lower level control panel is permitted if manufacturer's instructions allows for such operations.

16.4.6.6.1. Emergency Stop. The platform shall have an emergency stop control which will stop all platform movement. **(T-0)** This control shall not require continuous operator actuation to stop movement.

16.4.6.6.2. Outrigger Controls. Aerial device outrigger controls shall be guarded to protect against inadvertent operation, and shall return to neutral when released by the operator. **(T-0)** These controls shall be located so the operator can see the outrigger being operated. **(T-0)**

16.4.6.7. Boom and basket load limits specified by the manufacturer shall not be exceeded.

16.4.6.8. Aerial lift trucks shall not be moved with the boom elevated and personnel in the basket unless the lift truck is specifically designed for such operation. In all cases, the manufacturer's operating instructions shall be followed. **(T-0)**

16.4.6.9. Vehicle-mounted elevating and rotating work platforms shall not be used during high winds, thunderstorms or any other adverse or mission-limiting weather conditions which could endanger workers using the platform. Refer to the operator's manual or applicable TO for specified wind limits.

16.4.6.10. Platforms other than buckets or baskets shall include a guardrail system which shall:

16.4.6.10.1. Include a top rail, 42 inches high, and at least one rail midway between top rail and platform surface around its upper periphery. Both rails shall withstand 300 pounds of force applied in any direction. **(T-0)**

16.4.6.10.2. Include toeboards on all sides of platforms. Toeboards shall be securely fastened in place and with not more than 1/4-inch clearance above floor level. **(T-0)** **Exception:** A toeboard is not required at the access opening. Where there is exposure to personnel or electrical wires below the platform, removable toeboards or the equivalent shall be provided IAW 29 CFR 1910.28. **(T-0)** The minimum toeboard height shall be four (4) inches. **(T-0)**

16.4.6.10.3. Include access for personnel entering the platform in the lowered position. **(T-0)** Access steps or rungs shall have a slip-resistant surface. **(T-0)**

16.4.6.11. A full body harness and lanyard (sized to limit free fall distance to six (6) feet or less, or the free fall distance permitted by the system, whichever is less) shall be worn by each bucket or platform occupant. **(T-0)** Each lanyard shall be attached to a designated anchor point on the boom or basket. **(T-0)** Refer to 29 CFR 1910.66 for additional information.

16.4.6.12. Belting off to an adjacent pole, structure or equipment while working from an aerial lift shall not be permitted.

16.4.6.13. Workers shall stand firmly on the basket floor, not sit or climb on edge of basket or use planks, ladders or other devices for a work position. **(T-0)**

16.4.6.14. Climber's equipment shall not be worn while performing work from an aerial lift.

16.4.6.15. Aerial devices, including insulated aerial devices, shall not be brought into contact with energized or potentially energized conductors. Workers shall not rely on dielectric capabilities of aerial devices.

16.4.6.16. Consult BE prior to work near suspected sources of non-ionizing radiation, e.g., radar and microwave equipment. Refer to **Chapter 30** for additional guidance.

16.4.6.17. Before using an aerial device, the worksite shall be surveyed for hazards, such as un-tamped earth fills, ditches, drop-offs and floor obstructions, debris, overhead obstructions and electrical conductors, weather conditions and presence of unauthorized persons. **(T-0)**

16.4.6.18. Before and during each use, the operator shall:

16.4.6.18.1. Check for overhead obstructions and electrical conductors. **(T-0)**

16.4.6.18.2. Ensure load weight does not exceed manufacturer's rated capacity. **(T-0)**

16.4.6.18.3. Ensure outriggers and stabilizers are used if required by manufacturer's instructions. **(T-0)**

16.4.6.18.4. Ensure guardrails are properly installed, including bolts, pins or other locking devices on removable railings and attachments, and that gates are closed. **(T-0)**

16.4.6.18.5. Use outrigger pads when necessary to provide firm footing. **(T-0)**

16.4.6.18.6. Set brakes. **(T-0)**

16.4.6.18.7. Chock wheels before using the lift on an incline. **(T-0)**

16.4.7. Maintenance and Repair of Powered and/or Mobile Units:

16.4.7.1. If deficiencies affecting safe operation are discovered during the daily operator inspection (or during use), the equipment shall immediately be removed from service until repaired. **(T-0)** The manufacturer's recommended maintenance procedures shall be followed and tests outlined in paragraph **16.4.5** shall be conducted prior to returning an aerial device to service following repairs to the ladder, boom or work platform. **(T-0)**

16.4.7.2. All repairs shall be accomplished by qualified personnel. **(T-0)**

16.5. Manually-Propelled and Self-Propelled Mobile Work Platform and Scaffolds (Towers).

16.5.1. Work platforms with work levels four (4) feet or higher and accessed by a ladder or stairway at an angle over 60 degrees, shall have guardrails, midrails and toeboards IAW paragraph **16.4.6.10** on all four (4) sides of the work platform. **(T-0) Exception:** A toeboard is not required at the access opening.

16.5.2. Working Loads:

16.5.2.1. Work platforms and scaffolds shall carry their designed load under all conditions of use. **(T-0)** Aircraft maintenance work platforms shall support design loads listed in their TOs. Parts, additions or accessories for safe use of platforms and scaffolds shall be part of the design. **(T-1)**

16.5.2.2. Specific design and construction requirements are not part of this standard due to the wide variety of materials and design possibilities. However, the design used shall produce a mobile ladder stand or scaffold that will safely hold specified loads. **(T-0)** Materials selected shall be strong enough to meet test requirements and protected against corrosion and deterioration. **(T-0)**

16.5.2.2.1. The design working load of ladder stands shall be calculated based on one or more 250-pound persons with 50 pounds of equipment each. **(T-0)**

16.5.2.2.2. Scaffold design work loads shall be calculated based on:

16.5.2.2.2.1. Light - Designed and constructed for a work load of 25 pounds per square foot. **(T-0)**

16.5.2.2.2.2. Medium - Designed and constructed for a work load of 50 pounds per square foot. **(T-0)**

16.5.2.2.2.3. Heavy - Designed and constructed for a work load of 75 pounds per square foot. **(T-0)** **Note:** Ladder stands and scaffolds shall support at least four (4) times the design work load. **(T-0)**

16.5.2.3. Mobile ladder stand and scaffold materials shall meet strength, dimension and weight specifications in this standard to safely support the design work load. **(T-0)**

16.5.2.4. Bolts or other fasteners used to assemble ladders, scaffolds and towers shall be large enough and in sufficient quantity at each connection to develop designed strength. **(T-0)**

16.5.2.5. The operator shall ensure there are no sharp edges, burrs or other hazards to personnel on exposed surfaces. **(T-0)**

16.5.3. Work Levels.

16.5.3.1. Maximum work level height shall not exceed four (4) times the minimum or least base dimension (width) of any mobile ladder stand or scaffold. Where the basic mobile unit does not meet this requirement, suitable outrigger frames shall be used to obtain this least base dimension or the unit shall be tied with guy wires or braced to keep the unit from tipping. **(T-0)**

16.5.3.2. The minimum platform work level width for mobile scaffolds (towers) shall not be less than 20 inches. Ladder stands shall have a minimum step width of 16 inches. **(T-0)**

16.5.3.3. The supporting structure for the work level shall be rigidly braced, using cross bracing or diagonal bracing with rigid platforms at each work level. **(T-0)**

16.5.3.4. Ladder stand steps shall have slip-resistant treads or a slip-resistant coating. **(T-0)**

16.5.3.5. The work level platform of scaffolds shall be wood, aluminum, plywood planking, steel or expanded metal, for the scaffold's full width, except for necessary openings. **(T-0)** Work platforms shall be secured to the support structure. **(T-0)** Planking shall be 2-inch (nominal) scaffold grade minimum 1,500 fiber (f) (stress grade) lumber or equivalent. **(T-0)**

16.5.3.6. Scaffold work platforms four (4) feet or higher shall have guardrails, midrails and toeboards IAW paragraph **16.4.6.10** **(T-0)**

16.5.3.7. Scaffolds shall have a climbing ladder or stairway (for access and egress) affixed or built into the scaffold. **(T-0)** The ladder or stairway shall be located so it will not tip the scaffold. **(T-0)** A landing platform shall be provided at intervals not exceeding 30 feet. **(T-0)**

16.5.3.8. Self-propelled elevating work platforms and manually-propelled mobile work platforms shall not be moved with personnel on the working platform unless allowed by manufacturer's instructions. Locking pins or other devices, as required, shall be in place IAW equipment-specific TOs or manufacturer's specifications before anyone is allowed to ascend the stairs or ladder. **(T-0)** If allowed by manufacturer's instruction the following requirements need to be accomplished prior to any movement with personnel on the working platform:

16.5.3.8.1. Guardrails, mid-rails, and toe-boards shall be installed on all exposed sides IAW paragraph **16.4.6.10** **(T-0)**

16.5.3.8.2. The floor or surface shall be within 3° (0.6288 inches of rise in 12 inches of run) of level, smooth (the equivalent of broom-finished concrete) and free from pits, holes or obstructions. **(T-0)**

16.5.3.8.3. The minimum dimension of the scaffolding base when ready for rolling shall be at least one-half of the height. **(T-0)** Outriggers, if used, shall be installed on all four sides of the scaffold and then can be included as part of the base dimension. **(T-0) Note:** Measure at the widest width of the base.

16.5.3.8.4. All tools and materials are secured or removed from the platform before the mobile scaffold is moved. **(T-0)**

16.5.3.8.5. Employees on the mobile scaffold shall be advised by a spotter and be aware of each movement in advance. **(T-0)**

16.5.3.8.6. Employees on the work platform of the mobile scaffold may move the scaffold when the mobile scaffold is equipped with a manual system in which the propelling force is applied to the wheels only and cannot exceed normal walking speed.

16.5.3.8.7. The force necessary to move the mobile scaffold shall be applied as close to the base as practicable, and provision shall be made to stabilize the tower during movement from one location to another. **(T-0)**

16.5.3.9. Full-body harnesses shall be worn with lanyard attached to the structural anchor point when using self-propelled mobile work platforms (if guard rails will be removed) with manufacturer-installed structural anchor points and the platform elevated four (4) feet or more above the surface. **(T-0)** Self-propelled work platforms manufactured without an approved structural anchor point shall have protective guardrails, midrails (when required) and toeboards installed on all open sides IAW paragraph **16.5.1** **(T-0)** When within 14 inches of the work surface, e.g., aircraft and buildings, guardrails need not be in place on the side that is within 14 inches of a working surface. Bolts, pins or other locking devices shall be provided and used on all removable railings and attachments. **(T-0)**

16.5.3.10. Personal fall arrest equipment anchorages shall be capable of supporting at least 5,000 pounds (22.2 kilonewton [kN]) per worker attached, or shall be designed, installed, and used as part of a complete personal fall arrest system which maintains a safety factor of two, under the supervision of a qualified person. **(T-0)** Refer to **Chapter 13,** *Fall Protection,* and 29 CFR 1910.66 for additional guidance.

16.5.3.11. Lanyards, "D" rings, snap-hooks and all fall arrest system components shall sustain a minimum 5,000 pound tensile load IAW 29 CFR 1910.66. **(T-0)**

16.5.4. Operations.

16.5.4.1. Training requirements in paragraph **16.4.6.3** also apply to all manually-propelled elevating aerial platforms and self-propelled elevating work platforms.

16.5.4.2. Operators shall know the location of operating and safety manuals, including the manual defining dealer, owner, lessor, lessee, user and operator responsibilities on the aerial platform. **(T-0)** Operators shall be familiar with and use these manuals when questions arise. **(T-0)**

16.5.4.3. Aerial platforms shall be given a visual inspection and functional test before use each day or at the beginning of each shift including, but not limited to, the following:

16.5.4.3.1. Operating and emergency controls. **(T-0)**

16.5.4.3.2. Safety devices. **(T-0)**

16.5.4.3.3. Personal protective devices, including fall protection. **(T-0)**

16.5.4.3.4. Air, hydraulic and fuel system leaks. **(T-0)**

16.5.4.3.5. Cables and wiring harness. **(T-0)**

16.5.4.3.6. Loose or missing parts. **(T-0)**

16.5.4.3.7. Tires and wheels. **(T-0)**

16.5.4.3.8. Placards, warnings and control markings. **(T-0)**

16.5.4.3.9. Outriggers, stabilizers and other structures. **(T-0)**

16.5.4.3.10. Guardrail system, including bolts, pins or other locking devices on all removable railings and attachments. **(T-0)**

16.5.4.3.11. Any special items required by the manufacturer. **(T-0)**

16.5.4.3.12. Inspection deficiencies shall be documented IAW applicable TO or local procedure for stands not covered by a TO. **(T-0)** A visible indicator, e.g., AF Form 981, *Out of Order*, or other means shall be affixed to stands removed from service until repaired and returned to service. **(T-0)**

16.5.4.4. The operator shall ensure the following before each elevation of the platform:

16.5.4.4.1. The aerial platform is operated on a surface within the manufacturer's limits. **(T-0)**

16.5.4.4.2. Outriggers, stabilizers, extendable axles or other stability enhancing means are used as required by the manufacturer. **(T-0)**

16.5.4.4.3. Guardrails are installed and access gates or openings are closed per manufacturer's instructions, including bolts, pins or other locking devices on all removable railings and attachments. **(T-0)**

16.5.4.4.4. The load and its distribution on the platform and any platform extensions do not exceed the manufacturer's rated capacity for the specific configuration. **(T-0)**

16.5.4.4.5. There is adequate clearance from overhead obstructions. **(T-0)**

16.5.4.4.6. Minimum safe approach distances to energized power lines and parts are maintained. **(T-0)**

16.5.4.4.7. The operator and all personnel on the platform wear fall protection devices and other safety gear, as required, at all times. **(T-0)**

16.5.4.5. Users shall inspect and maintain aerial platforms to ensure proper operation. **(T-0)** The frequency of inspection and maintenance shall be based on the manufacturer's recommendations and compatible with operating conditions and severity of the operating environment. **(T-0)** Aerial platforms not in safe operating condition shall be immediately removed from service until repaired. **(T-0)** A qualified person shall make repairs IAW manufacturer's recommendations. **(T-0)** This periodic inspection shall include those requirements in paragraphs **16.5.4.3** and **16.5.4.4** **(T-0)**

16.5.4.6. Controls for manually elevated platforms shall be clearly marked for direction and function. **(T-0)** Controls for platform elevating and lowering mechanisms shall be self-holding and readily accessible from the ground. Controls at the platform are optional. **(T-0)**

16.5.4.7. Upper controls of power elevated platforms shall be:

16.5.4.7.1. Clearly marked as to direction and function. **(T-0)**

16.5.4.7.2. A type that automatically returns to the off or neutral position when released. **(T-0)**

16.5.4.7.3. Protected against inadvertent operation. **(T-0)**

16.5.4.7.4. Readily accessible to the operator. **(T-0)**

16.5.4.7.5. Designed to include a control that must be continuously activated for upper controls to function and that automatically returns to the off position when released. **(T-0)**

16.5.4.8. Aerial platforms with a powered elevating assembly shall have a clearly marked emergency lowering means readily accessible from ground level. **(T-0)**

16.5.4.9. The aerial platform shall have a readily identifiable emergency stop device at upper control and lower control stations that will stop powered functions and platform movement. **(T-0)**

16.5.4.10. The control system shall be designed so a single control system malfunction will not cause unintended platform movement. **(T-0)**

16.5.5. Wheels and Casters.

16.5.5.1. Wheel and casters shall be sized to support four times the design working load. **(T-0)**

16.5.5.2. Scaffold casters shall have a positive wheel and (or) swivel lock to prevent movement. Two of the four casters on ladder stands shall swivel and be lockable. **(T-0)**

16.5.5.3. Screwjacks or other means for adjusting height shall be provided where leveling of the elevated work platform is required. **(T-0)**

16.5.5.4. At least two brakes, wheel locks or permanently installed jacks shall be operable on all mobile work platforms. **(T-0)**

16.5.6. Mobile Tubular Welded Frame Scaffolds:

16.5.6.1. Scaffold vertical members shall be properly braced by cross or diagonal braces. **(T-0)** Braces shall automatically square and align vertical members so the erected scaffold is always plumb, square and rigid. **(T-0)**

16.5.6.2. Spacing of panels or frames shall be consistent with loads imposed. **(T-0)** Frames shall be placed one on top the other with coupling or stacking pins to provide vertical alignment of legs. **(T-0)**

16.5.6.3. Panels shall be locked together vertically by pins or equivalent if uplift can occur. **(T-0)**

16.5.6.4. Scaffold over 50 feet in height shall be erected IAW manufacturer's instructions and under the supervision of a qualified professional engineer. **(T-0)** The installation civil engineering activity is the authorizing agency for scaffold erection.

16.5.7. Mobile Tubular Welded Sectional Folding Scaffolds.

16.5.7.1. General. Scaffolds, including sectional stairway and sectional ladder scaffolds, shall be designed and erected IAW paragraph **16.5.6.4** **(T-0)**

16.5.7.2. Stairway. Each section of folding stairway scaffold shall include a stairway, detachable work platform and a set of pivoting and hinged folding diagonal and horizontal braces. **(T-0)**

16.5.7.3. Sectional Folding Stairway Scaffolds. These are medium duty scaffolds (light duty when equipped with a "high clearance" base section). **Note:** High clearance bases have a greater open space so the scaffold may be placed over obstructions like machinery or shrubbery. When high clearance bases are used to support sectional folding stairway scaffolds, the entire scaffold's load capacity shall be reduced. **(T-0)** Sectional folding stairway scaffolds shall not exceed 4 ½ feet in width and 6 feet in length.

16.5.7.4. Sectional Folding Ladder Scaffolds. Sectional folding ladder scaffolds are light duty scaffolds (includes special base [open end] sections designed for high clearance over obstructions). For special applications, 6-foot folding ladder scaffolds, except high clearance base sections, shall be designed as medium duty scaffolds. **(T-0)** A sectional folding ladder scaffold shall not exceed 6 feet 6 inches in width for a 6-foot long unit, 8 feet 6 inches for an 8-foot unit, or 10 feet 6 inches for a 10-foot long unit. End frames of sectional ladder and stairway scaffolds shall be designed so horizontal bearers provide support for multiple planking levels. **(T-0)**

16.5.8. Mobile Tube and Coupler Scaffolds. Couplers shall be made of structural type material, such as drop-forged steel, malleable iron or structural grade aluminum. **(T-0)** Use of gray cast iron is prohibited. Refer to paragraph **16.5.6.4** for the erection of scaffolds.

16.5.9. Mobile Work Platforms. The minimum base width shall conform to paragraph **16.5.3.2** **(T-0)** Rigid diagonal bracing to vertical members shall be provided. **(T-0)**

16.5.10. Mobile Ladder Stands:

16.5.10.1. Base Width. Minimum base width shall be IAW paragraph **16.5.3.2** **(T-0)** Maximum base section length shall be the total length of combined steps and top assembly, measured horizontally, plus 5/8 inch per step of rise. **(T-0)**

16.5.10.2. Steps. Steps shall be uniformly spaced, with a rise of 9 inches to 10 inches, and a depth of at least 7 inches. **(T-0)** Slope of the steps section shall be 55 to 60 degrees, measured from the horizontal. **(T-0)**

16.5.10.3. Handrails. Units with more than 4 steps or 60 inches vertical height to the top step shall be equipped with handrails. **(T-0)** Handrails shall be at least 29 inches high and the same height all along the step, measured vertically from the center of the step. **(T-0)**

16.5.10.4. Load design shall meet requirements of paragraph **16.5.2.2.1** **(T-0)**

16.5.11. Mobile Work Platforms and Ladder Stands shall:

16.5.11.1. Meet criteria in paragraphs **16.5.9** and **16.5.10** **(T-0)** If these mobile work platforms have steps, they shall meet mobile ladder stand criteria for step dimensions and handrails. **(T-0)**

16.5.11.2. Be maintained free of grease, oil, ice, snow, mud or any other slippery substance or object which could cause slips and falls. **(T-0)** Step treads and walking surfaces shall be in good repair. **(T-0)** Repair worn surfaces with suitable materials or make safe using abrasive or non-slip materials.

16.5.11.3. Removable guardrails may be used on all open sides of aircraft maintenance platforms. Guardrails removed for material handling shall be replaced as soon as material handling is complete. **(T-0)** Protective guardrails are not required at the platform entrance if there is a ramp or stairway (angle less than 60 degrees) IAW paragraph **16.5.1** Protective guardrails shall only be removed from the side(s) of the platform positioned as close as practical (less than 14 inches) and parallel to aircraft, building or other working surface. **(T-0)** Guardrails shall be installed on all open sides if platform levels are four (4) feet or higher above ground or floor. **(T-0)** Bolts, pins or other locking devices shall be provided and used on all removable railings and attachments. **(T-0)** Only guardrails and toeboards meeting criteria in paragraph **16.4.6.10** shall be used. **(T-0)**

16.5.11.4. Prior to any user ascending a raised mobile platform: all locking devices (e.g., pins, collars, etc.) shall be installed, hydraulic pressure shall be released, the platform shall be slowly lowered until locking devices are securely engaged and hydraulic pressure valve(s) shall be closed. **(T-0)** If the raisable portion of the platform cannot be elevated from ground level, the user may ascend to that platform portion and adjust platform height. However, requirements for locking devices, pressure release and closing valves shall be met prior to starting any task or work. **(T-0)**

16.5.11.4.1. Ascending/descending work platform. The climbing apparatus shall be considered a ladder if it does not meet step dimension criteria in paragraph **16.5.10.3** and/or the angle of the apparatus is greater than 60 degrees from horizontal. **(T-0)** Personnel ascending/descending ladders shall face the ladder and maintain a firm hold on the ladder. **(T-0)** Personnel ascending/descending stairs (less than or equal to 60 degrees) shall face the direction of travel and use hand rails. **(T-0)**

16.5.11.4.2. Refer to **Chapter 7,** *Walking – Working Surfaces*, for additional guidance on ladder safety.

16.5.11.5. Mark mobile work platforms with reflective materials to the maximum extent authorized by appropriate TOs, such as TO 35-1-3, *Corrosion Prevention and Control, Cleaning, Painting, and Marking of USAF Support Equipment (SE)*. **(T-0)** When not being transported, mobile work platforms shall be secured to prevent collision with aircraft, vehicles or other equipment. **(T-1)** Designated flightline storage areas for mobile work platforms shall be determined by AGE Flight Commander and Airfield Manager and approved by the Maintenance Group Commander. **(T-1)** Refer to **Chapter 24,** *Aircraft Flightline -Ground Operations and Activities*, for further guidance.

16.5.11.6. Mobile work platforms shall be operationally inspected per the equipment TO or manufacturer's owner manual and TO 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures.* **(T-0)** Maintenance work stands shall have four (in any combination) of the following: operational brakes, wheel locks or permanently installed jacks (e.g., two operational brakes and two permanently installed jacks). **(T-1)** No stand will be used unless all brakes are set and all wheel casters locked. **(T-1)** Wheel will be locked either 90 or 180 degrees from the caster lock pin if it interferes with the wheel brake handle. **(T-1)** Wheel chocks may be used in conjunction with these requirements. Vehicle chocks may be constructed or locally manufactured IAW TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding*, Section 4.1.2. Platforms shall be locked when not in use to avoid rolling down slanted surfaces or being moved by wind. **(T-1)** Stands with defects shall be tagged as unserviceable. **(T-0)**

Note 1: Some maintenance work stands may only have two operational brakes and no permanently installed jacks. Both brakes are required to be set.
Note 2: A daily inspection is not required for days the stand is not used.

16.5.11.7. When mobile work platforms are being moved:

16.5.11.7.1. Personnel and equipment may remain on self-propelled and manually-propelled work platforms when moved if manufacturer's instructions allow such activity and the requirements of paragraph **16.5.3.8** and subparagraphs are followed.

16.5.11.7.2. Platforms to be towed shall be equipped with hitches designed for such purpose. **(T-0)**

16.5.11.7.3. The following rules apply when platforms are towed by vehicles:

16.5.11.7.3.1. Maximum towing speed for one maintenance stand is 10 miles per hour and 5 miles per hour for two or more maintenance stands. **(T-1)** However, when surfaces and terrain make it necessary, speed shall be reduced accordingly. **(T-1)**

16.5.11.7.3.2. No more than four type B1, B4, B5 and similar small stands may be towed as follows: two sets of two in tandem on a double hitch or two in tandem on a single hitch. Type B3, J7 and similar large stands shall be towed singly on a center mounted hitch. **(T-1)** Four-wheeled units shall not be towed behind two-wheeled units. Large pieces of AGE, when towed in tandem, shall not block the driver's vision of last item being towed.

16.5.11.7.3.3. Safety pins shall be used to secure pintle hooks and trailer hitches. **(T-1)**

16.5.11.8. Mobile work platforms used where static electricity is hazardous to the work operation, such as fuel cell repair or refueling vehicle maintenance, shall be grounded and equipped with static discharge plates for personnel to dissipate accumulated static electricity. **(T-0)**

16.5.11.9. Maintain mobile work platforms and ladder stands IAW appropriate 35-series TOs. **(T-1)**

Chapter 17

SCAFFOLDING

17.1. Scope. This chapter applies to all scaffolding used in the Air Force, except rolling scaffolds (mobile towers), which are covered in **Chapter 16,** *Mobile Elevating Work Platforms.* It specifies criteria for assembly, erection, storage and safe use of scaffolding. Since the Air Force primarily uses pre-formed tubular scaffolding, construction requirements for wooden pole scaffolding are not part of this chapter. In the event an Air Force organization must construct a wood scaffold, the design and material specifications contained in 29 CFR 1910.27, 29 CFR 1926, Subpart L, *Scaffolds*, and 29 CFR 1915.71, *Scaffolds, Ladders and Other Working Surfaces*, shall be followed. **(T-0)** Refer to **Chapter 16** for information on manually-propelled mobile ladder stands, mobile work platforms or mobile towers. **Note:** Scaffolds and support equipment for Air Force use will meet design and construction specifications of 29 CFR 1910.27. **(T-0)**

17.2. Hazards. Elevated work platforms and scaffolds present hazards associated with falls or falling objects. These hazards can be minimized by properly designing platforms and scaffolds, training personnel, and supervisors enforcing safe work practices. Supervisors must also consider the physiological effects of high places on individual workers, such as dizziness or instability. Factors such as illness, fatigue and physical deficiencies can also contribute to mishaps. **(T-1)**

17.3. General Requirements.

17.3.1. Scaffolds shall be provided when work cannot be done safely from the ground or from solid construction and shall be constructed and erected only by qualified, trained personnel. (T-0) When ladders are used they will conform to requirements in **Chapter 7,** *Walking – Working Surfaces.* **(T-0)**

17.3.2. The footing or anchorage for scaffolds shall be designed to support the maximum intended load without settling or displacement. **(T-0)** Unstable objects such as barrels, boxes, loose brick or concrete blocks shall not be used to support scaffolds or planks. **(T-0)**

17.3.3. Guarding requirements.

17.3.3.1. Guardrails shall be installed on open sides and ends of platforms 4 feet or more (and toeboards, if 10 feet or more) above the ground or floor except: **(T-0)**

17.3.3.1.1. Scaffolding wholly within the interior of a building and covering the entire floor area of any room providing no side is exposed to a hoistway, elevator shaft, stairwell or other floor openings. **(T-0)**

17.3.3.1.2. Needle-beam scaffolds and floats used by structural iron workers. **(T-0)**

17.3.3.2. Scaffold guarding will consist of:

17.3.3.2.1. A guardrail of 2- by 4-inch lumber or equivalent material installed at a height of 36 to 42 inches above the platform. **(T-0)**

17.3.3.2.2. A midrail (when required in this standard) of 1- by 4-inch lumber or equivalent.

17.3.3.2.3. Vertical supports installed at intervals not exceeding 10 feet. **(T-0)**

17.3.3.2.4. Toeboards a minimum of four (4) inches in height. **(T-0)**

17.3.3.2.5. A wire mesh screen shall be installed between the toeboard and guardrail (extending the entire length of the opening) where persons work or pass beneath the scaffold. The wire mesh shall be number 18-gauge US Standard wire 1/2-inch mesh or equivalent. **(T-0)**

17.3.3.3. No more than 2 workers shall be permitted on suspension scaffolds with an intended working load of 500 pounds. **(T-0)** No more than 3 workers shall be permitted on suspension scaffolds with an intended working load of 750 pounds. **(T-0)** Each worker shall be protected by a personal fall arrest system attached to a lifeline. **(T-0)** The lifeline shall be securely attached to substantial members of the structure (not scaffold), or to securely rigged lines, which will safely suspend the worker in case of a fall. **(T-0)**

17.3.4. Scaffolds and their components shall be capable of supporting at least four (4) times the maximum intended load. **(T-0)**

17.3.5. Scaffolds shall not be altered or moved horizontally while in use or occupied. **(T-0)**

17.3.6. Scaffolds, their accessories and other devices prescribed in this chapter shall be maintained in good condition. **(T-0)** Scaffold parts shall be inspected prior to use. If any of the following deficiencies are found, the scaffold shall not be used until repaired or replaced:

17.3.6.1. Accessory or structural damage. **(T-0)**

17.3.6.2. Missing parts or members. (For example, braces, toeboards, guardrails, anchors, etc.). **(T-0)**

17.3.6.3. Broken, bent or rusted frames or accessories. **(T-0)**

17.3.6.4. Altered parts or accessories. (For example, substitution of smaller planking, bolts or anchors for those required). **(T-0)**

17.3.6.5. Broken or deteriorated lifelines or ropes and their attachments and/or anchorages. **(T-0)**

17.3.6.6. Any other conditions which would jeopardize the safety of workers. **(T-0)** Scaffolds found defective shall be removed from service and tagged with a danger tag. **(T-0)**

17.3.7. Scaffolds shall not be loaded in excess of the designed working load. **(T-0)**

17.3.8. Planking shall be Scaffold Grade as recognized by grading rules for the species of wood used. **(T-0)**

17.3.9. Nails or bolts used in the construction of scaffolds shall be of adequate size and in sufficient numbers at each connection to develop the designed strength of the scaffold. **(T-0)** Nails will not be subjected to a straight pull and shall be driven full length. **(T-0)**

17.3.10. Planking or platforms shall be overlapped (minimum 12 inches) and secured from movement. **(T-0)**

17.3.11. A ladder or equivalent safe access shall be provided. **(T-0)**

17.3.12. Scaffold planks shall extend beyond their end supports by not less than 6 inches or more than 12 inches. **(T-0)**

17.3.13. The poles, legs or uprights of scaffolds shall be plumb and securely and rigidly braced to prevent swaying and displacement. **(T-0)**

17.3.14. Materials being hoisted onto a scaffold shall have a tag line. **(T-0)**

17.3.15. Workers shall wear hard hats during erection, maintenance and teardown of overhead scaffolding. Protective gloves are also recommended. **(T-0)**

17.3.16. The clearance between scaffolds and power lines shall be as follows:

17.3.16.1. Scaffolds shall not be erected, used, dismantled, altered or moved such that they or any conductive material handled on them might come close to exposed and energized power lines.

17.3.16.2. **Exception:** Scaffolds and materials may be closer to power lines, where such clearance is necessary for performance of work, and only after the utility company or electrical system operator has been notified of the need to work closer and the utility company or electrical system operator has de-energized or relocated the lines, or installed protective coverings to prevent accidental contact with the lines. **(T-0)**

17.3.17. Adverse weather conditions such as ice, snow, rain and wind can create a hazardous working surface. A plan shall be established addressing adverse weather conditions and measures to be taken to protect workers performing work under adverse weather conditions. **(T-1)** The following rules shall apply to work under adverse weather.

17.3.17.1. Personnel shall not work on scaffolds covered with ice or snow. **(T-1)** If the work surface remains slippery after ice or snow removal, it shall be sanded or otherwise treated to prevent workers from slipping. **(T-1)**

17.3.17.2. Personnel shall not work on scaffolds during storms or high winds. **(T-1)** Due to the many types and uses of scaffolding, it is impractical to determine specific wind criteria for work stoppage. Supervisors are responsible for assessing unsafe environmental and climatic work conditions and will take necessary preventive measures to protect workers. **(T-1)**

17.3.18. Tools, materials and debris shall not be allowed to accumulate in quantities that could cause a hazard. **(T-1)** When possible, containers shall be provided on scaffolds for storage of loose materials. **(T-1)** Supervisors shall ensure good housekeeping practices are followed to prevent tripping hazards. **(T-1)**

17.3.19. Chemically-active environments can destroy fiber rope. Rope materials such as polyester, nylon and manila can be damaged when exposed to caustics and acids. When fiber rope is used near corrosive substances or chemicals, the manufacturer shall be consulted for assistance in determining the proper type rope to use. **(T-0)**

17.3.20. Wire or fiber rope used for scaffold suspension shall support at least six (6) times the intended load. **(T-0)**

17.3.21. The use of shore scaffolds or lean-to scaffolds is prohibited. **(T-0)**

17.3.22. Lumber sizes, when used in this standard, refer to nominal sizes except where otherwise stated. **(T-0)**

17.3.23. Scaffolds shall be secured to permanent structures by anchor bolts, reveal bolts or other equivalent means. **(T-0)** Window cleaners' anchor bolts shall not be used. **(T-0)**

17.3.24. Special care shall be taken to protect scaffold members, including wire or fiber ropes, when using heat-producing processes. **(T-0)**

17.3.25. A covered storage area is recommended to protect scaffolding from damage and deterioration.

17.3.26. Wooden parts of scaffolding shall not be painted as paint can hide defects. **(T-0)** Clear varnish, lacquer, shellac or linseed oil shall be used when wood protection is needed. **(T-0)**

17.3.27. Individual workers shall not attempt to manually lift or move scaffold members which are excessively heavy, or because of their shape or size, cannot be safely handled. **(T-1)** In these cases, assistance shall be obtained from other workers or mechanical handling equipment shall be used. **(T-1)**

17.3.28. Hand tools used to assemble scaffolding shall be in good condition. **(T-0)** When powered hand tools are used, they shall be electrically grounded or of double insulated construction. **(T-0)**

17.4. Tube and Coupler Scaffolds.

17.4.1. When structural metals other than those stated in paragraphs **17.4.2**, **17.4.3** and **17.4.4** are used in scaffold construction, they must be designed to carry four (4) times the maximum intended load. **(T-0)**

17.4.2. A light-duty tube and coupler scaffold shall have posts, bearers, runners and bracing of nominal 2-inch outside diameter steel tubing. **(T-0)** The posts shall be spaced no more than 10 feet along the length of the scaffold and the scaffold shall be no wider than 6 feet. **(T-0)**

17.4.3. A medium-duty tube and coupler scaffold shall have posts, runners and bracing of nominal 2-inch outside diameter steel tubing. **(T-0)** Posts shall not be spaced more than eight (8) feet along the scaffold. **(T-0)** If the scaffold is six (6) feet wide, the bearer diameter must be 2 ½-inches outside diameter. **(T-0)** If the scaffold is five (5) feet wide, the bearer diameter may be two (2) inches outside diameter. **(T-0)**

17.4.4. A heavy-duty tube and coupler scaffold shall have all posts, runners and bracing of nominal 2-inch O.D. steel tubing, with the posts spaced not more than 6 feet 6 inches along the length of the scaffold. **(T-0)** The scaffold shall be no wider than six (6) feet. **(T-0)**

17.4.4.1. Tube and coupler scaffolds shall be limited in heights and working levels. **(T-0)** Drawings and specifications of tube and coupler scaffolds greater than the limitations shall be designed by a structural or civil engineer. **(T-0)** Design drawings or copies shall be made available to the installation CE for inspection purposes. **(T-1)**

17.4.4.2. Tube and coupler scaffolds shall be constructed and erected to support four (4) times the maximum intended loads or as set in the specifications established by a structural or civil engineer. **(T-0)**

17.4.4.3. Posts shall be accurately spaced, as required above, erected on suitable bases and maintained plumb. **(T-0)**

17.4.4.4. Runners shall be erected along the length of the scaffold. **(T-0)** They shall be located on both the inside and the outside posts at an even height. **(T-0)** Runners shall be interlocked to form continuous lengths and coupled to each post. **(T-0)** The bottom runners shall be located as close to the base as possible. **(T-0)** Runners shall be placed not more than 6 feet 6 inches on centers. **(T-0)**

17.4.4.5. Bearers shall be installed transversely between posts. **(T-0)** They shall be securely coupled to the posts bearing on the runner coupler. **(T-0)** When coupled directly to the runners, the coupler must be kept as close to the posts as possible. **(T-0)**

17.4.4.6. Bearers shall be at least 4 inches, but not more than 12 inches, longer than the post or runner spacing. **(T-0)** Bearers may be cantilevered for use as brackets to carry not more than two planks.

17.4.4.7. Cross bracing shall be installed across the width of the scaffold at least every third set of posts horizontally and every fourth runner vertically. **(T-0)** Bracing shall extend diagonally from the inner and outer runners upward to the next outer and inner runners. **(T-0)**

17.4.4.8. Longitudinal diagonal bracing shall be installed at approximately a 45-degree angle from near the base of the first outer post upward to the extreme top of the scaffold. **(T-0)** Where the longitudinal length of the scaffold permits, bracing shall be duplicated beginning at every fifth post. **(T-0)** In a similar manner, longitudinal diagonal bracing shall also be installed from the last post extending back and upward toward the first post. **(T-0)** Where conditions preclude the attachment of this bracing to the posts, bracing may be attached to the runners.

17.4.4.9. The entire scaffold shall be tied to and securely braced against the building at intervals not exceeding 30 feet horizontally and 26 feet vertically. **(T-0)**

17.5. Tubular Welded Frame Scaffolds.

17.5.1. Metal tubular frame scaffolds, including accessories such as braces, brackets, trusses, screw legs, ladders, etc., shall be designed and proved to safely support four (4) times the maximum intended load. **(T-0)**

17.5.2. Spacing of panels or frames shall be consistent with loads imposed. **(T-0)**

17.5.3. Scaffolds shall be braced by cross-bracing or diagonal braces, or both, for securing vertical members together laterally. **(T-0)** The cross-braces shall be of a length which will automatically square and align vertical members. **(T-0)** This will ensure the erected scaffold is always plumb, square and rigid. Brace connections shall be made secure. **(T-0)**

17.5.4. Scaffold legs shall be set on adjustable bases or plain bases placed on mud sills or other foundations able to support the maximum intended load. **(T-0)**

17.5.5. The frames shall be placed one on top of the other with coupling or stacking pins to provide proper vertical alignment of the legs. **(T-0)**

17.5.6. Where uplift may occur, panels shall be locked together vertically by pins or other equal means. **(T-0)**

17.5.7. To prevent movement, the scaffold shall be secured to the building or structure at intervals not to exceed 30 feet horizontally and 26 feet vertically. **(T-0)**

17.5.8. Drawings and specifications for frame scaffolds over 125 feet in height above the base plates shall be designed by a structural or civil engineer. **(T-0)** Copies of the drawings and specifications shall be maintained by the installation structural or civil engineer for as long as the scaffolding is in use. **(T-1)**

17.5.9. Tubular welded frame scaffolds shall be erected by competent and experienced personnel. **(T-0)**

17.5.10. Inspections shall be made of all welded frames and accessories and any maintenance, including painting or minor corrections authorized by the manufacturer, shall be made before use. **(T-0)**

17.5.11. Outrigger Scaffold requirements.

17.5.11.1. Outrigger beams shall extend not more than six (6) feet beyond the face of the building. **(T-0)** The inboard end of outrigger beams, measured from the fulcrum point to the extreme point of support, shall not be less than one and one-half times the outboard end in length. **(T-0)** The beams shall rest on edge, with sides plumb, and the edges horizontal. The fulcrum point of the beam shall rest on a secure bearing at least six (6) inches in each horizontal dimension. **(T-0)** The beam shall be secured in place against movement and braced at the fulcrum point against tipping. **(T-0)**

17.5.11.2. The inboard ends of outrigger beams shall be securely supported either by (a) struts bearing against sills in contact with the overhead beams or ceiling, or (b) tension members secured to the floor joists underfoot, or (c) by both, if necessary. **(T-0)** The inboard ends of outrigger beams shall be secured against tipping. **(T-0)** The entire supporting structure shall be braced in both directions to prevent any horizontal movement. **(T-0)**

17.5.11.3. Unless outrigger scaffolds are designed by a structural or civil engineer. **(T-0)** Outrigger scaffolds designed by a structural and/or civil engineer shall be constructed and erected according to such design. **(T-0)** Design copies shall be maintained by the installation structural or civil engineer. In the event the job location is off the installation, the on-site supervisor shall have a copy of the drawings and specifications in their possession. **(T-1)** Copies shall be retained as long as the scaffold is erected. **(T-0)**

17.5.11.4. Planking shall be laid tight and extend to within three (3) inches of the building wall. **(T-0)** Planking shall be nailed or bolted to outriggers. **(T-0)**

17.5.11.5. Where additional working levels are supported by the outrigger method, the plans and specifications of the outrigger and scaffolding structure shall be designed by a structural or civil engineer. **(T-0)**

17.6. Masons' Adjustable Multiple-point Suspension Scaffolds.

17.6.1. The scaffold shall be capable of sustaining a working load of 50 pounds per square foot, and loads shall not exceed that figure. **(T-0)**

17.6.2. The scaffold shall be provided with hoisting machines that meet requirements of Underwriters Laboratories or Factory Mutual Engineering Corp. **(T-0)**

17.6.3. The platform shall be supported by wire ropes (to conform with requirements in paragraph **17.3.20**) suspended from overhead outrigger beams. **(T-0)**

17.6.4. Scaffold outrigger beams shall consist of structural metal securely fastened or anchored to the frame or floor system of the building or structure. **(T-0)** Each outrigger beam shall be equal in strength to at least a standard 7-inch, 15.3-pound steel I-beam, be at least 15 feet long and not project more than 6 feet 6 inches beyond the bearing point. **(T-0)** Where the overhang exceeds 6 feet 6 inches, outrigger beams shall be composed of stronger beams or multiple beams. They shall be installed IAW approved designs and instructions. **(T-0)** If channel iron outrigger beams are used in place of I-beams, they shall be fastened together with the flanges turned out. **(T-0)**

17.6.5. Outrigger beams shall be set and maintained with their webs in a vertical position. **(T-0)** A stop bolt shall be placed at each end of every outrigger beam. **(T-0)** The outrigger beam will rest on suitable wood-bearing blocks. **(T-0)**

17.6.6. Scaffold parts such as bolts, nuts, fittings, clamps, wire ropes, and outrigger beams and their fastenings shall be kept in good working condition and shall be inspected before each installation and daily thereafter while the scaffold is in use. **(T-0)**

17.6.7. The free end of suspension wire ropes shall be equipped with proper size thimbles and be secured by splicing or other equivalent means. **(T-0)** The running ends shall be attached to the hoisting drum and at least four (4) turns of rope will remain on the drum. **(T-0)**

17.6.8. Where a single outrigger beam is used, the steel shackles or clevises, with which the wire rope are attached to the outrigger beams, shall be placed directly over the hoisting drums. **(T-0)**

17.6.9. The scaffold platform shall be equal in strength to at least 2-inch planking. **(T-0)**

17.6.10. When workers are working on the scaffold and an overhead hazard exists, overhead protection shall be provided not more than nine (9) feet above the platform. **(T-0)** It shall consist of 2-inch planking or material of equivalent strength laid tight. **(T-0)**

17.6.11. Scaffolds shall only be installed or moved under the control of the on-site job supervisor or a structural or civil engineer. **(T-0)**

17.7. Two-Point Suspension Scaffolds (Swinging Scaffolds).

17.7.1. Two-point suspension scaffold platforms shall not be less than 20 inches nor more than 36 inches wide. **(T-0)** The platform shall be fastened to the hangers by U-bolts or by other equal means. **(T-0)**

17.7.2. The hangers of two-point suspension scaffolds shall be made of wrought iron, mild steel or other material having a cross-sectional area capable of sustaining four (4) times the maximum intended load. **(T-0)** They shall be designed with a support for the guardrail, intermediate rail and toeboard. **(T-0)**

17.7.3. When hoisting machines are used on two-point suspension scaffolds, they shall be tested and approved by Underwriters Laboratories or Factory Mutual Engineering Corp. **(T-0)**

17.7.4. Roof irons or hooks shall be of wrought iron, mild steel or other material of proper size and design, securely installed and anchored. **(T-0)** Tiebacks of 3/4-inch manila rope or equivalent will serve as a secondary method of anchorage. **(T-0)** Tiebacks shall be installed at right angles to the face of the building, whenever possible, and secured to a structurally sound portion of the building. **(T-0)**

17.7.5. Two-point suspension scaffolds shall be suspended by wire, synthetic or fiber ropes. **(T-0)** Wire and fiber ropes will conform to paragraphs **17.3.19** and **17.3.20** **(T-0)**

17.7.6. Blocks for fiber ropes shall be of standard 6-inch size, consisting of at least one double and one single block. **(T-0)** The sheaves of blocks shall fit the size of rope used. **(T-0)**

17.7.7. Wire, synthetic and fiber ropes, slings, hangers, platforms and other supporting parts shall be inspected before every installation. **(T-0)** Daily inspections shall be made while the scaffold is in use. **(T-0)**

17.7.8. No more than 2 workers shall be permitted to work at one time on suspension scaffolds with an intended working load of 500 pounds. **(T-0)** No more than 3 workers shall be permitted to work at one time on suspension scaffolds with an intended working load of 750 pounds. **(T-0)** Each worker shall be protected by a personal fall arrest system. **(T-0)** The system shall be attached to substantial members of the structure (not the scaffold), or to securely rigged lines, which will safely suspend the worker in case of a fall. **(T-0)**

17.7.9. Two-point suspension scaffolds shall be lashed to the building or structure to prevent swaying. **(T-0)** Window cleaners' anchors shall not be used for this purpose. **(T-0)**

17.7.10. The platform of every two-point suspension scaffold shall be one of the following types:

17.7.10.1. The side stringer of ladder-type platforms shall be clear straight-grained spruce or material of equal strength and durability. **(T-0)** Rungs shall be of straight-grained oak, ash or hickory, at least 1 – 1/8 inch in diameter, with 7/8 inch tenons mortised into the side stringers at least 7/8 inch. **(T-0)** Stringers shall be tied together with tie rods not less than 1/4 inch in diameter, passing through the stringers and riveted up tight against washers on both ends. **(T-0)** The flooring strips shall be spaced not more than 5/8 inch apart except at the side rails where the space may be one inch. **(T-0)**

17.7.10.2. Plank-type platforms shall be made of not less than nominal 2- by 8-inch unspliced planks. **(T-0)** They shall be cleated together on the underside starting six (6) inches from each end. **(T-0)** The intervals in between cleats shall not exceed four (4) feet. **(T-0)** The plank-type platform shall not extend beyond the hangers more than 18 inches. **(T-0)** A bar shall be fastened to the platform at each end to prevent its slipping off the hanger. **(T-0)** The span between hangers for plank-type platforms shall not exceed 10 feet. **(T-0)**

17.7.10.3. Beam platforms will have side stringers of lumber not less than 2- by 6-inches set on edge. **(T-0)** The span between hangers shall not exceed 12 feet when beam platforms are used. **(T-0)** Flooring shall be supported on 2- by 6-inch crossbeams, laid flat and set into the upper edge of the stringers with a snug fit, at intervals of not more than four (4) feet, nailed in place. **(T-0)** Flooring shall be of 1- by 6-inch material properly nailed. **(T-0)** Floorboards shall not be spaced more than 1/2 inch apart. **(T-0)**

17.8. Stone Setters' Adjustable Multiple-Point Suspension Scaffolds.

17.8.1. The scaffold shall support a working load of 25 pounds per square foot and shall not be overloaded. **(T-0)** Scaffolds shall not be used for storage of stone or other heavy materials. **(T-0)**

17.8.2. The hoisting machine and its supports shall be of a type tested and listed by Underwriters Laboratories or Factory Mutual Engineering Corp. **(T-0)**

17.8.3. The platform shall be fastened to the hangers by U-bolts or other equal means. **(T-0)**

17.8.4. The scaffold unit shall be suspended from metal outriggers, iron brackets, wire rope slings or iron hooks which will safely support the maximum intended load. **(T-0)**

17.8.5. Outriggers, when used, shall be set with their webs in a vertical position, anchored to the building or structure and provided with stop bolts at each end. **(T-0)**

17.8.6. The scaffold shall be supported by wire rope conforming with paragraph **17.3.20** and suspended from overhead supports. **(T-0)** Free ends of suspension wire ropes shall be equipped with proper size thimbles, secured by splicing or other equal methods. **(T-0)** Running ends shall be securely attached to the hoisting drum, and at least four (4) turns of rope shall remain on the drum at all times. **(T-0)**

17.8.7. When two (2) or more scaffolds are used on a building or structure, they shall not be bridged one to the other, but shall be maintained at even height with platforms butting closely. **(T-0)**

17.8.8. Scaffolds shall only be installed or moved under the control of the on-site supervisor IAW designs and instructions of the structural or civil engineer. **(T-0)**

17.9. Single-Point Adjustable Suspension Scaffolds.

17.9.1. Scaffolding, including power units or manually operated winches, shall be tested and listed by Underwriters Laboratories or Factory Mutual Engineering Corp. **(T-0)**

17.9.2. Power units may be either electrically or air motor driven.

17.9.3. Power-operated gears and brakes shall be enclosed. In addition to the normal operating brake, power driven units must have an emergency brake which engages automatically when the normal speed of descent is exceeded. **(T-0)**

17.9.4. Guards, midrails and toeboards will completely enclose the cage or basket. **(T-0)** Guardrails shall be no less than 2 by 4 inches or the equivalent installed no less than 36 inches nor more than 42 inches above the platforms. **(T-0)** Midrails shall be 1 by 6 inches or the equivalent, installed equal distance between the guardrail and the platform. **(T-0)** Toeboards shall be a minimum of four (4) inches in height. **(T-0)** Each worker shall be protected by a personal fall arrest system. **(T-0)** The system shall be attached to substantial members of the structure (not the scaffold), or to securely rigged lines, which will safely suspend the worker in case of a fall. **(T-0)**

17.9.5. The hoisting machines, cables and equipment shall be regularly serviced and inspected after each installation and every 30 days thereafter. **(T-0)**

17.9.6. The units may be combined to form a two-point suspension scaffold. This type scaffold shall comply with paragraph **17.7** **(T-0)**

17.9.7. The supporting cable shall be straight for its entire length. **(T-0)** The operator shall not sway the basket or fix the cable to any intermediate points to change the original path of travel. **(T-0)**

17.9.8. Equipment shall be maintained and used IAW the manufacturer's instructions. **(T-0)**

17.9.9. Suspension methods shall conform to applicable provisions of paragraphs **17.6** and **17.7** **(T-0)**

17.10. Boatswains' Chairs. The chair seat shall not be less than 12 by 24 inches and of 1-inch thickness. **(T-0)** The seat shall be reinforced on the underside to prevent the board from splitting. **(T-0)**

17.10.1. The two (2) fiber rope seat slings shall be of 5/8-inch diameter, reeved through the four (4) each seat holes so as to cross each other on the underside of the seat. **(T-0)** Seat slings shall be of at least 3/8-inch wire rope when a worker is conducting a heat-producing process such as gas- or arc-welding. **(T-0)**

17.10.2. A personal fall arrest system shall be in place and used to protect the worker when using a boatswain's chair. **(T-0)** The lifeline shall be attached to substantial members of the structure (not the scaffold), or to securely rigged lines, which will safely suspend the worker in case of a fall. **(T-0)**

17.10.3. The tackle shall consist of correct size ball bearing or bushed blocks and properly spliced 5/8-inch diameter first-grade manila rope, or other rope which will satisfy the criteria, e.g., strength and durability of manila rope. **(T-0)**

17.10.4. Roof irons, hooks or the object to which the tackle is anchored shall be securely installed. **(T-0)** Tiebacks, when used, shall be installed at right angles to the face of the building and fastened to a chimney. **(T-0)**

17.11. Carpenters' Bracket Scaffolds.

17.11.1. Brackets shall consist of a triangular wood frame not less than 2 by 3 inches in cross section or of metal or equal strength material. **(T-0)** Each part shall be properly fitted and securely jointed. **(T-0)** Each bracket shall be attached to the structure by one of the following methods:

17.11.1.1. A bolt no less than 5/8 inch in diameter shall extend through the inside of the building wall. **(T-0)**

17.11.1.2. A metal stud attachment device. **(T-0)**

17.11.1.3. Welding to steel tanks. **(T-0)**

17.11.1.4. Hooking over a well-secured and strong supporting member. **(T-0)** Brackets shall be spaced no more than 10 feet apart. **(T-0)**

17.11.2. No more than two persons shall occupy any given 10 feet of a bracket scaffold at any one time. **(T-0)** Tools and materials shall not exceed 75 pounds. **(T-0)**

17.11.3. The platform shall consist of at least two 2- by 9-inch nominal size planks extending not more than 18 inches or less than 6 inches beyond each end support. **(T-0)**

17.12. Bricklayers' Square Scaffolds. The squares shall not exceed five (5) feet in width and five (5) feet in height. **(T-0)**

17.12.1. The squares shall be reinforced on both sides of each corner with 1- by 6-inch gusset pieces. **(T-0)** They shall also have braces 1 by 8 inches on both sides running from center to center of each part, or other methods to obtain equal strength and rigidity. **(T-0)**

17.12.2. The squares shall be set not more than five (5) feet apart for medium duty scaffolds, and not more than eight (8) feet apart for light duty scaffolds. **(T-0)** Bracing, 1 by 8 inches, extending from the bottom of each square to the top of the next square, shall be provided on both front and rear sides of the scaffold. **(T-0)**

17.12.3. Platform planks shall be at least 2- by 9-inch nominal size. **(T-0)** The ends of the planks shall overlap the bearers of the squares and each plank shall be supported by not less than three squares. **(T-0)**

17.12.4. Bricklayers' square scaffolds shall not exceed three (3) tiers in height and shall be constructed and arranged so one square will rest directly above the other. **(T-0)** The upper tiers will stand on a continuous row of planks laid across the next lower tier and be nailed down or otherwise secured to prevent displacement. **(T-0)**

17.13. Horse Scaffolds. Horse scaffolds shall not be constructed or arranged more than two tiers and shall not exceed 10 feet in height. **(T-0)** Horses shall be spaced not more than five (5) feet apart for medium duty and not more than eight (8) feet apart for light duty. **(T-0)**

17.13.1. When arranged in tiers, each horse shall be placed directly over the horse in the tier below. **(T-0)**

17.13.2. On scaffolds arranged in tiers, the legs shall be nailed down to the planks to prevent movement and each tier shall be cross braced. **(T-0)**

17.13.3. Horses or parts which have become weak or defective shall not be used. **(T-0)**

17.14. Needle Beam Scaffolds.

17.14.1. Metal beams or equal material used in scaffolding shall conform to paragraph **17.3.4** **(T-0)**

17.14.2. Ropes or hangers shall be provided for supports. **(T-0)** The span between supports on the needle beam shall not exceed 10 feet for 4- by 6-inch timbers. **(T-0)** Rope supports shall be equivalent in strength to 1-inch diameter first-grade manila rope. **(T-0)**

17.14.3. Ropes shall be attached to the needle beams by a scaffold hitch or a properly made eye splice. **(T-0)** The loose end of the rope shall be tied by a bowline knot or by a round turn and one-half-hitch. **(T-0)**

17.14.4. The platform span between the needle beams shall not exceed eight (8) feet when using 2-inch scaffold plank. **(T-0)** For spans greater than eight (8) feet, platforms shall be designed based on requirements for the special span. **(T-0)** The overhang of each end of the platform planks shall not be less than 1 foot and not more than 18 inches. **(T-0)**

17.14.5. When one needle beam is higher than the other, or when the platform is not level, the platform shall be secured against slipping. **(T-0)**

17.14.6. Unattached tools, bolts and nuts used on needle beam scaffolds shall be kept in suitable containers. **(T-1)**

17.14.7. One end of a needle beam scaffold may be supported by a permanent structural member conforming to paragraph **17.3.4** **(T-0)**

17.14.8. Each person working on a needle beam scaffold 20 feet or more above the ground or floor and working with both hands shall be protected by a personal fall arrest system. **(T-0)**

The lifeline shall be securely attached to substantial members of the structure (not the scaffold), or to securely rigged lines, which will safely suspend the worker in case of a fall. **(T-0)**

17.15. Plasterers, Decorators and Large Area Scaffolds. Plasterers, decorators, lathers and ceiling workers inside scaffolds shall be constructed IAW the general requirements set forth for independent wood pole scaffolds. **(T-0)** Platform planks shall be laid with the edges close together. **(T-0)** When independent pole scaffold platforms are erected in sections, the sections shall be provided with connecting runways equipped with guardrails. **(T-0)** Refer to 29 CFR 1910.27 for additional information.

17.16. Interior Hung Scaffolds.

17.16.1. Interior hung scaffold shall be hung or suspended from the roof structure or substantial ceiling beams. **(T-0)**

17.16.2. The suspended steel wire rope shall conform to paragraph **17.3.20**. **(T-0)**

17.16.3. For hanging wood scaffolds, the following minimum nominal size material is recommended:

17.16.3.1. Supporting bearers 2 by 9 inches on edge. **(T-0)**

17.16.3.2. Planking 2 by 9 inches or 2 by 10 inches, with a minimum span of 7 feet for heavy duty and 10 feet for light or medium duty. **(T-0)**

17.16.3.3. Steel tube and coupler parts may be used for hanging scaffolds providing both types of scaffold are designed to sustain a uniformly distributed working load equivalent to heavy duty scaffold loads with a safety factor of four (4). **(T-0)**

17.16.3.4. When a hanging scaffold is supported by wire rope, the rope shall be wrapped at least twice around the supporting members and twice around the bearers of the scaffold. **(T-0)** Each end of the wire rope shall be secured by at least three (3) standard wire rope clips. **(T-0)**

17.16.3.5. Overhead supporting members shall be inspected and checked for condition and strength before the scaffold is erected. **(T-0)**

17.17. Ladder-Jack Scaffolds. Ladder-jack scaffolds shall be limited to light duty and shall not exceed a height of 20 feet above the floor or ground. **(T-0)** Scaffold loads shall not exceed ladder safe working load. **(T-0)** They shall be designed and constructed as specified in **Chapter 7. (T-0)**

17.17.1. The ladder jack shall bear on the side rails in addition to the ladder rungs, or if bearing on rungs only, the bearing area shall be at least 10 inches on each rung. **(T-0)**

17.17.2. Ladders used in conjunction with ladder jacks shall be placed, fastened, held or equipped with devices to prevent slipping. **(T-0)**

17.17.3. Wood platform planks shall not be less than two (2) inches nominal in thickness. **(T-0)** Both metal and wood platform planks shall overlap the bearing surface not less than 12 inches. **(T-0)** The span between supports for wood shall not exceed eight (8) feet. **(T-0)** Platform width shall not be less than 18 inches. **(T-0)**

17.17.4. Not more than two (2) persons shall occupy any given eight (8) feet of any ladder jack scaffold at any time. **(T-0)**

17.18. Window-Jack Scaffolds. Window-jack scaffolds shall be used only for working at the window opening through which the jack is placed. **(T-0)** These scaffolds shall not be used to support planks placed between one window jack and another or for supporting other elements of scaffolding. **(T-0)** Window-jack scaffolds shall be provided with guardrails unless a personal fall arrest system is provided for the worker. **(T-0) Note:** Window-jack scaffolds shall be used by one person only. **(T-0)**

17.19. Roofing Brackets. Roofing brackets shall fit the pitch of the roof. **(T-0)** Brackets shall be secured in place by nailing in addition to the pointed metal projections. **(T-0)** The nails shall be driven full length into the roof. **(T-0)** When rope supports are used, they shall consist of first-grade manila of at least ¾-inch diameter, or equivalent. **(T-0)** A catch platform shall be installed below the working area of roofs which are more than 20 feet from the ground to the eaves and have a slope greater than 3 inches in 12 inches without a parapet. **(T-0)** The platform width shall extend two (2) feet beyond the projection of the eaves and shall be provided with a safety rail, midrail and toeboard, unless workers on such roofs are protected by personal fall arrest systems. **(T-0)**

17.20. Crawling Boards or Chicken Ladders. Crawling boards shall be at least 10 inches wide and 1 inch thick. **(T-0)** Cleats shall be 1 by 1-1/2 inches, equal in length to the width of the board and spaced at equal intervals not to exceed 24 inches. **(T-0)** Nails shall be driven through and clinched on the underside. **(T-0)** The crawling board shall extend from the ridge pole to the eaves when used in connection with roof construction, repair or maintenance. **(T-0)** A firmly fastened lifeline of at least ¾-inch rope shall be strung beside each crawling board for a handhold. **(T-0)** Crawling boards shall be secured to the roof by ridge hooks or equally effective means. **(T-0)**

17.21. Float or Ship Scaffolds. A float or ship scaffold is a suspension scaffold consisting of a braced platform resting on two (2) parallel bearers and hung from overhead supports by ropes of fixed length. **(T-0)** Float or ship scaffolds shall be limited to no more than three (3) workers and a few light tools, such as those needed for riveting, bolting and welding. **(T-0)** They shall be constructed IAW sub-paragraphs below. **(T-0)** Substitute design and materials are permitted, provided equal strength, stability and safety are ensured.

17.21.1. The platform shall not be less than 3 feet wide and 6 feet long, made of ¾-inch plywood, equivalent to American Plywood Association Grade B-B, Group 1, Exterior. **(T-0)** Under the platform, there shall be 2 supporting bearers made from 2- by 4-inch or 1-by 10-inch rough, selected lumber, or better. **(T-0)** They shall be free of knots or other flaws and project six (6) inches beyond the platform on both sides. **(T-0)** The ends of the platform shall extend about six (6) inches beyond the outer edges of the bearer. **(T-0)** Each bearer shall be fastened to the platform. **(T-0)**

17.21.2. A wood edging not less than ¾ by 1½ inches, or equal, shall be placed around all sides of the platform to prevent tools from rolling off. **(T-0)**

17.21.3. Supporting ropes shall be 1-inch diameter manila rope or equal, free from deterioration, chemical damage, flaws or other imperfections. **(T-0)** Rope connections shall be such that the platform cannot shift or slip. **(T-0)** If two ropes are used with each float, they shall be arranged to provide four (4) ends which are fastened to an overhead support. **(T-0)** Each of the two (2) supporting ropes shall be hitched around one end of a bearer and pass under the platforms to the other end of the bearer where it is hitched again, leaving enough rope at each end for the supporting ties. **(T-0)**

17.21.4. Each worker shall be protected by a personal fall arrest system. **(T-0)** The lifeline shall be attached to substantial members of the structure (not the scaffold) or to securely rigged lines, which shall safely suspend the worker in case of a fall. **(T-0)**

Chapter 18

HYRDROCARBON FUELS

18.1. Scope. This chapter covers the hazards, applications and safety protocols associated with hydrocarbon fuels.

18.1.1. Hydrocarbon fuels consist of aviation fuels, kerosene type fuels, octane, benzene and other natural gas composites used in the Air Force. Hydrocarbon fuels are a fat solvent, which can irritate skin. Fuels such as gasoline, kerosene, diesel and fuel oils have similar characteristics and warrant the same degree of safety as aviation fuels.

18.1.2. TO 42B-1-1, *Quality Control Fuels and Lubricants,* provides the military specifications for fuels. Refer to TO 42B-1-1-14, *Fuels for USAF Aircraft,* for a complete description of aircraft fuel classifications, characteristics and use.

18.2. Hazards. Unexpected and unwanted ignition of fuels can cause fires and explosions which may result in property damage, injury and/or loss of life. Ignition sources include open flames such as matches and cigarette lighters, cutting and welding sparks, static electricity, electrical arcing and lightning. Support equipment being operated in any fuels area shall meet the requirements of AFMAN 24-306, *Operation of Air Force Government Motor Vehicles,* and TO 36-1-191, *Technical and Managerial Reference for Motor Vehicle Maintenance.* **(T-0)**

18.2.1. Chemical Properties. Hydrocarbon fuels are insoluble in water, are soluble in many organic components and are excellent solvents for many organic materials. These fuels are chemically stable and insensitive to shock. Some dyes used in gasoline products are light sensitive and must be handled with minimum exposure to light to prevent change of color. Air Force fuels demonstrate good thermal stability over a wide range of ambient storage temperatures, but extreme temperature or prolonged storage will accelerate oxidation, gum and sediment formation. Hydrocarbon fuels react with strong oxidizers, and this reaction is accelerated at higher pressures and/or temperatures.

18.2.2. Ignition Hazard. Oxygen comprises approximately 21 percent by volume of the total atmospheric air. Leaks in oxygen gas storage cylinders or cryogenic generators can raise the oxygen level of air. Oxygen at concentrations of 16 percent or less will not support combustion. Hydrocarbon fuel vapors can create an explosive atmosphere (lower explosive limit 1 percent, upper explosive limit 7 percent, by volume). The ignition susceptibility of the fuel varies with flashpoint, pressure and the specific type of fuel. Hydrocarbon fuel fires may be both air-supported and other-oxidizer-supported. The rate of fuel evaporation increases with a rise in temperature. A mixture below lower explosive limits is too “lean” to burn and a mixture above the upper flammable and/or explosive range is too “rich” to burn.

18.2.3. Sources of Ignition.

18.2.3.1. Static Electricity. Static electricity can occur when fuel is stable (not flowing) or flowing. Static electricity can build up by the slightest movement in a stable environment, e.g., in a fuel tank or cell, container, etc. Fuel flowing through hoses or pipe systems can generate an electrostatic charge over 20,000 volts, sufficient to cause an arc or spark when touched. A conductivity additive in JP-4 and JP-8 minimizes static buildup during fuel flow. **Warning:** The additive reduces, but does not eliminate, static electricity in fuel flowing through hoses or pipes.

18.2.3.2. Clothing containing more than 65 percent nylon, rayon, wool or polyester shall not be worn as outer garments when working with/around low flash point fuels. **(T-0)** Flak vests shall not be worn during aircraft fuel servicing operations or during fuel operations where low flashpoint vapors may be present. **(T-1)** In all cases, a worker wearing a flak vest will always ground or bond him- or herself when approaching an aircraft and prior to beginning work. **(T-1)** If no spark occurs during bonding or grounding, normal work may begin. However, if a spark does occur during bonding or grounding, the worker will ground or bond him or herself frequently during all work phases. **(T-1) Note:** Commanders may authorize wear of body armor/flak vests and Gortex-type clothing in combat areas. **(T-2)** Outer garments shall not be removed or put on in the work area. **(T-0)** Matches or lighters shall not be handled or removed from pockets. **(T-0)**

18.2.4. Sources of Static Electricity.

18.2.4.1. The filter-separator unit generates static electricity when fuel flows through tiny filter openings (filtration). Workers should wait at least 30 seconds after flow stops so the static charge can dissipate from the filter before removing bonding connections, etc. **(T-0)**

18.2.4.2. Aircraft refuelers and petroleum transport vehicles. The filter separator installed on bottom and/or top loading fillstands and wire screens or line strainers, which have small openings, generate static charges. Screens with a pore size less than 300 micron with 50 mesh per inch can create static charges. Movement of fuel through piping or hose also generates static charges. Proper grounding and bonding are required to control static buildup and hazards. **(T-0)**

18.2.4.3. Avoid top loading refuelers from an overhead spout whenever possible. **(T-1)** An approved waiver will be obtained from the MAJCOM Occupational Safety office and Air Force Petroleum Office prior to performing top loading operations. **(T-1)** This method increases electrostatic charges when fuel freefalls through air and agitates fuel in the tank. If top loading is necessary, extend the filling spout to the bottom of the tank and keep submerged during the entire operation to reduce the static generation.

18.2.4.3.1. Bottom loading of refuelers minimizes fuel turbulence. For this reason, ensure permanent fuel storage tanks systems are designed for bottom loading. **(T-2)**

18.2.4.3.2. Regardless of the filling method used, danger signals such as crackling and hissing sounds indicate the presence of dangerous levels of static electricity. If this occurs, immediately stop filling operations and evacuate personnel until the static charge has dissipated. Identify and eliminate the cause of the static buildup before resuming operations. **(T-0)**

18.2.4.4. Support equipment can develop a static charge while parked due to movement of dust particles and air currents or during periods of thunderstorm activity.

18.2.4.5. Grounding and/or bonding requirements in TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding,* TO 42B-1-1, and TO 37-1-1, *Operation, Inspection, and Maintenance of Permanently Installed Fuel Storage and Dispensing Systems*, shall be followed. Remove or replace all static grounds with resistances of more than 10,000 ohms, and repair and retest damaged static grounds. Static grounds do not require periodic retest. **(T-1)**

18.2.5. Toxicity. Hydrocarbon fuels can irritate skin. Repeated contact can cause scaling, defatting, fissuring and blistering of the skin. Inhalation of vapor can irritate the upper respiratory tract and depress the central nervous system, resulting in depression, dizziness, headaches, anesthesia, coma or death. Aspiration causes severe lung irritation with coughing, gagging and rapidly developing pulmonary edema, which can progress to bronchopneumonia and death. Ingestion causes irritation of mucous membranes of throat, esophagus and stomach, followed by depression of the central nervous system.

18.2.6. Exposure to Fuel Additives. Air Force fuels may contain benzene. Benzene is present in both gasoline-based and kerosene-based fuels. **Note:** JP series fuels do not contain tetraethyl lead. All fuels contain benzene to some degree (0.1 to 5 percent by volume). Aviation gasoline usually contains higher concentrations of benzene than does heavier distillate fuels. However, benzene is toxic even in low concentrations. This is particularly true in confined spaces such as petroleum storage tanks. Fuels laboratories, listed in TO 42B-1-1, can analyze fuel for benzene content.

18.2.7. Asphyxiation and Confined Space. Hydrocarbon fuel vapors will displace oxygen in enclosed spaces and pits and may cause death due to asphyxiation. Refer to **Chapter 23**, *Confined Spaces,* for additional guidance.

18.3. General Requirements.

18.3.1. Fuel Spill Classifications. Fuel spill classification and emergency procedures are described in TO 00-25-172. Cleanup procedures shall be established IAW the installation environmental management office guidance. **(T-0)**

18.3.2. Training.

18.3.2.1. AFI 90-821, *Hazard Communication (HAZCOM) Program*, provides specific training requirements for personnel engaged in handling or use of hazardous materials. Employees working with fuels shall be trained IAW AFI 90-821. **(T-0)**

18.3.2.2. Ensure individuals exposed to petroleum products understand the hazards of static electricity. **(T-0)**

18.3.2.3. Ensure fuels handling personnel are trained in fire prevention and protection as it relates to their particular duties. Refer to **Chapter 6,** *Fire Protection and Prevention*, for additional guidance and information. **(T-0)**

18.3.2.4. Operations involving the handling, transfer or storage of hydrocarbon fuels normally require a minimum of two persons who are knowledgeable of fuel safety and operational procedures. **(T-1)** Refer to AFI 23-201, *Fuels Management*, for guidance on the two-person policy.

18.3.2.5. Ensure personnel are trained to prevent hydrocarbon fuels and propellant oxidizers being spilled in the same area. **(T-0)** If such a spill does occur and if the oxidizer is water soluble, flood the oxidizer with water to dilute it and help reduce the risk of an explosion or fire. **(T-0)** Notify the installation FES Flight when a fuel spill or oxidizer spill occurs. **(T-1)**

18.3.3. Petroleum Storage Tank Entry. UFC 3-460-03, *O&M: Maintenance of Petroleum Systems,* covers this subject in detail and shall be used as definitive guidance on all tank entry tasks. **(T-0)** **Chapter 23** also provides confined space guidance.

18.3.4. First Aid. Personnel shall take the following steps if hydrocarbon fuels are splashed or spilled onto them:

18.3.4.1. Remove contaminated clothing as soon as possible and wash affected skin areas with soap and water. Thoroughly air and launder contaminated clothing before it is worn again. Do not place contaminated clothing in lockers or other confined spaces. Hang clothing in a safe area away from fire and heat, and allow it to air dry. **(T-0)**

18.3.4.2. If fuel is splashed into the eyes, immediately flush the eyes with water continuously for at least 15 minutes; then seek medical attention. **(T-0)** Refer to **Chapter 9,** *Emergency Shower and Eyewash Units,* for guidance on emergency shower and eyewash units.

18.3.4.3. If fuel is swallowed, do not induce vomiting. **(T-0)** Seek medical assistance as soon as possible.

18.4. Fuel Storage Systems.

18.4.1. Safety Features. New construction, alteration and/or modification of petroleum facilities shall conform to UFC 3-460-01, *Design: Petroleum Fuel Facilities,* as well as all other applicable Air Force specifications and directives. **(T-0)** Existing facilities, unless hazards are present, are not required to meet current Air Force specifications or directives until a modification or alteration is planned. **(T-1)**

18.4.1.1. Access. Where necessary, pit covers shall be altered or replaced to provide free and unobstructed access. **(T-0)** Fuels Management in conjunction with Water Fuel Management personnel shall determine which pits are essential to the operation and control of the system. **(T-2)** Nonessential pits, or pits that can be made nonessential, shall be filled with sand to eliminate vapor hazards. **(T-1)** Essential pits shall be kept clean, dry and vapor-free. **(T-0)** Pit covers shall be closed except when in use or work is being done in the pit. **(T-0)**

18.4.1.2. Ventilation.

18.4.1.2.1. Adequate ventilation shall be provided for below-grade pump houses and deep pits to prevent accumulation of explosive vapor hazards. **(T-0)** Opening pit covers normally provides sufficient ventilation only for shallow pits and hand holes, but this must be consistent with BE's occupational and environmental health risk assessment. **(T-0)**

18.4.1.2.2. Entry into confined spaces and pits where oxygen may be displaced by fuel vapors shall be according to master entry plans and permits issued in compliance with **Chapter 23.** Contact BE for specific ventilation requirements. **(T-1)**

18.4.1.3. Drainage. Gravity drains or pumps shall be provided to control water in pits. **(T-1)** Drains from pits and/or pump house floors will not be connected to sanitary or storm sewer systems, unless permitted by the installation Environmental Management office. **(T-1)** Contact BE for an occupational and environmental health risk assessment.

18.4.1.4. Piping System Identification. Piping systems shall be color coded to aid in identifying the contents of piping in fuel storage areas. **(T-0)** Yellow shall be used as a primary warning for all flammable gases and liquids, and black and white shall be used for identification of contents. Refer to MIL-STD-161H, *Identification Methods for Bulk*

Petroleum Products Systems Including Hydrocarbon Missile Fuels, and **Chapter 20,** *Safety Color Coding, Labeling and Marking for Piping Systems,* for additional guidance. **(T-0)**

18.4.2. Safety Procedures.

18.4.2.1. Bond fuel transport vehicles, e.g., tank trucks, to the offloading header to dissipate static electricity charges generated during the handling operations. **(T-0)**

18.4.2.2. Place a drip pan under the outlet of each railroad tank car or transport truck before the dust or outlet cap is removed to collect any fuel leaked through the main valve during transportation. **(T-0)**

18.4.2.3. During transfer of fuel into an off-loading header, check the receiving tank for sufficient ullage before beginning the transfer. **(T-0) Warning:** Ensure the initial flow-rate does not exceed three (3) feet per second and is maintained until the liquid level is one (1) foot above the inlet level or until the pan or roof of the aboveground storage tank is floating freely. **(T-0)** Allow a minimum waiting time of 30 minutes for electrostatic charges to dissipate before performing manual gauging or temperature measurement. **(T-0)**

18.4.2.3.1. Make sure the gauging tape remains in contact with the gauging hatch to provide an electrical bond and prevent electrostatic arcing. **(T-0)**

18.4.2.3.2. Upon completion of gauging or temperature measurements, slowly remove the tape from the tank while maintaining contact between gauging hatch and tape. **(T-0)**

18.4.2.4. Danger signs.

18.4.2.4.1. Place danger signs 50 feet in the front and rear of railroad tank cars or transport trucks prior to off-loading operations into bulk storage. **(T-0)** These signs are not required during bulk off-loading operations at installation service stations or off-loading operations within posted secured areas. **(T-1)** However, the Fuels Management Flight Chief may require special procedures for unique installations. **(T-2)**

18.4.2.4.2. Ensure danger signs are posted on the perimeter fence of fuel storage areas. **(T-0)** If unfenced, post signs 50 feet from the dike area or fuel vents of underground storage tanks, or as determined by BE, in conjunction with the installation Occupational Safety Office. **(T-0)** Signs shall state: ―No Open Flame or Ignition Source Beyond This Point,‖ and meet requirements in **Chapter 29,** *Mishap Prevention Signs and Tags*. **(T-0)** Signs may include a second language, if needed.

18.4.2.5. Ensure adequate fire protection equipment, e.g., fire extinguishers, grounding/bonding equipment, proper PPE and any other equipment required to prevent these hazards, is available before starting fuel handling operations to protect personnel from fuel vapor and static hazards. **(T-0)** Personnel shall not be allowed on above-ground receiving tanks during filling operations or within 30 minutes thereafter. **(T-0)**

18.4.2.6. Because fuel may be present, never use open flame or heating element to thaw frozen valves on tank cars and tank trucks.

18.4.2.7. Use a two-person policy during fuel receipts and transfers.

18.4.2.8. All local procedures and checklists for the movement of fuel shall include emergency shutdown procedures.

18.4.2.9. After changing a filter separator element, slowly fill the filter vessel by partially opening the inlet and outlet valves to displace trapped air. **(T-1)** The slower flow will reduce static charging of the fuel. Refer to TO 37A-1-101, *General Instructions – USAF Fuel, Water and Lubricant Dispensing Equipment,* for complete details on filling filter separators after element change. **(T-1)**

18.4.2.10. Before starting fuel transfer actions, establish intrinsically safe communications, such as hot line, radio, telephone, etc., between pipeline pump station, barge or tanker, and receipt location. **(T-0)** To ensure emergency shutdown capability, provide communications throughout the entire receipt. **(T-0)**

18.4.2.11. Keep the dike basin area free of vegetation. Containment dikes and basins shall be constructed IAW UFC 3-460-01. **(T-0)**

18.4.2.12. Tank water drains and dike drain valves shall be locked (closed position) when not in use. **(T-0)**

18.4.2.13. Watch draining floating roof water drains to ensure no fuel runs out with the water from a leak in the drain pipe. **(T-0)**When possible, secure roof water drains by lock after draining. **(T-0)**

18.4.2.14. Provide adequate lighting in petroleum areas for safe and secure night operations (1-footcandle in general areas; 2-footcandles on catwalks). **(T-0)** In areas classified as National Fire Protection Association hazardous locations, lighting fixtures and wiring must comply with the requirements of National Fire Protection Association 30, *Flammable and Combustible Liquids Code,* and National Fire Protection Association 70, *National Electric Code*. **(T-0)**

18.4.3. Truck Fillstand Operations.

18.4.3.1. Position the fuel servicing vehicle to prevent placing a strain on fillstand components. **(T-1)**

18.4.3.2. Set the vehicle parking brake and chock the rear wheels. **(T-0)**

18.4.3.3. Bond the vehicle to the fillstand by connecting the vehicle conductor reels to a bonding receptacle on the fillstand. **(T-0)** When a hose cart or hydrant servicing vehicle is used as a fillstand, the hose cart or hydrant servicing vehicle operator shall bond the hose cart or hydrant servicing vehicle to the hydrant outlet piping. **(T-0)** The refueling unit operator shall bond the refueling unit to the hose cart or hydrant servicing vehicle. **(T-0)**

18.4.3.3.1. Fuel servicing vehicles that have the Scully overfill protection in cab power switch installed and an Intellitrol fillstand system may use the Sculcon cable on the fillstand as an approved ground/bond. **(T-1)**

18.4.3.3.2. Fuel servicing vehicles that do not have the Scully in cab power switch installed and still have the paddle switch on the bottom loader that activates the Scully system will need to be grounded/bonded to the fillstand using the grounding/bonding reel installed on the vehicle. **(T-0)**

18.4.3.4. Push the stop switch on the fillstand to ensure the transfer pump is not operating when the system does not have a deadman control installed. **(T-0)** This ensures the loading arm or hose is not pressurized prior to connecting to the vehicle and will avoid a possible fuel spill.

18.4.3.5. When beginning filling operations, the operator shall open appropriate fuel transfer valves, turn on the pump and check for leaks. **(T-0)**The operator shall check the bottom loading automatic shutoff device by pushing the test button on R-9 or R-11 refuelers during the first 500 gallons of fuel pumped into the vehicle, if equipped. **(T-0)**

18.4.3.6. Refueling vehicles equipped with a bottom loader and automatic shutoff valve do not require a person on top of the vehicle during loading. **(T-0)** Refer to **Chapter 13,** *Fall Protection,* and **Chapter 24,** *Aircraft Flightline – Ground Operations and Activities,* for proper fall protection precautions and requirements. **(T-0)**

18.4.3.7. When filling is complete, disengage the fuel storage system nozzle from the vehicle and obtain required forms from the bulk storage operator. **(T-0)** The operator shall conduct a "walk-around" inspection, check for leaks, remove the ground cable and wheel chocks, before departing the area. **(T-0)**

18.4.3.8. All fillstands shall be equipped with an emergency shutdown switch capable of stopping all associated transfer pumps in the event of a fire or other mishap. **(T-0)** Identify the emergency switch and ensure all personnel are familiar with its location. **(T-0)** Inspect the fillstand emergency shutdown switch during system checkout and activate it with the system operating at least every 30 days to ensure proper operation. **(T-1)** Refer to TO 37-1-1, General Operation and Inspection of Installed Fuel Storage and Dispensing Systems, for additional information.

18.4.4. Railroad Tank Car Operations. When unloading tank cars through bottom valve arrangement into installation bulk storage systems:

18.4.4.1. Isolate railroad tank car off-loading tracks (spur) from main tracks and ground them. **(T-0)** The off-loading header need not be grounded to the tank car since there is electrical continuity through the rail and tank car body. **(T-0)** The grounded railroad spur shall be checked to ensure a resistance reading of 10,000 ohms or less. **(T-0)**

18.4.4.2. Tank cars being loaded with aviation fuels or Mogas shall be bonded to the loading facilities. **(T-0)**

18.4.4.3. Insulate the railroad spur from the adjoining railroad track serving the rest of the installation by means of insulation blocks. **(T-0)** Bond each of the rails on both sides of the track by electrical connectors. **(T-0)** Connect the insulated and bonded tracks and ground them to the same grounding point with the piping at each unloading manifold. **(T-0)** The insulating and bonding of the tracks controls and discharges any static buildup.

18.4.5. Fueling Equipment Safeguarding.

18.4.5.1. Fuel servicing equipment parking areas shall be treated as above-ground fuels facilities and safeguarded accordingly. **(T-0)**

18.4.5.2. Fuel servicing equipment parking areas shall be paved, lighted and have sufficient slope to control drainage. **(T-0)** The parking area shall:

18.4.5.2.1. Have at least two entrances and/or exits to provide means for rapid egress should a hazardous situation develop. **(T-0)**

18.4.5.2.2. Be at least 100 feet from surrounding inhabited buildings and 50 feet from uninhabited buildings and taxiing aircraft. **(T-0)** See UFC 3-460-01 for further guidance and separation distances from other fixed facilities. **Note:** The 100-foot requirement may be modified for existing parking areas based on local conditions and the size, nature and importance of nearby buildings. **(T-0)** However, this separation distance will not be reduced below 50 feet. **(T-0)**

18.4.5.2.3. Maintain at least 25 feet center-to-center between fueling vehicles in parking areas. Vehicles shall be parked in single rows and be capable of driving into and out of parking positions in a single turn. **(T-0)**

18.4.5.2.4. Have sufficient firefighting equipment (portable or wheeled units) available and strategically located within the parking areas as required by the installation FES Flight.

18.4.5.3. Fuel Barge Operations. Locations that receive fuel by barges over waterways will adhere to requirements IAW 33 CFR Part 156 Subpart A, *Oil and Hazardous Material Transfer Operations*, Section 156.120, *Requirements For Transfer*. **(T-0)**

18.5. Fuel Servicing Operations.

18.5.1. Aircraft Servicing. Eliminate or control hazardous fuel vapors and ignition sources during any aircraft servicing operation. **(T-0)**

18.5.1.1. A fuel servicing safety zone shall be established during all fueling or defueling operations IAW TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding*. **(T-0)**

18.5.1.2. All support equipment not required in fueling or defueling operations or in concurrent fueling, maintenance or cargo-handling operations shall be moved outside the fuel servicing safety zone. **(T-0)** Position the equipment so a clear path is maintained to permit rapid evacuation of vehicles and personnel in an emergency. **(T-0)**

18.5.1.2.1. Aerospace Ground Equipment (AGE) shall be monitored and a Class B fire extinguisher shall be available in the immediate vicinity when the unit is operating in a fuel servicing safety zone. **(T-0)**

18.5.1.2.2. On flightlines with minimum aircraft separation, e.g., 10-15 feet wing tip to wing tip, and where ramp space is limited, powered support equipment such as generators, air conditioners and air compressors may be left in place if shut down and disconnected from the aircraft. **(T-0)**

18.5.1.2.3. When practical, mark support equipment parking locations on the ramp.

18.5.1.2.4. Powered support equipment that is not explosion-proof but required for aircraft fueling and defueling shall be parked the full length of the approved power cable from the aircraft and kept outside the fuel servicing safety zone. **(T-0)** The full length of the approved cable or air-start duct shall be maintained between the fueling point or vents to fighter aircraft. **(T-0)** Consider wind direction, ramp slope, locations of aircraft fuel overflow vents, location of servicing unit or fueling hydrant, and

mechanical strain on the power receptacle when using powered support equipment. **(T-0)**

18.5.1.2.5. The power unit brakes shall be applied and, if necessary, because of ramp slope, also chocked. Only approved cables shall be used with the power unit. **(T-0)**

18.5.1.2.6. Auxiliary power units shall not be parked under any part of an aircraft. **(T-0)**

18.5.1.3. Aircraft shall not be fueled or defueled inside any hangar or facility until a System Safety Engineering Analysis has been conducted. Specific facilities that already have an approved System Safety Engineering Analysis can be found in TO 00-25-172, Table 4.2. **(T-0)**

18.5.1.4. The Aircraft Servicing Supervisor shall ensure compliance with requirements of this standard, TO 00-25-172 and specific weapon system TOs; ensure a current checklist is used; know the type and quantity of fuel required; and ensure the proper number of people are present, briefed (to include emergency procedures) and positioned properly prior to the start of the operations. **(T-0)**

18.5.1.4.1. Ensure a fire guard is assigned during refueling and defueling operations. **(T-0)** A maintenance crew member shall be responsible for coupling the fueling nozzle to the single-point receptacle and assuring it is locked in place. **(T-0)**

18.5.1.4.2. For C-5 aircraft, the refueling equipment operator may perform the function of the maintenance crew member, to include monitoring the single point nozzle(s) during the fuel servicing, with installation commander approval. Refer to TO 00-25-172 for additional guidance. **(T-1)**

18.5.1.5. Fuels operators are responsible for performing the mission in a safe manner. **(T-0)** The operator shall continually monitor the equipment for sparks and other ignition sources, unusual noises and other indications of possible malfunctions. **(T-0)** Servicing shall be stopped immediately if the operator determines it is unsafe. **(T-0)** When using hydrant systems, all operating personnel shall know the location and proper use of the system emergency shutoff switch. **(T-0)**

18.5.1.5.1. Servicing aircraft with the wrong fuel can be catastrophic. Fueling personnel shall ensure aircraft receive the proper fuel. **(T-0)**

18.5.1.5.2. All transient alert and maintenance control personnel shall state both the type of aircraft and the fuel desired when requesting support from the fuels service center. **(T-1)**

18.5.1.5.3. Refueling drivers shall verify, prior to commencing any refueling operation, that the type of aircraft to be serviced is the same type aircraft specified on the refueling dispatch log. **(T-1)**

18.5.1.5.4. Refueling personnel and the maintenance crew chief shall ensure the fuel in the servicing unit, as indicated on the unit, is the correct type of fuel required for the aircraft to be fueled, as indicated by the TO, aircraft decals or other positive means. **(T-1)** Similar precautions are required when refueling units are refilled from bulk sources. **(T-1)**

18.5.2. Aircraft Fueling and Defueling by Truck. In addition to the general servicing safety precautions and standards, the following procedures shall be followed when servicing aircraft from fuel trucks.

18.5.2.1. Keep as much distance as possible between aircraft being fueled and other aircraft, at least 20 feet from the fuel servicing safety zone between aircraft (wingtip to wingtip) to be serviced and other aircraft, except for fighter, trainer and light cargo types, which may be within 10 feet (wingtip to wingtip) of each other's fuel servicing safety zone. **(T-0)** In positioning the tank truck and the aircraft, place them so the fuel vapor will not be carried downwind toward a source of ignition. **(T-0)**

18.5.2.1.1. Do not drive or park fuel servicing vehicles under any portion of an aircraft. **(T-1)** 18.5.2.1.2. However, fuel servicing vehicles with an elevated platform may be positioned under the wing of aircraft, provided there is ample clearance and the aircraft is configured for and actually performing under-the-wing fueling operations. **(T-1)** Alternatively, a maintenance platform shall be used when this type fuel servicing vehicle is not available. **(T-1)**

18.5.2.1.2.1. Fuel service vehicles will not be positioned closer than 10 feet from the aircraft, except for the following aircraft: A-10, C-5, C-17, C-130, E-4B, VC-25, Boeing 747, C-27 and U-2R aircraft only, the vehicle may be within 10 feet but no closer than 4 feet from the aircraft in any direction. **(T-1)** For C-5, C-17, E-4B, VC-25 and Boeing 747 aircraft, the fuel truck may be positioned as far under the wing as necessary for the fuel hose to reach the aircraft.

18.5.2.2. A spotter shall be used when backing refueling trucks toward the aircraft. **(T-1)** A chock shall be pre-positioned to act as a stop block to maintain proper aircraft and/or equipment separation. **(T-1)** When the truck is in position, the parking brake shall be set and all chocks installed. **(T-1)**

18.5.2.3. Aircraft wheel chocks, fabricated according to the applicable aircraft Dash-2 TOs, shall be placed fore and aft of the main landing gear or as specified in applicable aircraft TOs. **(T-1)** Vehicle chocks may be constructed as per Commercial Item Specification A-A-52475, or locally manufactured IAW TO 00-25-172. **(T-1)**

18.5.2.4. The operator shall monitor the control panel and be prepared to shut down fueling if a fuel leak or other malfunction occurs. **(T-1)**

18.5.2.5. Accomplish emergency shutdown IAW TO procedures. **(T-2)** For fuel spills, other than minor aircraft venting, the aircraft fuel servicing truck shall not be evacuated until the area is cleaned up and declared safe by the installation FES Flight. **(T-2)**

18.5.2.6. During defuel operations with units not equipped with an operable high level shutoff system, a person shall be stationed on the top of the refueling truck to observe the tank fuel level and signal the pump operator when full to prevent an overflow. **(T-1)** Units with inoperable high level shutoffs shall not be utilized unless mission essential. **(T-1)** Refer to **Chapter 13** and **Chapter 24** for proper fall protection precautions and requirements.

18.5.2.7. During multiple source refueling, refueling unit operators must continuously monitor fuel-flow meters to detect any indication of reverse fuel flow. **(T-0)** Caution: If

reverse flow occurs, operations shall be stopped immediately and not restarted until the cause(s) are determined and corrected. **(T-0)**

18.5.3. Aircraft Fueling and Defueling From Hydrant Systems.

18.5.3.1. Hydrant system fueling and defueling operations shall be supervised. **(T-1)** Hydrant system pump houses shall be manned IAW TO 37-1-1. **(T-1)** The hosecart/hydrant servicing vehicle operator shall hold the remote control switch, magnet lanyard or deadman control throughout the refueling operation. **(T-1)** Before fuel delivery begins, aircraft fuel tank caps shall be checked to ensure they are secure. **(T-0)** The hosecart/hydrant servicing vehicle hoses and valves are heavy and require more than one person to safely handle, especially during a hose evacuation malfunction. **(T-1)** To prevent damage, do not drag the hose or valve on the ramp. **(T-0)** Other members of the fuel servicing crew shall help the hosecart/hydrant servicing vehicle operator stow the hoses. **(T-1)**

18.5.3.2. On Type I and II systems, the operator shall ensure there is no pressure at the outlet prior to hooking up the "Moosehead" valve. **(T-1)**

18.5.3.3. The operator shall inspect the remote control cables to ensure they are hermetically sealed and serviceable when used. **(T-0)**

18.5.3.4. Hoses shall be pressurized and inspected for leaks prior to the first servicing of the day. **(T-0)**

18.5.3.5. Hoses shall be wrapped in a manner to prevent rubbing on hosecart tires or dragging on pavement. **(T-0)**

18.5.3.6. All personnel involved in the servicing operations shall know the location of hydrant emergency shutoff switches. **(T-0)**

18.5.4. Fueling New or Recently Repaired Aircraft Tanks or Tanks That Have Been Purged.

18.5.4.1. Aircraft fuel tanks/cells with nitrogen inerting systems may be filled at the normal rate of flow with the nitrogen system activated. **(T-0)**

18.5.4.2. Aircraft without a nitrogen inerting system must be fueled at the slowest possible flow rate until each fuel tank/cell is full or to the level dictated by the mission. **(T-0)**

18.5.5. Fueling From Drums. Refuel from drums IAW TO 00-25-172. Bond fuel containers and aircraft as when fueling from tank trucks or hydrants. **(T-0) Note:** Fueling from drums shall be accomplished only as an emergency measure. **(T-0)** Fueling from cans or "topping off" is particularly hazardous due to the potential for spills and static ignition. **(T-0)**

18.5.6. Ground Servicing Operations.

18.5.6.1. Aircraft fuel servicing hazards are also present when servicing support equipment, vehicles and organizational and/or support equipment tanks. Therefore, commanders, supervisors and operators must recognize that ground servicing operations warrant the same degree of attention to safety afforded aircraft servicing operations. **(T-2)** Refueling units in ground servicing operations shall be inspected for safety deficiencies per the locally established maintenance program. **(T-2)** Many aircraft operation procedures that contain fuels, vapors and prevent ignition also apply to ground operations.

18.5.6.2. Service Station Operations. Loading, storage and handling of fuels shall be IAW 29 CFR 1910.106(g), *Service Stations.* **(T-0)**

18.5.6.3. Support equipment, vehicles and organizational and/or support equipment tanks shall not be fueled within 50 feet of open flames or spark-producing devices. **(T-0)** Personnel shall not smoke during fueling operations and shall allow sufficient time for fuel vapors to dissipate after fueling is completed before smoking if fueling is conducted off the flightline. **(T-0)**

18.5.6.3.1. Personnel shall not operate portable electrical devices, e.g., cell phones, drills, flashlights, etc., during fueling operations unless the device is intrinsically safe or listed for use in a fuel vapor environment. **(T-0)**

18.5.6.3.2. Static charge may develop when the operator exits and re-enters the vehicle and ignite fuel vapors near the nozzle. Personnel should not re-enter the vehicle during the fueling operation unless they ground themselves prior to re-entering. **(T-0)**

18.5.6.3.3. Support equipment and vehicles shall be serviced outdoors, with engines turned off and with parking brakes engaged. **(T-0)**

18.5.6.3.4. During fueling, operators shall ensure the nozzle of the fuel hose is in constant contact with the filler pipe of the support equipment, tank and/or vehicle fuel tank, to provide an electrical bond. **(T-0)**

18.5.6.3.5. Nozzles used at attended/unattended motor vehicle service stations and fleet fueling sites shall be listed IAW National Fire Protection Association 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages,* and have automatic-closing type hose nozzles with a latch open device. **(T-0)** Nozzles used at attended/unattended marine motor fuel dispensing facilities/sites shall be listed IAW National Fire Protection Association 30A and have automatic-closing type hose nozzles without a latch open device. **(T-0)** Nozzles used for dispensing by gravity from tanks above the dispensing/delivery point shall only be a manually operated nozzle. **(T-0)**

18.5.6.3.6. Nozzles used on mobile support refueling equipment shall be automatic-closing type hose nozzles without a latch open device. **(T-0)**

18.5.6.3.6.1. Operating instructions shall be conspicuously posted in the dispensing area for unattended self-service stations. **(T-0)** The instructions shall include location of emergency controls and a requirement that user stay outside of their vehicle and in view of the fueling nozzle during dispensing operation. **(T-0)**

18.5.6.3.6.2. Emergency instructions shall also be conspicuously posted in the dispenser area. **(T-0)**The emergency instructions shall incorporate the following or equivalent wording:

18.5.6.3.6.2.1. Use emergency stop button. **(T-0)**

18.5.6.3.6.2.2. Report accident by calling (installation FES number) and report location. **(T-0)**

18.5.6.3.7. Fuel-dispensing systems including dispensers, hoses, nozzles, breakaway fittings, swivels, flexible connectors, dispenser emergency shutoff valves, vapor

recovery systems and pumps that are used for alcohol blended motor fuels greater than 15 percent alcohol content shall be listed or approved for the specific purpose. **(T-0)**

18.5.6.3.8. All compressed natural gas, liquefied natural gas and liquefied petroleum gas refueling dispensers, hoses, nozzles, breakaway fittings, swivels and flexible connectors, dispenser emergency shutoff valves, vapor recovery systems and pumps shall be listed or approved for the specific purpose. All compressed natural gas, liquefied natural gas and liquefied petroleum gas motor vehicle fuel dispensing shall be in an outdoor location. **(T-0)**

18.6. Fuel Laboratory Operations.

18.6.1. Fuels Handling and Laboratory Personnel.

18.6.1.1. Duty Hours. A normal duty day shall not exceed 12 hours. **(T-1)** Duty times begin when personnel report for duty and end when all fuels operations have been completed or transferred to another individual. **(T-1)** For personnel dispatched to duty locations removed from the support installation, duty time does not end until travel to the support installation or specified location for rest is completed. **(T-1)**

18.6.1.2. Rest Period. A normal rest period shall afford an individual the opportunity for at least eight (8) hours of sleep. **(T-1)**

18.6.1.3. Authorized Duties. Only qualified personnel or personnel under the direct supervision of a lab-qualified individual shall perform laboratory sampling or analyses. **(T-0)** Functional managers shall certify personnel authorized to perform specific fuel analysis functions. **(T-0)**

18.6.2. Fuels Laboratory Design Requirements. UFC 3-460-01, UFC 3-600-01, *Fire Protection Engineering for Facilities*, and AF Joint (AFJ) 32-series regulations shall be consulted for existing facilities (as a minimum operating standard) and for new construction. **(T-0)** In case of conflict with national fire codes or building codes, these handbooks take precedence. The installation CE, FES Flight, Occupational Safety office and BE shall make an initial inspection to certify the acceptability of the fuels laboratory. **(T-0)**

18.6.3. Sampling and Analysis Safety. The installation Fuels Management Office shall establish guidance for general safety, sampling safety and laboratory safety during laboratory analyses. **(T-1)**

18.6.3.1. General.

18.6.3.1.1. Post safety instructions in fuel laboratories. **(T-0)**

18.6.3.1.2. Workers shall be informed of chemical hazards IAW 29 CFR 1910.1200., *Hazard Communication.* (T-0) Additionally, hazard communication training shall be provided for workers labeling containers or developing or using SDSs. **(T-0)** Refer to AFI 90-821 for additional guidance and information.

18.6.3.1.3. Label outside of doors of non-explosion proof refrigerators to indicate "NOT FOR FLAMMABLE STORAGE." **(T-0) Warning:** Do not store food or beverage in the refrigerator. **(T-0)**

18.6.3.1.4. The laboratory supervisor shall ensure ovens are equipped with a temperature limiting automatic shutoff control. **(T-0)** Cooking, eating food or drinking beverages in the fuels laboratory is prohibited. **(T-0)**

18.6.3.1.5. The quantity of test fuel in the laboratory shall not exceed 10 gallons, including fuel awaiting analysis, unless analysis specifies a larger sample size. **(T-0)**

18.6.3.1.6. Do not pour fuel into sinks connected to a sanitary drain. Contact the installation Environmental Management office for disposal guidance. **(T-0)**

18.6.3.1.7. Inspect waste fuel drums located outside the laboratory daily and empty them when full. **(T-0)**

18.6.3.1.8. Do not use waste fuel to kill vegetation. **(T-0)**

18.6.3.1.9. Post "No Smoking Within 50 Feet" signs at all laboratory entrances. **(T-0)**

18.6.3.1.10. Ensure fire extinguishers are readily available in the laboratory. **(T-0)** Contact the installation FES Flight for proper types and sizes. **(T-0)** Refer to **Chapter 6** for additional guidance and information.

18.6.3.1.11. Ensure at least two people are in the laboratory when tests involving fuels or acids are performed. **(T-0)** One of these people must be a fully qualified lab technician. **(T-0)**

18.6.3.1.12. Personnel shall not introduce or handle spark-producing materials such as matches, lighters, keys, etc., while in the laboratory. **(T-0) Exception:** Flashpoint laboratory equipment.

18.6.3.2. Sampling Safety.

18.6.3.2.1. Bond all sampling equipment when taking samples. **(T-0)** Allow time for static charges to equalize before disassembly of the in-line sampling equipment IAW TO 42B-1-1. **(T-0)**

18.6.3.2.2. When sampling above-ground storage tanks, use the two-person policy. **(T-0)** Ensure personnel ground themselves prior to climbing tank ladders by grasping the guardrail with a bare hand. **(T-0)** In extremely cold weather, they shall grasp a warm metal object such as a coin and touch it to the guardrail and ensure the coin contacts the guardrail's metal surface. **(T-0)**

18.6.3.2.3. Do not sample storage tanks during filling operations. **(T-0)** Allow at least 30 minutes after filling a tank before taking a sample to allow static electricity charges to dissipate. **(T-0)**

18.6.3.2.4. Use only bronze, steel or other conductive tapes, chains or cables to lower the sampler into the tank. **(T-0)** Ground all metallic components to the tank before opening the sampling hatch and inserting sampling components. **(T-0)** Maintain continuous contact between the tape and the hatch opening while lowering the tape into the tank. **(T-0)**

18.6.3.2.5. Do not overfill sampling containers. **(T-0)** Allow adequate space for fuel expansion. **(T-0)**

18.6.3.2.6. Be careful when taking fuel samples from crashed aircraft to prevent ignition of residual fuel vapors. **(T-0)** Contamination is also a problem and personnel shall ensure the sample is representative of the uncontaminated fuel in the aircraft fuel tanks. **(T-0)**

18.6.3.3. Safety During Laboratory Analyses.

18.6.3.3.1. Ground or bond all laboratory equipment used in analyzing fuels. **(T-0)** Electrical equipment is grounded to the building electrical service ground system when plugged in with a serviceable 3-rong (ground) electrical plug; therefore, no other ground wires are required. **(T-0)** Ground waste fuel containers by extending a ground wire with clamps from the container to the laboratory common ground system. **(T-0)**

18.6.3.3.2. Do not use fuel analysis thermometers for other purposes. **(T-0)**

18.6.3.3.3. Ensure workers understand hazards of handling toxic reagents. Local procedures shall not deviate from TO requirements. **(T-0)**

18.6.3.3.4. Minimize eye exposure to ultraviolet light during operation and repair of the Aeronautical Engine Laboratory water detector. **(T-0)**

18.6.3.3.5. A safety flask (liquid trap) is required between the vacuum pump and the filtration apparatus to prevent fires in ground fuel filtration equipment. This prevents fires caused by flammable liquid from being drawn into the vacuum pump. **(T-0)**

18.6.3.3.6. Petroleum ether used in laboratory analyses is highly flammable. Perform all fuels analyses under operating exhaust hoods. **(T-0)**

18.6.3.3.7. Do not leave waste fuel in the laboratory overnight unless properly stored. **(T-0)**

18.6.3.3.8. The installation Fuels Management Office shall develop emergency procedures and coordinate them with the installation FES Flight and Occupational Safety office. **(T-1)** These procedures include, but are not limited to, evacuation, equipment shutdown and notification of the installation FES Flight. Emphasize techniques to extinguish clothing fires. **(T-1)**

18.6.3.3.9. Mark all containers in the laboratory, regardless of size, to identify contents. Workers shall not pipette fuels by mouth. **(T-0)**

18.6.3.3.10. Do not conduct laboratory analyses or allow fuel in the laboratory unless exhaust systems are functioning. **(T-0)**

18.6.3.3.11. Wear approved eye protection when performing or observing fuels analyses. Make sure an approved emergency shower/eyewash is provided IAW **Chapter 9**. **(T-0)**

18.6.3.3.12. Ensure all facility and equipment electrical repairs meet National Fire Protection Association 70, *National Electric Code*, requirements. **(T-0)**

18.6.3.3.13. Electrical receptacles in fuels laboratories shall be at least four (4) feet above floor level or working surface. **(T-0)**

18.6.4. Inspection of Fuels Laboratory. Supervisors shall inspect their facilities and operations to identify and control or eliminate hazards before they cause a mishap. **(T-0)** Personnel shall

be instructed to notify their supervisors of potential hazards. **(T-0)** Hazards shall be categorized according to potential severity and probability of occurrence IAW AFI 91-202. **(T-0)** Immediate action shall be taken to eliminate those hazards in Categories IA, IB, IIA, and IIB. **(T-0)**

18.6.4.1. External Support Inspections. Periodic inspections shall be accomplished by the installation FES Flight, BE and Occupational Safety office. **(T-1)** BE shall conduct an occupational and environmental health risk assessment whenever there is reason to believe an exposure may be hazardous, as necessary. **(T-1)** Functional managers shall maintain copies of these inspection reports for a minimum of two (2) years or until the next higher headquarters inspection, whichever comes first. **(T-1)**

18.6.4.2. Internal Inspection of Fuels Laboratory. Internal safety inspections are the responsibility of all assigned personnel. **(T-1)** Potential safety and health hazards must be identified and hazard abatement plans established as outlined in AFI 91-202. **(T-0)** Items requiring special attention during daily, weekly or monthly internal inspections include **(T-1)**:

18.6.4.2.1. Inspect all electrical connections of equipment for loose or defective connections and frayed insulation. **(T-1)**

18.6.4.2.2. Visually inspect all ground wires for frays or loose connections. Check electrical continuity monthly with a resistance (ohm) meter. Inspections shall be documented on the AFTO Form 95, *Significant Historical Data*, or MAJCOM or locally devised automated systems. **(T-1)**

18.6.4.2.3. Inspect electrical grounding of the fuels laboratory building monthly and electrical resistance annually. **(T-1)** Electrode resistance to ground shall not exceed 25 ohms under dry conditions. **(T-1)** Inspections shall be documented on the AFTO Form 95, or MAJCOM or locally devised automated systems. **(T-1)**

18.6.4.2.4. Ensure laboratory personnel use correct PPE when handling acids. **(T-0)**

18.6.4.2.5. Make sure all acid solutions are stored in a double container. **(T-0)**

18.6.4.2.6. Ensure labels on containers accurately reflect contents. **(T-0)**

18.6.4.2.7. Make sure waste fuel containers are emptied daily. **(T-0)** Contact the installation Environmental Management office for additional guidance and information.

18.6.4.2.8. Ensure only authorized personnel are in the laboratory when testing fuels. **(T-0)**

18.6.5. Housekeeping. Good housekeeping is essential in the fuels laboratory and is the responsibility of all personnel. **(T-0)**

18.6.5.1. Provide plainly marked metal containers with self-closing lids for combustible waste such as rags, paper towels and other flammable solid materials. **(T-0)** Paint these containers yellow with red letters designating, “COMBUSTIBLE SOLID WASTE.”

18.6.5.2. Fuel spills can cause fires and create slipping hazards. **(T-0)** Spills shall be cleaned up immediately. **(T-0)**

18.6.5.3. Use only noncombustible absorbent materials to clean up spills of flammable/combustible materials. **(T-0)**Do not use sawdust or wood shavings as an absorbent. **(T-0)**

18.6.5.4. Do not clean fuels laboratory floors with flammable liquids. **(T-0)**Use nonskid waxes when waxing floors. **(T-0)**

18.6.5.5. Unplug all lab equipment at the end of the work day, unless instructed by TO, manufacturer's instructions or when allowed by the installation FES Flight. **(T-0)**

18.6.5.6. Keep outside areas, approximately 25 feet, around fuels laboratories free of weeds, trash and other combustible materials. **(T-0)**

18.6.5.7. Ensure aisles in fuels laboratories are clear and permit unobstructed egress of personnel in case of fire. **(T-0)**

18.6.5.8. Limit waste fuel containers within the laboratory to five (5) gallons each. **(T-0)** Empty the containers when full and at the end of the normal work day. **(T-0)** Paint containers red with a two-inch yellow band around the center of the container. **(T-0)** Stencil the type of fuel in one-inch letters inside the yellow band on the front side of the drum. **(T-0)**

18.6.5.9. Never pour acids into fuel containers. **(T-0)**

18.6.5.10. Position a 55-gallon drum, or an equivalent container, outside the laboratory at least 50 feet from the building. **(T-0)** Paint the drum red with a four-inch yellow band around the center of the drum. **(T-0)** Stencil the grade of fuel in two-inch letters inside the yellow band on the front side of the drum. **(T-0)** Ground all waste containers and drums. **(T-0)** **Note:** A metal drum (Department of Transportation (DOT) specifications) or approved metal portable tank not exceeding 60 gallons may be placed within the laboratory if equipped with a self-closing cover and a device to prevent propagation of flame into the drum/tank; located at least 10 feet, horizontally, from energized electrical outlets; and approved by the installation FES Flight. **(T-0)**

Chapter 19

COMPRESSED GASES

19.1. Scope. All workers who store, handle or use compressed gas cylinders shall be thoroughly familiar with procedures, safety requirements and potential mishap hazards associated with their use. Information pertaining to each specific gas is contained within its product labeling and Safety Data Sheet. **(T-0) Note:** Compliance with precautions provided on product labels and Safety Data Sheets is mandatory. **(T-0)**

19.1.1. For additional guidance, refer to 29 CFR 1910 - Subpart H, *Hazardous Materials*, 29 CFR 1910.101 *Compressed Gases (General Requirements)*, National Fire Protection Association 55, *Compressed Gases and Cryogenic Fluids Code*, and the Compressed Gas Association.

19.1.2. Responsibilities.

19.1.2.1. Supervisors shall ensure workers are trained and familiar with the properties and hazards of the products they use, and the handling, usage and storage requirements of compressed gas cylinders. **(T-0)** Supervisors shall ensure valves, hoses, pipes, etc., are compatible with the compressed gases being used and non-compatible with breathing air. **(T-0) Warning:** Valves, hoses, pipes, etc., used with breathing air will not be interchanged with other compressed gases under any circumstances, even though the parts may be physically compatible.

19.1.2.2. The worker shall ensure the cylinder and attached equipment are in proper working condition and any discrepancies are fixed or reported to the supervisor. **(T-0)**

19.2. General Requirements.

19.2.1. All cylinders shall be inspected for damage, e.g., dents, gouges, evidence of leakage or cracks before use. **(T-0)** Damaged cylinders shall be tagged, "Out of Service", and returned to the manufacturer or distributor. **(T-0)** Check the cylinder upon arrival for the test date, usually stamped on the neck of the cylinder. Workers shall store the cylinder with the newest delivery behind older deliveries to ensure cylinders are used in the sequence received. **(T-0) Note 1:** DOT 8 and 8AL Cylinders must have the cylinder shell and porous filler requalified IAW Compressed Gas Association Pamphlet C-13. **(T-0) Note 2:** Requalification of cylinders, including DOT-8 cylinders will be in accordance with 29 CFR 180.209, *Requirements for Requalification of Specification Cylinders.*

19.2.1.1. Cylinders shall be hydrostatically tested IAW DoD and Department of Transportation (DOT) regulations. **(T-0)** Refer to MIL-STD-1411B, *Inspection and Maintenance of Compressed Gas Cylinders*, for additional guidance on inspection and requalification criteria for cylinders.

19.2.1.2. Each time a cylinder is requalified, the date of the test or inspection indicating the month and year shall be stamped into the shoulder, collar or foot ring of the cylinder with a steel stamp. **(T-0)** This date is used to determine the next scheduled re-qualification date. The service period for each type of cylinder is considered expired if the latest marked re-qualification date precedes the current date by more than the period indicated. Cylinders shall not be accepted or used if the requalification date does not meet specifications. **(T-0)**

19.2.2. Workers must know cylinder contents. **(T-0)** Do not use a cylinder if you cannot quickly determine its contents either by wording on the cylinder or a tag securely attached to the cylinder. If the tag has become detached or the label defaced, do not use the cylinder. Do not rely on color coding of the cylinder. Different manufacturers use different color codes.

19.2.2.1. US Air Force or Department of Defense-owned cylinders will be color-coded and contents stenciled on the cylinder IAW MIL-STD-101C, *Color Code for Pipelines and Compressed Gas Cylinders.* **(T-0)** Color codes for commonly used gases will be posted in the cylinder storage area. **(T-1)** Two (2) DD Form 1574s, *Serviceable Tag—Materiel*, shall be placed on all cylinders. **(T-1)** The first tag is used to identify the contents of the cylinder and the second tag will identify the cylinder. **(T-1)** Additionally, the cylinder will carry a DOT identification label and a hazard class label. **(T-0)** For commercially filled cylinders, the user is responsible for affixing a three (3) part cylinder status tag (Full, In-use, Empty), which is useful for identifying content status and cylinder inventory. **(T-0)** Refer to TO 42B5-1-2, *Use, Handling, and Maintenance Instruction – Storage Type Gas Cylinders*, paragraphs 2.2 and 2.2a, for additional guidance and information.

19.2.3. Workers shall be aware of the flammability, corrosiveness or oxidation potential as well as the physiological properties, e.g., toxic, anesthetic or irritating, of compressed gases they use or handle. **(T-0)**

19.2.4. Handle all cylinders carefully. Careless handling may damage cylinders and valves. Install valve and dust covers when cylinders are not in use. Use cylinders for no purpose other than containing compressed gases; handle them with the same care whether full or empty.

19.2.5. Secure all cylinders, whether in use or in storage, full or empty, by using a chain or other fastening device to a solid fixture (wall, stanchion, etc.) to prevent cylinders from falling over. Non-metallic or synthetic straps may be used to secure non-flammable gases, except oxygen.

19.2.6. Move cylinders safely. Appropriate dollies or hand trucks shall be used to move cylinders weighing more than 50 pounds. **(T-1)** The cylinder shall be secured to the hand-truck prior to and during movement. **(T-1)** Movement by spinning, sliding, rolling, etc., is prohibited. Cylinders less than 50 pounds may be moved without using a dolly or hand-truck. Proper lifting techniques shall be used when lifting cylinders. **(T-0)**

19.2.6.1. Electromagnets or slings shall not be used to move cylinders. **(T-0)**

19.2.6.2. Cylinders shall not be moved unless the regulator is removed and the protective cap is in place and securely fastened to the cylinder. **(T-0)** (Cylinders secured to a hand-truck are exempt from this requirement as long as regulators and hoses are connected to the cylinders.)

19.2.7. Some gases/cylinders pose problems if placed in a horizontal position. Keep all cylinders in a vertical position at all times, unless the cylinders are designed to work in a horizontal position. **(T-0)**

19.2.8. Do not tamper with cylinder valves or any part of a valve, such as a safety nut or stem-packing nut. **(T-0)**

19.2.9. Use cylinders only with the appropriate equipment. **(T-0)** Do not force connections or use unauthorized adapters. **(T-0)** Never use a cylinder without a regulator. **(T-0)**

19.2.10. Always close the cylinder valve when the cylinder is not in use or when it is empty. Replace safety covers and dust caps. **(T-0)**

19.2.11. Oxygen will support the rapid combustion of most materials. Flammable materials, such as oil, paint or grease, may ignite if exposed to pressurized oxygen gas.

19.2.11.1. Most compressed oxygen is not intended for breathing and shall not be substituted for air used in ventilation systems. **(T-0)** Oxygen will not be used as a substitute for compressed air. **(T-0)**

19.2.11.2. Never oil or grease an oxygen regulator. **(T-0)** If oil or grease is found on an oxygen cylinder or regulator, it must be taken out of service immediately and the cylinder returned to the supplier. **(T-0)**

19.2.12. Before attempting to place regulators or other fittings on a cylinder, ensure the threads on the cylinder match those on the fittings. **(T-0)** The type of thread, number of threads per inch and the hand of the thread must match to ensure a satisfactory seal. **(T-0)** If the fittings are hard to turn, do not force them; instead, check the threads. **(T-0)**

19.2.13. Open cylinder valves slowly (cracking) so the gas is not released suddenly into the regulators. **(T-0)** Operate valve hand-wheels only by hand. Do not use cheaters or pipes. **(T-0)** Cylinders without fixed hand-wheels shall be equipped with keys, handles or nonadjustable wrenches on the valve stems during the time they are in service. **(T-0)**

19.2.14. Before removing a regulator from a cylinder, close the control valves and allow the gas to escape from the regulator. **(T-0)** Welders shall not leave an area with regulators or lines pressurized. **(T-0)**

19.2.15. On oxygen cylinders, do not use a regulator previously used for oil-pumped gases or any combustible gases. **(T-0)** Gauges on oxygen regulators shall be marked, "USE NO OIL." **(T-0)**

19.2.16. Acetylene is a colorless, flammable gas with a distinctive garlic-like odor. A mixture of this gas with oxygen or air in a confined area will explode on contact with a flame or other ignition source. A pressure-reducing regulator must be used when drawing acetylene from a cylinder. **(T-0)** Acetylene delivery pressure shall not exceed 15 pounds per square inch gauge or 30 pounds per square inch absolute. **(T-0)**

19.2.16.1. Acetylene readily forms explosive compounds with copper, silver and mercury. Avoid contact between acetylene and these metals, their salts, compounds and high-concentration alloys. **(T-0)**

19.2.16.2. Acetylene cylinders will never be placed on their sides, or laid down for any reason. **(T-0)**

19.2.17. Only cylinders that are in use should be located in the lab or work area. **(T-0)** Cylinders shall be secured by a chain or other effective fastening device to a solid fixture (wall, stanchion, etc.) to prevent cylinders from falling over. **(T-0)** Spare or empty cylinders shall only be stored in a designated storage area. **(T-0)**

19.2.18. Compressed gas cylinders represent a hazard because the gases may be:

19.2.18.1. Flammable. These gases can burn or explode if ignited.

19.2.18.2. Asphyxiants (Inert). Gases that are chemically inactive, but may displace oxygen and cause death.

19.2.18.3. Oxidizers. Oxidizing gases such as compressed oxygen and nitrous oxide do not burn, but support combustion of flammable materials by releasing oxygen or other oxidizing substances. Increasing the concentration of an oxidizer can stimulate and accelerate combustion. Materials that are nonflammable under normal conditions may burn in oxygen-enriched atmospheres.

19.2.18.4. Corrosive. A gas that causes destruction of living tissue by chemical action.

19.2.18.5. Toxic. A gas that may cause illness or death if inhaled, ingested or from skin contact. Refer to 29 CFR 1910.1200., *Hazard Communication*, for additional information.

19.2.18.6. Extremely Cold (Cryogenic). A cryogenic liquid has a boiling point below minus 130º F (minus 90º) at 14.7 pounds per square inch absolute.

19.3. Storage.

19.3.1. All cylinders shall be secured by a metal chain, straps, braces or other restraining devices to a solid fixture (wall, stanchion, etc.) to prevent cylinders from falling over. **(T-0)** Synthetic straps shall not be used to secure cylinders of flammable gases or oxygen. **(T-0)** While in storage, cylinder valve protection caps shall be firmly in place. **(T-0)**

19.3.1.1. Doors or gates for gas cylinder supply areas shall be locked. **(T-0)**

19.3.1.2. Enclosures for gas supply systems shall not be used for storage purposes other than for cylinders. **(T-0)**

19.3.1.3. Cylinders attached to a manifold shall also be secured to solid fixtures to prevent the cylinder from falling over. **(T-0)**

19.3.1.4. The enclosure shall be posted as a "No Smoking Area." **(T-0)**

19.3.2. Do not store cylinders in locations where temperatures may exceed 125 ºF (51.7º C) or near other sources of heat to prevent excessive pressures in the cylinders. **(T-0)** Many cylinders have fusible safety plugs that will release the contents when high temperatures or pressures exist in the cylinder.

19.3.2.1. Do not store cylinders where there is danger of accidental damage or in areas where they will be subject to corrosive chemicals. **(T-0)** Do not store flammable gases near electrical wires, batteries or other conductors or sources of electricity. **(T-0)**

19.3.2.2. Empty cylinders must be plainly marked "EMPTY" and stored in a separate area, segregated, if possible, from full cylinders. **(T-0)** When stored together, full and empty cylinders shall be stored so that the older cylinders (old stock) can be removed first with minimum handling of other cylinders (newer stock). **(T-0)** Refer to TO 42B5-1-2 for additional guidance and information.

19.3.2.3. The preferred method of securing compressed gas cylinders is by enclosure within a length of chain firmly anchored at both ends to a solid fixture (wall, stanchion, etc.). An alternative method of securing is with a canvas tank strap securely clamped to an immovable table or bench top. In either case, the anchor points of the chain or strap shall

be about 2/3 the way up the tank. **(T-0)** Metallic or synthetic nylon straps shall not be used to secure cylinders of flammable gases or oxygen. **(T-0)**

19.3.2.4. Cylinders stored in the open shall be adequately protected from extreme heat and cold. **(T-0)** Cold weather usually increases the brittleness of the cylinder metal, and if brittle cylinders are handled roughly, they can rupture. Remove accumulated ice or snow to prevent cylinders from rusting. **(T-0)**

19.3.2.5. When gas cylinders are stored indoors, ventilate the area to prevent accumulation of flammable or asphyxiating gases in the atmosphere. **(T-0)** Cylinders shall not be kept in unventilated enclosures. **(T-0)**

19.3.3. Cryogenic cylinders shall be fitted with stainless steel or other suitable plumbing only. **(T-0)**

19.3.4. Stored cylinders (either inside or outside) shall not obstruct exit routes or other traffic areas. **(T-0)**

19.3.5. All stored cylinders shall have their valves closed. **(T-0)** Valve protection caps shall always be in place and hand tight except when cylinders are in use or connected for use. **(T-0)** All cylinders shall be stored valve end up. **(T-0)**

19.3.6. Oxygen cylinders shall not be stored within 20 feet of combustible material (especially oil and grease), reserve stocks of acetylene, other fuel gas cylinders or near any other substance likely to cause or accelerate fire. **(T-0)** The only exception is when oxygen and acetylene cylinders are secured on a welding cart with regulator and hoses attached. If the cart is not used several times a week, the regulators shall be removed and the cylinders properly stored. **(T-0)**

19.3.7. Storage facilities shall be prominently labeled/posted with the types of gases being stored. **(T-0)** Where gases of different types are stored at the same location, cylinders shall be grouped by type of gas and the groups arranged to take into account the gases contained. **(T-0)** Cylinders shall be prominently labeled IAW DOT regulations. **(T-0)**

19.4. Disposal and Shipping.

19.4.1. Disposal of Compressed Gas Cylinders. Disposal of compressed gas cylinders shall be accomplished IAW DoD 4160.21-M, *Defense Materiel Disposition Manual.* Refer to TO 42B5-1-2, Section 10.4, *Disposition of Cylinders,* for additional guidance.

19.4.1.1. Non-government owned cylinders shall be returned to the owner. **(T-0)** If the owner cannot be determined, cylinders shall be processed IAW DoD 4160.21-M. **(T-0)**

19.4.1.2. Cylinders rejected for failure to pass hydrostatic testing or any other reason shall be disposed of as condemned property after the identification numbers, symbols and cylinder contents have been destroyed. **(T-0)**

19.4.1.3. Acetylene cylinders are filled with a porous mass and a solvent that keeps the acetylene in solution. An unserviceable cylinder may retain varying quantities of solvent and gas. Prior to attempting to destroy one of these cylinders, it is important every precaution be taken to de-energize the cylinder.

19.4.2. Prior to shipment, empty cylinders shall be inspected for dents, bulges, oxidation pits or other damage. **(T-0)** Faulty cylinders shall be handled as required by the latest DOT

regulations. **(T-0)** Cylinders shall be shipped IAW the instructions in AFMAN 24-204, *Preparing Hazardous Materials for Military Air Shipments.* **(T-0)**

19.4.2.1. Ensure cylinders (especially oxygen) will not be contaminated with oil, grease, paint, etc., by the shipper while en route to or from the filling agency. **(T-0)**

19.4.2.2. All acetylene cylinders, when classified empty, shall be required to have 5 – 38 pounds per square inch gauge (psig) pressure. **(T-0)** This requirement prevents ambient air from contaminating the cylinder and allows the cylinder to be shipped at an empty cylinder rate.

Chapter 20

SAFETY COLOR CODING, LABELING AND MARKING FOR PIPING SYSTEMS

20.1. General Information. This chapter establishes minimum requirements for positive identification of hazardous material in piping systems except sections buried in the ground, concrete or part of vehicles or field mobility equipment/systems, etc. This standard requires a color code and lettered legend identification system, positioned in a distinctive manner as a visual aid, for marking piping systems. **(T-0)** Color marking shall not be substituted for elimination of hazards by safety engineering, but shall be used to supplement other established mishap prevention practices. **(T-0)**

20.2. Hazards and Human Factors. Deaths and injuries to personnel and damage to property may occur from mistakes made in turning valves on or disconnecting pipes at the wrong time or place. To lessen the risk from error, confusion or inaction, especially in an emergency, a uniform system for identification of piping contents shall be used to warn personnel when piping contents are inherently hazardous. **(T-0)** Personnel working with piping systems shall be trained to associate various levels of hazards with common colors and lettered legends in piping systems to alert them to potential hazards. **(T-0)**

20.3. General Requirements.

20.3.1. Federal Regulatory Requirements. Essential regulatory requirements are contained in 29 CFR 1910, Subpart J, *General Environment Controls*, American Society of Mechanical Engineers A13.1, *Scheme For The Identification Of Piping Systems*, MIL-STD-161H, *Identification Methods For Bulk Petroleum Products Systems Including Hydrocarbon Missile Fuels*, and MIL-STD-101C, *DoD Color Code for Pipelines and Compressed Gas Cylinder.* Follow Military-Standard (MIL-STD)-101C for agents not identified in American Society of Mechanical Engineers A13.1. Hazard identification using color coding and marking are included in this standard.

20.3.2. Marking. Marking of physical hazards by standard warning colors is not a substitute for elimination of the hazards.

20.3.3. Location. Each location shall be carefully evaluated to minimize the number of markings needed, thereby emphasizing markings which are used and eliminating confusion when colors are indiscriminately applied. **(T-0)** For locations where all piping contains the same materials (for example — a liquid fuels pump house), minimal marking is required. **(T-0)**

20.3.4. Method of Identification for Piping Systems.

20.3.4.1. Lettered Legend. Positive identification of piping system contents, hazardous materials and classification for fire protection shall be by lettered legend giving the name of the contents in full or abbreviated form in black or white, whichever provides suitable contrast to warning colors. **(T-0)** These titles shall be prominently displayed adjacent to color warnings to prevent errors by personnel. **(T-0)** Where the view is unobstructed, legends shall be lettered on the two lower quarters of the pipe or covering. **(T-0)** Lettering in this position is unlikely to be obscured by dust collection or mechanical damage.

20.3.4.2. Location. Letter legends shall be visible from operating positions. **(T-0)** Identifications by title and color shall be located immediately adjacent to all operating accessories such as valves, regulators, flow checks, strainers, cleanouts and vents. **(T-0)** In addition, primary color warnings shall be painted throughout the system at convenient intervals. **(T-0)** An arrow shape indicating direction of flow shall appear on piping systems in any color coded installation. **(T-0)** A double-headed arrow shall be placed on lines subject to reverse flow. **(T-0)** For pipes smaller than 3/4-inch in diameter, metal tags shall be used with lettering etched or filled in with enamel and attached at the same locations color bands would be placed. **(T-0)** Titles shall use upper case letters and Arabic numerals, whenever practical. **(T-0) Note:** Labeling containers and fixed systems containing materials not meeting the definition of hazardous or dangerous materials is not required. However, such containers may be labeled when the occupational environment dictates (hospitals, laboratories, etc.).

20.3.4.3. Color Band. Color bands shall completely encircle the pipe or the entire piping system may be painted the designated color. **(T-0)**

20.3.4.3.1. Color band width may range from 8 to 32 inches.

20.3.4.3.2. Color bands may be painted on the pipe or the pipe may be wrapped with self-adhesive colored tape.

20.3.4.3.3. The direction of material flow within the pipe shall be indicated by an arrow at each color band or identification tag (except for electrical conduit). **(T-0)**

20.3.4.4. Color Band Location.

20.3.4.4.1. At some locations, it may be desirable to code pipes only at junctions or distribution points, while on other systems more frequent markings may be required. In any case, the number and location of identification markings shall be based on the particular needs of each system to ensure the piping system is positively identified. **(T-0)**

20.3.4.4.2. Color bands used for pipe identification shall be located at frequent intervals on straight pipe runs, close to valves and changes in directions, and where pipes pass through walls and floors. **(T-0)** Color coding bands shall be used sparingly for fire protection piping in areas designed to be suitably pleasing. **(T-0)** If desired, the entire piping system may be color coded.

20.3.4.5. Use of Colors. Primary and secondary warning colors applied to the piping system, either by paint or colored bands, shall conform to paragraphs **20.3.4.2** and **20.3.4.6** **(T-0)** These colors shall be used to identify the main classification of piping contents because the colors are readily distinguishable, one from another, under normal conditions. **(T-0)**

20.3.4.5.1. Piping systems, which do not require warning colors, may be painted to match surroundings (if not in conflict with other color designations of this standard) or such systems may be painted aluminum, black or remain unpainted.

20.3.4.5.2. A primary warning color shall appear on all dangerous piping systems and fire protection materials. **(T-0)** Primary warning colors shall consist of a single color applied as a band or bands which completely encircle pipes in the system. **(T-0)** In lieu

of color bands, all pipe and covering for an entire system may be painted the primary warning color if that color is different from the background color. The use of color bands is preferred. In addition, primary warning colors shall be used throughout the system, where the system passes underground or through walls and at any other conspicuous places where warnings are required by safety authorities. **(T-0)** If desired, operating accessories may also be painted with the primary warning color.

20.3.4.5.3. Secondary Warning Color. Any piping system with a secondary hazard distinctively different from that indicated by its primary warning color shall have a secondary warning color applied. **(T-0)** The color of the band shall be selected according to the definitions for warning colors specified in this standard. **(T-1)** Location on piping systems shall be immediately adjacent to all operating accessories such as valves, regulators, flowchecks, strainers, cleanouts, pumps, dispensing points and vents. **(T-0)**

20.3.4.6. Use of Arrows. Arrows shall be used to indicate the normal direction of flow in a piping system. **(T-0)** A double-headed arrow shall be placed on lines subject to reverse flow. **(T-0)** When used, arrows shall appear adjacent to each primary warning color segment. **(T-0)** When the entire piping system is paint, the primary warning color, the arrow, if desired, shall be black or white, whichever contrasts. **(T-0)**

20.3.4.7. Cryogenics. Labels and paint will flake off pipes carrying cryogens (typically liquid oxygen and nitrogen). Metal signs with identification markings shall be attached above or hung below cryogen piping by metal bands. **(T-0)**

20.3.4.8. Bulk Petroleum Product System and Hydrocarbon Missile Fuels. MIL-STD-161H contains specific marking guidance for these systems.

20.4. Worker Training. Supervisors shall ensure personnel working with piping systems are trained in the hazards of the system contents and requirements of this chapter. **(T-0)** Job safety training shall be documented IAW AFI 91-202. **(T-1)**

20.5. Classification of Material in Piping Systems. The classification of materials in a piping system shall be as specified in paragraph **20.3.4.1** **(T-0)**

Chapter 21

HAZARDOUS ENERGY CONTROL

21.1. Scope. This chapter establishes requirements for procedures, training and periodic inspection for an hazardous energy control program to prevent unexpected start-up. It applies to all machines, equipment, Air Force employees and contractors who may be exposed to hazardous energy during servicing, maintenance or modification activity performed by the Air Force. When contractors are performing the servicing, maintenance or modification activity they will follow OSHA guidance for protection of their employees. Refer to paragraph **21.8** for additional information.

21.1.1. Refer to paragraph **1.5** and AFI 91-202 for further information on job hazard analysis (JHA) and job safety lesson plan. **Note:** A job hazard analysis is not required when existing guidance adequately covers all safety requirements of an operation or process. Examples are TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding*, and aircraft specific procedural Technical Orders.

21.1.2. Manually-operated machines and equipment that require the operator to perform functions by hand may store energy (residual energy) or pose hazards to workers if broken or defective.

21.2. Hazardous Energy Control Program. A hazardous energy control program requires the following elements:

21.2.1. Energy isolating devices and procedures to lockout/tagout (LOTO) all machines and equipment.

21.2.2. Retrofit of machines and equipment, as needed, to accept a lockout device. A JHA shall be conducted to ensure all hazards are identified and steps put in place prior to performing maintenance until the machine or equipment can be replaced or modified. **(T-0)**

21.2.3. Identification of hazardous energy sources, such as electrical, pressure/vacuum (hydraulic, pneumatic); chemical; ionizing and non-ionizing radiation sources; thermal, kinetic or mechanical (rotational, gravity) energy; energy stored in capacitors, springs or gravity equipment; machinery or system components that are suspended, blocked or chocked; hydraulic or compressed air accumulators, etc. **Note:** Manual (non-powered) equipment energy sources must also be identified. **(T-0)**

21.2.4. Procedures be developed and documented for safe and proper use of locks and tags on energy isolating devices. **Note:** Push buttons, selector switches, interlock circuits and other control-type devices are not energy-locking devices.

21.2.5. LOTO procedures be strictly followed when working on equipment that may generate, hold or release any form of hazardous energy while the equipment is shut down.

21.2.6. A training plan for initial and recurring LOTO training. Refer to paragraph **21.5**

21.2.7. All LOTO devices provide a positive means to isolate and prevent uncontrolled release of hazardous energy. LOTO is required whenever service, maintenance or modification will be performed on equipment or machinery where unexpected energizing, start-up or release of stored energy could injure personnel or damage equipment. **(T-0)**

21.2.8. Lockout of all energy sources prior to inspection, maintenance or servicing actions (including but not limited to**:** installation, set up, adjustments, lubrication, cleaning or tool changes) requiring removal of guards. Energy sources shall remain locked out until all actions are complete. **(T-0)**

21.2.9. Use of occupational safety and health signs and tags IAW **Chapter 29,** *Mishap Prevention Signs and Tags.* Refer to paragraph **21.3.3** for additional guidance.

21.2.10. LOTO program self-assessment and annual inspections be conducted and documented to ensure requirements of this standard are followed. **(T-1)** Refer to paragraphs **21.6.1** and **21.6.2** for additional guidance.

21.3. Specifications for Lockout/Tagout (LOTO).

21.3.1. LOTO devices and tags are not required when:

21.3.1.1. Working on cord and plug connected electrical equipment if:

21.3.1.1.1. There is a single energy source which can be easily identified and isolated.

21.3.1.1.2. All hazardous energy is controlled by unplugging the equipment and there is no potential for stored, residual or accumulated hazardous energy.

21.3.1.1.3. The plug remains under continuous positive control of the worker performing servicing, maintenance or modification. **Note:** A plug LOTO device is recommended.

21.3.1.2. Operations on energized equipment (e.g., measuring, troubleshooting, calibration), when continuity of service is essential to safety or shutdown cannot be reasonably accomplished. **Note:** Supervisor approval is required for such operations and documented safety procedures that provide an equivalent level of safety shall be established and followed. **(T-0)**

21.3.1.3. Minor tool changes, adjustments and servicing during normal operations provided:

21.3.1.3.1. Such activities are routine, repetitive and integral to use of the equipment,

21.3.1.3.2. Work is done using alternative measures that provide effective worker protection.

21.3.1.4. Hot Tap Operations. Work on transmission and distribution systems, such as gas, steam, water or petroleum products, can be performed on pressurized pipeline systems if:

21.3.1.4.1. The supervisor or authorized worker demonstrate continuity of service is essential.

21.3.1.4.2. System shutdown is impractical and documented procedures are in place and used.

21.3.1.4.3. Appropriate PPE is used that will provide effective protection for workers.

21.3.2. Authorized Lockout Devices. These locks are used only to ensure safety of authorized workers when servicing, maintenance or modification of equipment and machines and shall:

21.3.2.1. Be readily identifiable as a lockout device, e.g., numbered (CESM-1, CEOI-3, etc.), specific color lock or band, like red, and/or labels affixed to the lock. **(T-0)**

21.3.2.2. Not be used for any other purpose. **(T-0)**

21.3.2.3. Be singularly keyed with only authorized workers retaining the key(s) to the lock(s) when in use; a log shall be maintained by the shop supervisor to identify equipment being locked out under the LOTO program. **(T-1)**

21.3.2.4. Be applied to energy isolation device(s) prior to any servicing, maintenance or modification actions. **(T-1)**

21.3.2.5. Be substantial to prevent removal except by excessive force using special tools, such as bolt cutters or other metal cutting tools. **(T-0)**

21.3.2.6. Be inventoried and maintained to ensure accountability. **(T-1)** There's no requirement to inventory devices, zip ties, chains or tags. However, LOTO devices should be adequate to support the expected LOTO requirements identified in the shop specific procedures.

21.3.3. Authorized Tagout Devices. AF Form 983, *Danger – Equipment Lockout Tag*, or DoD or commercial equivalent tags, shall be used in conjunction with energy-isolating devices. **(T-1)** AF Forms 979, *Danger Tag*, or 982, *Do Not Start Tag*, or DoD or commercial equivalent tags, shall be used in conjunction with administrative devices. **(T-1)** These tagout devices immediately alert workers to existing and/or potential hazards from servicing, maintenance or modifications to equipment or machinery. All mishap prevention tags shall be standardized Air Force forms as listed in **Chapter 29,** or DoD or commercial equivalent and available through normal form distribution channels, or commercially purchased by the user if the commercial equivalent is chosen as the method of tagging. **(T-1)** The functional manager or supervisor shall ensure an adequate supply of locks and tags are available. **(T-1)**

21.3.3.1. Air Force tags, or equivalent DoD and commercial tags are authorized for lockout purposes and shall be used for lockout situations. **(T-1)** All employees shall be instructed that these tags indicate that equipment is locked out for maintenance or inoperability. **(T-0)**

21.3.3.2. Tagout devices shall:

21.3.3.2.1. Withstand the environment for the duration of expected exposure. **(T-0)**

21.3.3.2.2. Be constructed and printed so they do not deteriorate or become illegible, especially in wet or corrosive environments. Laminated devices (tags) are acceptable. **(T-0)**

21.3.3.2.3. Warn against hazardous conditions if equipment or machinery is energized. **(T-0)**

21.3.3.2.4. Clearly identify the worker who applies them. **(T-0)**

21.3.3.2.5. Be secured with a self-locking, non-reusable and non-releasable attachment, such as a nylon or plastic cable tie, with a minimum unlocking strength of 50 pounds. **(T-0)**

21.3.4. Responsible Parties.

21.3.4.1. All workers are responsible for recognizing when LOTO is being used, the general reasons for LOTO and the importance of not tampering with or removing LOTO devices.

21.3.4.2. Authorized workers are responsible for:

21.3.4.2.1. Recognizing work conditions that require LOTO, assessing all hazardous energy sources, using correct LOTO procedures and materials, and maintaining control of their key(s). **(T-0)**

21.3.4.2.2. Applying their own locks and tags when performing servicing, maintenance or modifications, and shall never apply LOTO for anyone else. **(T-0)**

21.3.4.3. Workers shall immediately advise the work area supervisor of inoperable equipment or machinery. **(T-0)** Supervisors shall determine if hazardous energy control (LOTO) or administrative devices, IAW paragraphs **21.4** and **29.8,** are needed and, if so, that appropriate devices are attached. **(T-1)** They shall coordinate placement of tags and assignment of Risk Assessment Codes by fire, safety or health personnel, as necessary, IAW paragraph **29.6,** *General Requirements for Use of Tags.* **(T-1)**

21.3.4.3.1. Equipment and machinery shall be shut down and locked out IAW paragraph **21.4** **(T-0)**

21.3.4.3.2. Machinery/Equipment placed in an "out of service" status for business or production purposes (e.g., poor efficiency, recycled, sold, etc.) and not related to servicing or maintenance shall not be locked with a hazardous energy control (LOTO) device. **(T-1)** Refer to paragraph **29.8** for additional guidance on administrative devices.

21.3.4.3.3. See paragraph **21.4.9** for procedures on transfer of locks and tags.

21.3.5. Supervisors shall:

21.3.5.1. Generate and maintain equipment-specific written LOTO procedures. **(T-0)**

21.3.5.2. Perform a self-assessment of work environments using these procedures at least annually. **(T-0)** Refer to paragraph **21.6.1** for additional guidance on LOTO self-assessment.

21.3.5.3. Determine appropriate training and assure workers are provided needed training. **(T-0)**

21.3.5.4. Prohibit workers from working on equipment requiring LOTO until trained and authorized to perform LOTO. **(T-0)**

21.3.5.5. Assign and document worker LOTO authorization. **(T-1)**

21.3.5.5.1. Designate specific equipment or categories of equipment and develop control procedures. **(T-1)**

21.3.5.5.2. Verify worker is qualified to perform necessary energy-control procedures. **(T-1)**

21.3.5.6. Ensure consistent application and enforcement of LOTO policies. **(T-1)**

21.3.5.7. Keep accurate LOTO logs. **(T-1)**

21.3.5.7.1. Ensure authorized workers make log entries when applying/removing LOTO devices. **(T-1)**

21.3.5.7.2. Ensure LOTO logs are readily available for equipment or machinery being serviced, i.e., on equipment or machinery or in a centralized location for those areas where multiple maintenance tasks are being performed. **(T-1)**

21.3.5.8. Ensure necessary LOTO hardware is available. **(T-1)**

21.3.5.8.1. Maintain a roster of all LOTO assigned to authorized personnel. **(T-0)**

21.3.5.8.2. Control LOTO tags before and after use. **(T-1)** Tags or a log containing the tag information shall be maintained for one year after removal to verify the status of locks and tags used during a review period. **(T-1)**

21.3.5.9. Control emergency keys for LOTO locks. **(T-1)**

21.3.5.10. Remove LOTO devices only in an emergency. **(T-0)** Refer to paragraph **21.4.5** for additional guidance.

21.3.5.11. Maintain LOTO tags after removal from machinery or equipment. **(T-1)**

21.3.5.12. Be trained as an authorized worker. **(T-1)**

21.3.6. Contractors. Contract personnel engaged in activities that require LOTO shall:

21.3.6.1. Comply with OSHA regulations for lockout/tagout procedures including a written plan and employee training certificates. **(T-0)**

21.3.6.2. Inform unit site-supervisors of the contractor's LOTO procedures. **(T-0)**

21.3.6.3. Be familiar with Air Force LOTO procedures. **(T-0)**

21.3.6.4. Ensure all individuals involved in the activity understand and comply with restrictions and prohibitions of hazardous energy control procedures applicable to activities being performed. **(T-0)**

21.3.7. Verification. All LOTO operations shall use written procedures. **(T-0)** Refer to paragraph **21.3.5.1**

21.3.7.1. All sources of hazardous energy shall be shut off and secured. **(T-0)** Each disconnecting means shall be legibly marked to indicate its purpose unless located and arranged so the purpose is evident. **(T-0)** Markings shall be sufficiently durable to withstand the environment involved. **(T-0)** Refer to **Chapter 8**, *Electrical Safety* and National Fire Protection Association 70, *National Electrical Code*, for further guidance on disconnecting means.

21.3.7.2. LOTO shall be performed at each identified hazardous energy control point by each worker authorized to work on the equipment. **(T-0)** Each authorized worker shall:

21.3.7.2.1. Apply their issued or assigned LOTO device when servicing, maintaining or modifying machinery or equipment, regardless of duration of activity or proximity to the energy-isolating device (e.g., circuit breaker, switch or valve). **(T-0)**

21.3.7.2.2. Personally witness or verify the absence of hazardous energy or assure that the verification has been performed. **(T-0)**

21.3.8. Equipment-Specific Energy Control. An equipment-specific written procedure shall be developed and used unless the equipment or machine undergoing servicing, modification or maintenance meets the requirements of paragraph **21.3.1** **(T-0)** Supervisors need not document LOTO procedures for machines or equipment if ALL of the following elements are met:

21.3.8.1. No potential for stored or residual energy or re-accumulation of energy after shutdown.

21.3.8.2. Has a single energy source easily identified and isolated.

21.3.8.3. Isolation and lock out of single energy source completely de-energizes and deactivates the equipment or machinery.

21.3.8.4. Isolation from energy source maintained for duration of maintenance or servicing.

21.3.8.5. A single lockout device and tag achieve lock out of the equipment or machinery.

21.3.8.6. The lockout device is under the exclusive control of the authorized worker performing maintenance or servicing.

21.3.8.7. Maintenance or servicing does not create hazards for other workers.

21.3.8.8. No accidents involving the unexpected activation or re-energization of the machine or equipment during servicing or maintenance have occurred when utilizing this exception.

21.3.9. Equipment-Specific Written Procedures. The supervisor shall:

21.3.9.1. Develop equipment-specific written energy control procedures with input from authorized workers most familiar with the equipment or machine. **(T-1)** If procedures exist in equipment TOs, the supervisor shall review those procedures to ensure they are specific and address all types of hazardous energy contained in the equipment or machinery. **(T-0)**

21.3.9.2. Ensure equipment or machines requiring written procedures are identified and procedures posted on equipment or readily available to workers authorized to LOTO the equipment. **(T-1)** Also see paragraph **21.3.9.5**

21.3.9.2.1. Written procedures shall be specific to each piece of equipment (by model or serial number) or machine**,** shall address all types of hazardous energy contained, and shall be written to the level of detail necessary to safeguard personnel. **(T-0)**

21.3.9.2.2. Complex equipment may require a separate procedure for each type of hazardous energy to be controlled.

21.3.9.2.3. If the procedure is not posted on the equipment, the equipment shall be clearly labeled to indicate the availability and location of the procedure. **(T-0)** The supervisor or worker responsible for the equipment may determine the appropriate format and content of the label.

21.3.9.2.4. Consult maintenance and service manuals to ensure accuracy and sufficient level of LOTO detail. **(T-0)** Review TOs, manuals, drawings, tags, labels and signs to identify and locate all disconnecting means to ensure power is interrupted by a physical

break and not only de-energized by a circuit interlock. **(T-0)** Make a list of disconnecting means to be locked/tagged. **(T-0)**

21.3.9.2.4.1. Review disconnecting means to determine their interrupting ability. **(T-0)** Determine if it is possible to verify a visible open point or if other precautions are necessary. **(T-0)**

21.3.9.2.4.2. Review other work activity in the area, identify where and how other personnel might be exposed to electrical and other types of energy hazards, and establish energy control methods. **(T-0)**

21.3.9.3. Ensure LOTO procedures are used by authorized workers on the equipment or machine. **(T-0)**

21.3.9.4. Review and update procedures as necessary when there is a change in the equipment or associated hazards. **(T-0)**

21.3.9.5. LOTO Procedure Required Content. Equipment-specific written procedures shall incorporate all applicable elements of general LOTO procedures and any specific information. **(T-0)** Each LOTO step shall be clearly explained in the context of the specific equipment or machine. **(T-0)** Written procedures shall include the specific equipment or machine to which the procedure applies and must identify: **(T-0)**

21.3.9.5.1. All jobs to be accomplished and equipment involved. **(T-0)**

21.3.9.5.2. The procedure that requires control of hazardous energies. **(T-0)**

21.3.9.5.3. Components or locations generating hazardous energies to be controlled. **(T-0)**

21.3.9.5.4. Energy sources/types that shall be controlled. **(T-0)**

21.3.9.5.5. Process for notifying affected workers before controls are applied and after removal. **(T-0)**

21.3.9.5.6. Procedural steps to shut down and secure equipment or machinery. (Includes specific locations to shut down, isolate, block, and safe releasing and securing of all potentially stored or residual hazardous energies. **(T-0)**

21.3.9.5.7. Type of LOTO hardware required and procedural steps for applying LOTO. **(T-0)**

21.3.9.5.8. Procedural steps to test and verify lockout effectiveness for hazardous energy control. **(T-0)**

21.3.9.5.9. Procedural steps to restart equipment or machinery. **(T-0)**

21.3.9.5.10. Workers authorized to perform LOTO. **(T-1)**

21.4. LOTO Procedures. Only authorized workers shall perform LOTO procedures. **(T-0)** Personnel directly affected by the operation or shutdown of the equipment or machine shall be notified of LOTO devices. **(T-0)** Notification shall be given before controls are applied and after they are removed. **(T-0)** Refer to paragraph **21.7** for sample procedures. Procedures for applying locks or tags shall include and be performed in the following order. **(T-0)** **Note 1:** If not specifically called for by governing directives for the task being performed, it is recommended

that workers be assigned in teams (minimum of two [2] people), one serving as a safety observer. **Note 2:** When high energy electrical sources are to be locked out, both workers shall be qualified in high energy operations. **(T-0)**

21.4.1. Prior to Start. Prior to starting any procedure, authorized worker(s) shall physically locate and identify all isolating devices to ensure that switches, valves or other energy isolating devices are locked and tagged out and manual or freely moving components are blocked or chocked to prevent movement. **(T-0)** Authorized worker(s) shall resolve questions on identification of electrical or other energy sources with their supervisor before proceeding. **(T-1)** If following equipment-specific written procedures would compromise safety, the authorized worker, with supervisor approval, may modify the sequence of steps, but all steps shall be performed.

21.4.2. The Nine Step LOTO Process. The Authorized Worker shall:

21.4.2.1. Step One – Preparation. Determine if equipment-specific written energy control procedures are applicable to the task. If so, the worker shall review control procedures and ensure they are followed correctly. **(T-0)**

21.4.2.1.1. Prior to shutting down equipment or machines, the supervisor, authorized worker or operator must have knowledge of and assess the type (e.g. electrical, mechanical, hydraulic), magnitude (e.g. 120 volts, 60 psi, etc.) and hazards of the energy to be controlled, including hidden energy sources such as springs, capacitors, elevated parts, etc. **(T-0) Note:** Equipment or machinery may contain more than one type of energy.

21.4.2.1.2. Determine, IAW written procedures, appropriate methods for controlling the hazardous energy. **(T-0)** Methods for energy-isolation may include, but are not limited to, circuit breakers, disconnect switches or valves.

21.4.2.2. Step Two – Notification. Notify all affected workers of the impending shutdown and that they shall not disturb lockout devices or attempt to re-start the equipment until informed it is safe to resume normal operations. **(T-0)**

21.4.2.3. Step Three – Shutdown. Verify it is safe to shut down the equipment or machine. **(T-0)**

21.4.2.3.1. The equipment or machine shall be turned off or shut down using normal stopping and shutdown procedures (depress stop button, open toggle switch, close shut off valve, etc.). **(T-0)**

21.4.2.3.2. When equipment or machines use a simple wall plug as the single energy source and all hazardous energy, including stored, residual or accumulated hazardous energy is controlled by unplugging of the equipment, it shall be unplugged and the plug controlled by the supervisor or authorized worker IAW paragraph **21.3.1.1.3** **(T-0)**

21.4.2.4. Step Four – Isolation and Verification.

21.4.2.4.1. Isolate all energy sources by operating (switch off, valve off, etc.) energy-isolating device(s). **(T-0)**

21.4.2.4.2. Verify the correct energy-isolating device has been operated and that steps taken to ensure energy isolation (LOTO applied to disconnect, valve, etc.) correctly correspond to the equipment that requires LOTO. **(T-0)**

21.4.2.4.3. Ensure all energy isolating devices needed to control the energy to or contained within the equipment or machine are used. **(T-0)**

21.4.2.5. Step Five – LOTO Device Application.

21.4.2.5.1. Affix LOTO devices (typically locks) to hold energy-isolating devices in an "off" or "safe" position that physically prohibits normal operation of the energy-isolating device. Both tags and locks shall be installed. **(T-1)**Tags are warning devices attached to energy isolating devices and cannot provide the physical restraint or security of a lock.

21.4.2.5.1.1. Tags shall indicate date, time, reason and name of the worker installing the device. **(T-0)**

21.4.2.5.1.2. To prevent inadvertent or accidental detachment, tags shall be securely attached with a self-locking and non-releasable attachment (e.g., a nylon or plastic cable tie-off strap) with a minimum unlocking strength of 50 pounds. **(T-0)**

21.4.2.5.1.3. Tags may cause a false sense of security. Workers shall understand the use and limitations of tags as part of the overall energy control program. **(T-0)** Refer to paragraph **21.4.3** for more detailed information on tagout procedures.

21.4.2.5.1.4. Initial LOTO devices shall be attached to each energy-isolating device by the first authorized worker. **(T-0)** Additional authorized workers who perform service, maintenance or modification on the equipment or machine shall apply their own locks during their maintenance activities. **(T-0)** Refer to paragraph **21.4.4** for additional information on multiple lockouts.

21.4.2.6. Step Six – Additional Measures. Once the system is locked and tagged out, all potentially hazardous stored or residual energy shall be relieved, disconnected, restrained or otherwise rendered safe. **(T-0)**

21.4.2.6.1. Insert physical restraints (blocks, chocks) for moving or raised parts, blind flanges for pressurized piping, disconnect springs (if safe to do so), etc., to ensure moving parts are physically restrained or disconnected.

21.4.2.6.2. The authorized worker shall completely release or otherwise control any stored energy and block any unexpected motion. **(T-0)** Equipment or machines shall be in a zero energy state. **(T-0)**

21.4.2.6.2.1. For stored mechanical energy, vent valves, spring releases, blocking devices or equipment repositioning, as appropriate, shall be used. **(T-0)**

21.4.2.6.2.2. For stored electrical energy, approved grounding wands or discharge devices shall be used. **(T-0)** If re-accumulation of stored energy to a hazardous level is possible, verification of isolation, such as leaving the ground wand in place, shall be continued until servicing, maintenance or modification is complete. **(T-0)**

21.4.2.6.3. The authorized worker shall demonstrate the equipment or machine is de-energized or isolated before starting work on LOTO equipment or machinery. **(T-0)**

21.4.2.7. Step Seven – Isolation Confirmation.

21.4.2.7.1. Physically attempt to operate energy-isolating devices and attempt to restart the equipment or machine using normal controls. **Caution:** Return operating controls to "safe" or "off" position after the test.

21.4.2.7.2. When the equipment to be worked on does not have normal controls, e.g., on/off switch, etc., use the following procedure for isolation confirmation. Test potential energy sources using appropriately rated and calibrated instruments or testers. Instruments used to test voltage, pressure or temperature shall be checked for proper operation both before and after use. **(T-0)** If the authorized worker is not qualified to test the energy being isolated, he or she shall ensure the energy is tested by a qualified person. **(T-1)**

21.4.2.8. Step Eight – Keep LOTO Devices in Place. A lock and tag shall remain in place until work on the equipment or machine is complete. **(T-0)**

21.4.2.8.1. In rare circumstances, it may be necessary to temporarily remove LOTO devices before work is complete, such as for adjustment or repositioning equipment.

21.4.2.8.2. Use the following sequence of actions when LOTO devices must be temporarily removed from the energy-isolating device:

21.4.2.8.2.1. Notify all affected workers and supervisors.

21.4.2.8.2.2. Clear equipment or machine of tools and materials.

21.4.2.8.2.3. Remove all workers from equipment or machine area and ensure required tools are safely and properly positioned. **(T-0)**

21.4.2.8.2.4. Remove all repositioning and blocking devices and return all vents and valves to normal operating positions.

21.4.2.8.2.5. Remove all grounding/shorting conductors, hooks or wands.

21.4.2.8.2.6. Put on any required PPE.

21.4.2.8.2.7. Energize and proceed with testing or positioning.

21.4.2.8.2.8. De-energize all systems; reapply lockout/tagout measures; notify all affected workers and supervisors; and continue servicing, maintenance or modification of equipment or machine.

21.4.2.9. Step Nine – Before restoring machines and equipment to service, the supervisor or authorized employee will: **(T-0)**

21.4.2.9.1. Ensure all personnel, tools and maintenance or servicing equipment have been removed and guards reinstalled. **(T-0)**

21.4.2.9.2. Notify personnel the locks or tags have been removed and equipment is in service. **(T-0)**

21.4.2.9.3. Remove all locks or tags and restore the energy isolating device to the 'ON' position. **(T-0)**

21.4.3. Tag-Out Only. A "tag-out only" procedure may be used in the rare case a device cannot be locked out. Use extra caution with Tag-Out Only procedures as tags are warning devices and do not provide the physical restraint and security of a lock. Tags may evoke a false sense of security by the worker. A Tag-Out Only procedure may be used if:

21.4.3.1. A justifiable and verifiable need is identified.

21.4.3.2. Approval is obtained from the supervisor.

21.4.3.3. Authorized workers follow LOTO procedures, with the following changes:

21.4.3.3.1. Omit placement of the lock.

21.4.3.3.2. In place of the lock, a secondary means of isolation shall be used. **(T-0)** Removing an isolating circuit element, blocking a controlling switch, opening an extra disconnect device or removing a valve handle are examples of secondary measures. The secondary means of isolation shall be identified on the tag affixed IAW equipment-specific written LOTO procedures. **(T-0)**

21.4.3.3.3. The tag is secured with a self-locking and non-releasable attachment (e.g., a nylon or plastic cable tie-off strap) with a minimum unlocking strength of 50 pounds. A tag used without a lock shall be supplemented with at least one additional safety measure that provides a level of safety equivalent to that obtained by use of a lock. **(T-0)** These devices shall be attached so they interfere with the operation of energy isolating devices (worker has to undo or remove the tag to operate isolating device). **(T-0)**

21.4.3.3.4. If tag placement would compromise safety by obscuring indicator lights or controls or where a tag cannot be attached directly to the energy-isolating device due to design, the tag shall be located as close as safely possible to the device, in a position immediately obvious to anyone trying to operate the device. **(T-0) Note:** Energy-isolating devices for such equipment or machinery shall be modified or designed to accept a lockout device whenever new equipment or machinery is installed or major replacement, repair, renovation or modification is performed. **(T-0)**

21.4.4. Multiple Lockout. If more than one worker needs to LOTO equipment or machinery:

21.4.4.1. Each authorized worker shall place his/her own lock on the lockout device and install their own tagout device. **(T-0)**

21.4.4.2. A multiple lockout device (hasp) shall be used when an energy-isolating device cannot accept multiple locks. **(T-0)**

21.4.4.3. Each worker shall remove his/her own LOTO devices when work is complete. **(T-0)**

21.4.5. Three Step Release from Lockout/Tagout Process.

21.4.5.1. Step One – Preparation and Notification. Before removing lockout or tagout devices and reenergizing machines or equipment, the authorized worker shall:

21.4.5.1.1. Notify all affected workers the system is ready for return to service. Ensure all personnel are clear of the equipment point of operation and other hazard zones. **(T-0)**

21.4.5.1.2. Inspect the work area and ensure all tools, debris and non-essential personnel are removed or are a safe distance from the equipment or machinery. **(T-0)**

21.4.5.1.3. Replace safety guards**,** inspect equipment or machinery and ensure guards are operational. **(T-0)**

21.4.5.2. Step Two – Removal of Additional Devices.

21.4.5.2.1. The authorized worker shall remove any additional devices applied IAW LOTO Application Step Six. **(T-0)** See paragraph **21.4.2.6**

21.4.5.2.2. Remove all safety grounding devices.

21.4.5.2.3. Verify the work for which LOTO was applied is complete and it is safe to reenergize the equipment or machinery.

21.4.5.3. Step Three – Removal of all Locks and Tags.

21.4.5.3.1. Each LOTO device shall be removed only by the authorized worker who applied it. **(T-0)** When the authorized worker who applied a LOTO device is not available to remove it, his or her supervisor may remove the device using emergency removal procedures in paragraph **21.4.6** This is considered an emergency procedure, undertaken only in extreme circumstances, i.e., use of equipment or machinery is required immediately.

21.4.5.3.2. Authorized workers shall remove all LOTO devices and restore the energy isolating device to the 'ON' position. **(T-0)**

21.4.5.3.3. Notify all workers the lockout condition has been cleared (locks and tags removed) and equipment or machinery is ready for service.

21.4.5.3.4. Energize the equipment or machinery and restore to normal operating condition.

21.4.5.3.5. Annotate LOTO log with clearance information.

21.4.6. Emergency Removal of LOTO Devices. In some instances, a lock and/or tag may have to be removed by someone other than the person who applied the lockout device. For example, contractors may complete their work and leave without removing their issued locks, or a worker may be absent due to illness or other reasons. Under such circumstances, the supervisor may need to remove the lock, but the supervisor assumes responsibility for the safety of the equipment and those who work with it. If the authorized worker who applied a LOTO device is not available to remove it, the supervisor may remove the device, if it is safe to do so, provided:

21.4.6.1. Specific training and procedures are developed, documented and incorporated into the shop energy control program which demonstrate safety equivalent to removal of the device by the authorized worker who applied it. **(T-0)** Locks should never be removed in haste or confusion.

21.4.6.2. The supervisor verifies the authorized worker who applied the device is not at the facility. Before removing another's lock, the supervisor must perform all of the following steps, in the order listed:

21.4.6.2.1. The supervisor makes every reasonable effort to contact the authorized worker who applied the device. This shall include a thorough search of the premises, the individual's normal workplace (if different) and telephone calls to both home and office numbers. **(T-0)**

21.4.6.2.1.1. These efforts are documented (e-mail, voicemail, etc.).

21.4.6.2.1.2. If the authorized worker is contacted, the supervisor informs the worker their LOTO device must be removed and the reason for the removal. **(T-0)** The supervisor shall determine if the worker can return to work and, if not, shall advise the worker his/her LOTO device will be removed and returned by the supervisor. **(T-0)**

21.4.6.2.2. Determine and understand the reason for the lockout. **(T-0)**

21.4.6.2.3. Determine and understand the need for removal of the lock by someone other than the person placing it. **(T-0)**

21.4.6.2.4. Thoroughly examine all parts of the locked out system and assess its readiness for use. **(T-0)** This requires a visual inspection of all wiring, conduit, piping, etc., between the energy isolating device and the equipment, and a complete inspection and understanding of the equipment. If the supervisor is not completely familiar with the equipment, he/she must enlist the aid of those who are. **(T-0)** Supervisors are cautioned that the person asking to have the lock removed may not be the best consultant on this issue.

21.4.6.2.5. If the supervisor is satisfied that the person who placed the lock cannot be contacted or cannot be present and that there is an immediate need to operate the equipment, and that the equipment and all connected apparatus are safe for operation and the supervisor has verified it is safe to remove the LOTO device, the supervisor may use the emergency key to remove the LOTO device or cut it off if the key is not available. Procedures for release from lockout/tagout covered under paragraph **21.4.5** shall be followed when removing LOTO device(s). **(T-0)**

21.4.6.2.6. It is essential the person who originally placed the lock be notified as soon as possible that the lock has been removed. **(T-0)** The supervisor ensures the worker is given the removed lock and informed of the reasons for removal before the worker returns to duty. **(T-0)**

21.4.7. Temporary LOTO Device Removal. If necessary to temporarily remove LOTO devices to start equipment or machinery for test or component repositioning, restoration procedures shall be performed IAW paragraph **21.4.2.8.1** thru **21.4.2.8.2.8** **(T-0)** The equipment or machinery shall be locked and tagged out IAW paragraph **21.4.2.5** when test or repositioning procedures are complete. **(T-0)**

21.4.8. Group LOTO. A group LOTO procedure may be appropriate when multiple authorized workers perform servicing, maintenance or modification on the same equipment or machinery and multiple lockout procedures in paragraph **21.4.4** are not feasible.

21.4.8.1. The supervisor shall:

21.4.8.1.1. Determine if a group LOTO procedure is appropriate. **(T-1)**

21.4.8.1.2. Convene a meeting of all members of the group covered by the procedure. **(T-1)**

21.4.8.1.3. Describe tasks to be performed. **(T-1)**

21.4.8.1.4. Delegate primary LOTO responsibility to a designated authorized worker for the group. **(T-0)**

21.4.8.1.5. Ensure each member of the group is trained and authorized to work LOTO IAW paragraph **21.3.5.3** **(T-0)**

21.4.8.2. The designated authorized worker shall:

21.4.8.2.1. Follow each step of the LOTO procedures. **(T-0)**

21.4.8.2.2. Place his/her key(s) inside a gang lock box. Gang lock boxes shall be constructed to permit attaching multiple locks to the outside of the enclosure to prevent opening until all locks are removed. **(T-0)**

21.4.8.2.3. All other workers in the group shall assure each step of the LOTO procedures is complete, then lock and tag the gang lock box to prevent access until all locks are removed. **(T-0)**

21.4.8.2.4. When work is complete, each worker shall remove his/her lock from the gang lock box, the designated authorized worker shall remove his/her lock off of the gang lock box, obtain the key(s) from the lock box and return the equipment to service IAW paragraph **21.4.5** **(T-0)**

21.4.9. Shift Changes. Specific, written procedures shall be developed and used during shift or personnel changes to ensure continuity of lockout and tagout protection. **(T-0)** This includes provision for orderly transfer of LOTO devices between off-going and on-coming supervisors and authorized workers to minimize exposure to hazards from unexpected energization, start-up or release of stored energy from equipment or machinery.

21.4.9.1. The authorized worker going off-shift shall leave his/her lock/tag on the lockout until the oncoming authorized worker has placed his/her own lock/tag on the lockout. **(T-0)**

21.4.9.2. The off-going authorized worker may then remove his/her lock/tag from the lockout.

21.4.9.2.1. The off-going authorized worker shall provide the on-coming authorized worker and supervisor information regarding the status of equipment or machinery affected. **(T-1)**

21.4.9.2.2. All such transfers shall be documented in the appropriate lockout/tagout log. **(T-1)**

21.4.9.3. Verification of the lockout (energy state) shall be performed by a supervisor or designated authorized worker for the on-coming shift prior to any maintenance or servicing on locked out equipment or machinery. **(T-1)** Any authorized worker on the equipment or machinery may verify the lockout status during/after shift change. **Note:** All authorized workers are strongly encouraged to perform their own verification of lockout before performing duties on locked out equipment or machinery.

21.4.9.4. Equipment or machinery shall remain locked out during maintenance and servicing activities. **(T-0)**

21.4.9.5. Basic Shift Change Examples:

21.4.9.5.1. Guiding Principles:

21.4.9.5.1.1. There shall be no loss of LOTO continuity during shift changes. **(T-0)**

21.4.9.5.1.2. Procedures for LOTO during shift changes shall be documented and followed. **(T-0)**

21.4.9.5.1.3. Each authorized worker shall have a specific key, and keys shall not be traded between authorized workers. **(T-0)**

21.4.9.5.2. **Example 1:** Outgoing shift authorized workers need to remove their locks at the end of their shift.

21.4.9.5.2.1. The on-coming shift authorized workers:

21.4.9.5.2.1.1. Apply their locks before the out-going shift authorized workers remove theirs.

21.4.9.5.2.1.2. Perform any necessary LOTO steps.

21.4.9.5.2.1.3. Verify the energy state.

21.4.9.5.3. **Example 2:** Responsibility is transferred between designated authorized workers.

21.4.9.5.3.1. Ideally, both are present for a formal exchange in which on-coming authorized workers apply their locks, and then out-going authorized workers remove theirs.

21.4.9.5.3.2. Keys to LOTO devices in lockboxes may be transferred; however, keys to issued or assigned locks shall not be transferred. **(T-0)**

21.4.9.5.3.3. Other LOTO steps are performed as necessary, including verification of energy state.

21.5. Training.

21.5.1. Both authorized and affected employees as defined by OSHA will receive training IAW 29 CFR 1910.147(c)(7), *The Control of Hazardous Energy, Training and Communication.* **(T-0)** Supervisors shall verify training IAW 29 CFR 1910.147 for both authorized and affected employees is accomplished. **(T-1)**

21.5.2. Recurring Training. Recurring training shall be performed at least annually. **(T-1)** The training shall establish employee proficiency, include an in-depth review of current and previous procedures and introduce a new or revised control methods and procedures, as necessary. **(T-1)**

21.5.3. Retraining. Authorized workers and affected employees shall be retrained IAW 29 CFR 1910.147(c)(7)(iii). **(T-0)**

21.5.4. Training Documentation. All training, e.g., familiarization, initial and recurring, shall be documented. **(T-1)** Training documentation shall be certified current and include each individual's name, type and dates of training on the AF Form 55 or equivalent product IAW AFI 91-202. All training documentation shall be readily available during inspections and LOTO program evaluations. **(T-1)**

21.6. Program Evaluations.

21.6.1. Self-Assessments. Shop LOTO self-assessments shall be conducted by an authorized worker or supervisor annually, to ensure compliance with all program elements. **(T-1)** Self-assessments shall be designed to correct any deviations or inadequacies observed. **(T-1)** The assessment shall be documented, provide for a demonstration of the procedures and include, as a minimum: **(T-1)**

21.6.1.1. Identification of equipment and machinery for which the LOTO program applies.

21.6.1.2. Review of LOTO log books for equipment or machinery in LOTO program.

21.6.1.3. A review of each worker's responsibilities under the program.

21.6.1.4. That all necessary training has been conducted, is current and properly documented.

21.6.1.5. The date of the inspection and the unit representative conducting the self-inspection.

21.6.2. Annual Inspection. Functional managers and commanders shall ensure annual inspections of LOTO procedures within their organization are conducted by an individual above the shop level supervisor to verify and document effectiveness of the energy control procedures. **(T-1)** A qualified occupational safety inspector shall review LOTO inspection reports during organization safety inspections to ensure compliance. **(T-1)** The inspection shall include, as a minimum:

21.6.2.1. Review of LOTO procedures with authorized workers. **Note**: If only tag-out is used for energy control the review will include affected workers. **(T-0)** Refer to paragraph **21.4.3** for tag-out only procedures.

21.6.2.2. Observation of LOTO procedures to ensure workers understand and follow procedures. **(T-0)**

21.6.2.3. Review of training and self-assessment documentation to ensure LOTO requirements are met. **(T-1)**

21.6.2.4. Out-brief of shop or unit supervisor or, as appropriate, documented in the written report. **(T-1)**

21.7. Sample Lockout/Tagout Procedures. The following sample lockout/tagout procedures are provided to help supervisors and authorized workers comply with requirements in this chapter and 29 CFR 1910.147. It includes a basic LOTO checklist for developing LOTO procedures.

21.7.1. Preparation for Lockout/Tagout. Workers required to use LOTO procedures shall be knowledgeable of the type and magnitude of the energy, the hazards to be controlled and the method or means to control the energy. Authorized workers shall notify all affected workers of the application of LOTO devices before they shut down equipment or machinery. **(T-0)**

Notification shall be given prior to controls being applied and after controls are removed from equipment or machinery. **(T-0)**

21.7.1.1. There are four (4) common types of energy sources: electrical (most common form), hydraulic or pneumatic, fluids and gases, and mechanical. Some equipment or machinery uses more than one energy source, so equipment-specific procedures shall be followed to properly identify and lockout/tagout all energy sources. **(T-0)**

21.7.2. Electrical.

21.7.2.1. Shutoff power at machine and disconnect.

21.7.2.2. Disconnecting means shall be locked and tagged. **(T-0)**

21.7.2.3. Press start button to verify correct systems are locked out.

21.7.2.4. Return controls to their safest position.

21.7.2.5. Safety precautions:

21.7.2.5.1. Capacitors, if present, shall be drained of stored energy. **(T-0) Warning:** Workers should be aware that capacitors may take several minutes to completely discharge.

21.7.2.5.2. Possible disconnecting methods include: power cords, power panels (look for primary and secondary voltage), breakers, the operator's station, motor circuit relays, limit switches or electrical interlocks.

21.7.2.5.3. Some equipment may have a motor isolating shutoff and a control isolating shutoff.

21.7.2.5.4. If electrical energy is removed by simply unplugging the power cord, the cord shall be kept under control of the authorized worker or the cord's plug end locked out or tagged out. **(T-0)**

21.7.3. Hydraulic/Pneumatic.

21.7.3.1. Shut off all energy sources (pumps and compressors). If pumps and compressors supply energy to more than one piece of equipment or machinery, lockout/tagout the valve supplying energy to the equipment or machinery.

21.7.3.2. Drain and bleed stored pressure from hydraulic/pneumatic lines. **Caution:** Draining and bleeding hydraulic/pneumatic lines and accumulators could cause equipment movement. Use manufacture actuator/cylinder locking devices, as required.

21.7.3.3. Ensure controls are returned to their safest position (off, stop, standby, etc.). **(T-0)**

21.7.4. Fluids and Gases.

21.7.4.1. Identify the type of fluid or gas.

21.7.4.2. Close valves to prevent flow, then lockout/tagout.

21.7.4.3. Determine the isolating device, close and lockout/tagout.

21.7.4.4. Drain and bleed lines to zero energy state. Also see paragraph **21.7.3.2** **Note:** Some systems may have electrically controlled valves. If so, they must be shut off, locked and tagged out. **(T-0)**

21.7.4.5. Check for zero energy state at the equipment or machinery.

21.7.5. Mechanical Energy (gravity activation or stored in springs, etc).

21.7.5.1. Block out or use safety chain.

21.7.5.2. Apply lockout and tagout safety device(s).

21.7.5.3. Shut off and lockout/tagout electrical system.

21.7.5.4. Check for zero energy state.

21.7.5.5. Return controls to safest position.

21.7.6. Release from Lockout/Tagout.

21.7.6.1. Inspection. Ensure work is complete, tools inventoried and equipment used is serviced, maintained and any modification is complete. **(T-1)**

21.7.6.2. Clean-up. Remove all towels, rags, work-aids, chemicals/lubricant spills, etc.

21.7.6.3. Replace guards. Replace all guards possible. Sometimes a guard may need to be left off until the start sequence is over to allow adjustment. However, all other guards should be in place.

21.7.6.4. Check controls. All controls shall be in their safest position. **(T-0)**

21.7.6.5. The work area shall be checked to ensure all employees are safely positioned and notified that lockout/tagout devices are being removed. **(T-0)**

21.7.6.6. Remove locks/tags. Remove only issued or assigned locks and tags.

21.7.7. Procedures involving more than one worker. When more than one authorized worker performs servicing, maintenance or modification, each authorized worker shall place his/her own lock and tag on the energy-isolating source. **(T-0)** If the equipment cannot be locked out, then each authorized worker must place his or her tag on the equipment or machinery. **(T-0)**

21.7.8. Removal of Authorized Worker's Lock. When a supervisor removes an authorized worker's lockout/tagout, he/she shall verify the authorized worker who applied the device is not in the facility, make a reasonable effort to advise the worker his/her device has been removed and ensure the worker is informed his/her device was removed before he/she resumes work. **(T-0)** The supervisor shall return the worker's LOTO devices and keys. Refer to paragraph **21.4.6**

21.8. Contractors. IAW DoDI 6055.01, responsibilities for the safety and health of contractor operations are generally limited to protecting DoD and Air Force operations and the safety of DoD personnel, facilities and equipment. IAW Section 3704 of Title 40, United States Code (U.S.C.) and Sections 36.513, 52.236-13, 323.70 and 352.223.70 of Title 48, CFR (References [af] and [ag]), contractors are responsible for safety and health risks to their personnel and the protection of the public, except where DoD has contractually agreed to assume responsibility for the contract employee's health and safety. The DoD Components may establish additional oversight of contractor operations where they determine it is in the best interest of DoD. In making this

determination, the DoD components must consider the relative merits of DoD oversight leading to lower mishap losses, improved services and ultimate savings to the government, versus the liability for legal and tort claims and compensation liability by acting as a controlling employer. DoD responsibilities must be clearly stated in contract language, including DoD contractor personnel deploying with the force. **(T-0)** Refer to DoDI 6055.01, Enclosure 5, for additional information. supervisors and safety and health professionals will contact the installation Contracting Office or Army Corps of Engineers of Engineers for Corp projects when any doubt exists about whether a contractor is in compliance with contract safety and health specifications.

21.8.1. When contractor personnel are engaged in activities covered by this standard, the on-site supervisor and contractor shall inform each other of their respective lockout/tagout procedures. **(T-0)** The on-site supervisor shall ensure their personnel understand and comply with the contractor's energy control procedures. **(T-0)** Air Force and contractor personnel conducting joint lockout/tagout operations shall use requirements in this standard. **(T-1)** These details will be specified in the contract. **(T-1)**

21.8.2. The unit supervisor and the authorized worker most familiar with the equipment or machinery being serviced by the contractor shall ensure the contractor is provided specific information related to the known hazards of the work to be conducted, e.g., type and magnitude of energy sources. **(T-1)** All affected workers shall be made aware of the contractors work and the need to follow prescribed related safety procedures.

21.8.3. Air Force personnel are restricted from accessing contractor work areas, unless working in conjunction with the contractor. **(T-1)** If this is impractical or cannot be accomplished, the on-site Air Force supervisor shall assure the contractor's work does not jeopardize Air Force employees, equipment and property. **(T-1)**

Chapter 22

FLAMMABLES AND COMBUSTIBLES

22.1. Scope. This chapter addresses key flammable and combustible liquids criteria, specific aspects of flammable and combustible liquids storage, use and handling, and implements 29 CFR 1910.106, *Flammable Liquids,* and National Fire Protection Association 30, *Flammable and Combustible Liquids Code.* It includes storage (inside/outside), use and handling of these liquids in containers or tanks of 60 gallons or less and in portable tanks up to 660 gallons capacity. It also includes storage in fuel tanks of two (2) gallons or less located on small gasoline-powered equipment such as lawnmowers and snow-blowers. It does not apply to petroleum products in fuel tanks of motor vehicles, aircraft, boats, other watercraft, large portable or stationary engines, petroleum products in portable tanks over 660 gallons, alcoholic beverages when packed in individual glass, plastic, metal or ceramic containers not exceeding 4 liters in volume, medicines, foodstuffs and cosmetics, special purpose vehicles designed and maintained for storage and transportation of flammable or combustible liquids, or liquids having no flashpoint which may not burn under normal conditions. **Note:** While this section deals primarily with flammable and combustible liquids, flammable and combustible gases in compressed gas cylinders present similar fire hazards. Gases in cylinders, e.g., acetylene, propane, hydrogen, shall be stored and handled IAW 29 CFR 1910.101, *Compressed Gases* (General Requirements) and National Fire Protection Association 55, *Compressed Gases and Cryogenic Fluids Code*. **(T-0)** Use of these gases shall comply with requirements in this standard, National Fire Protection Association 70, *National Electric Code*, and National Fire Codes related to use and storage of flammable materials. **(T-1)**

22.1.1. Flammable Liquids. A flammable liquid has a closed cup flashpoint below 100 degrees Fahrenheit (F) (37.8^{o} C) and a vapor pressure not exceeding 40 pounds per square inch, gauge (2068 millimeters [mm] mercury [Hg]) at 100 degrees F (37.8^{o} C). Flammable liquids are categorized as Class I liquids and are further subdivided as follows below. Refer to National Fire Protection Association 30, *Flammable and Combustible Liquids Code*, for additional information and guidance on flammable liquids. **Note:** There are a few chemicals with a flashpoint outside these limits, such as anhydrous ammonia, that are still considered flammable liquids. Refer to **Table 22.1** for additional information.

22.1.2. Combustible Liquid. A liquid having a closed cup flashpoint at or above 100° F (37.8^{o} C). Combustible liquids are categorized as Class II or Class III liquids. Refer to **Table 22.1** for additional information.

22.2. Hazards. Flammable and combustible liquids require careful handling at all times. Many of these liquids are used by the Air Force, and mishandling is a significant cause of injury or occupational illness. Hazards associated with use of flammable or combustible liquids include explosions, burns from fire, chemical burns, asphyxiation, inhalation of vapors, absorption through the skin, skin irritation and eye damage from direct contact or exposure. The volatility of flammable or combustible liquids is increased by heat and, when heated to temperatures higher than their flashpoints, they present a greater hazard. The best means of employee protection is to engineer hazards out of the job so the employee is not exposed. If this is not possible, PPE may be required. A documented job hazard analysis (JHA) shall be conducted to determine if hazards are present and take actions necessary to protect employees from injury, illness or death. **(T-0)** Refer to paragraph **1.5** and AFI 91-202 for additional guidance on JHA.

22.2.1. Solvents with flammable characteristics must be handled with care. **(T-0)** Solvents can burn or explode if handled or used improperly.

22.2.2. Some flammable and combustible liquids are highly reactive with other substances, subject to explosive decomposition or have other properties that dictate extra safeguards. Contact the installation Occupational Safety office, FES Flight or BE when in doubt or for additional guidance. The following lists some common water-reactive substances:

22.2.2.1. Alkali Metals (Lithium [Li]).

22.2.2.2. Potassium [K].

22.2.2.3. Sodium [Na].

22.2.2.4. Cerium [Ce].

22.2.2.5. Calcium [Ca].

22.2.2.6. Hydrides.

22.2.2.7. Phosphorous Trichloride.

22.2.2.8. Phosphorous Pentasulfide.

Note: Water-reactive materials shall not be stored where fire protection sprinklers are in place. **(T-0)** These materials shall not be stored with flammable or combustible liquids. **(T-0)** Refer to 29 CFR 1910.106 and the latest edition of the Emergency Response Guide. Ensure emergency response personnel are advised that water-reactive materials are present. **(T-0)**

22.2.3. Sparks resulting from accumulation of static electricity can ignite flammable vapors or gases. The flow of flammable liquids through non-conductive hoses or passages can also produce static charges. Unless safely conducted to a ground, these charges accumulate and become an ignition source. Refer to National Fire Protection Association 30 for additional guidance.

22.2.4. Supervisors and employees engaged in operations where fuels, solvents or other flammable liquids are used must be constantly alert and avoid unsafe practices. **(T-0)** It is hazardous to use fuels (such as gasoline) to clean floors or clothing, or use open solvent or gasoline containers near electrical equipment or pilot lights. The use of low-flashpoint petroleum solvents shall be avoided, when possible. **(T-0)** Open flames, open heaters, equipment not properly grounded and non-explosion proof electrical equipment shall not be used in the presence of flammable or combustible liquids. **(T-0)** Refer to National Fire Protection Association 30 for additional guidance.

22.3. Training.

22.3.1. Functional Managers and/or Supervisors shall ensure:

22.3.1.1. All employees and handlers of flammable or combustibles have accomplished appropriate training associated with tasks and hazards related to the work environment. **(T-0)**

22.3.1.2. Personnel handling, storing or using hazardous materials are trained IAW AFI 90-821, *Hazard Communication (HAZCOM) Program.* **(T-0)**

22.3.1.3. Individuals involved in dispensing of flammable or combustible liquids are instructed on hazards of static electricity. **(T-0)**

22.3.1.4. Employees handling and storing flammable or combustible liquids are trained in fire prevention and protection as it relates to their duties. **(T-0)**

22.3.2. Job safety training shall include, as a minimum, information on the need for and use of approved PPE; maintenance and care of PPE, safe chemical handling procedures; and emergency treatment practices in case of exposure, ingestion or inhalation of liquids or vapors. **(T-0)** Refer to **Chapter 14,** *Personal Protective Equipment (PPE)*, and AFI 90-821 for additional guidance.

22.4. Personal Protective Equipment (PPE).

22.4.1. PPE shall be used whenever there are hazards that can do bodily harm through absorption, inhalation or physical contact. **(T-0)** This equipment includes respiratory protective devices, special clothing and protective devices for the eyes, face, head, torso and extremities. All PPE shall be approved for the work performed and shall be maintained in satisfactory condition. **(T-0)** Refer to **Chapter 27** for additional requirements.

22.4.2. Functional Managers and/or Supervisors shall ensure PPE is available and appropriately worn when handling flammable or combustible liquids. **(T-0)**

22.4.3. Air Force personnel shall comply with all PPE requirements when handling flammable or combustible liquids. **(T-0)**

22.5. Housekeeping. Where flammable and combustible liquids are used or handled, except in closed containers, means shall be provided to dispose promptly and safely of leakage or spills. **(T-0)** Refer to the appropriate SDS for spill clean-up procedures and PPE required.

22.5.1. Leaking containers shall be removed to a safe location outside the building, and the contents transferred to an undamaged container IAW guidance from the installation FES Flight and Environmental Management office. **(T-0)**

22.5.2. Functional Managers and/or Supervisors shall ensure:

22.5.2.1. Appropriate spill and containment control materials are readily available at storage or dispensing areas. **(T-0)**

22.5.2.2. Leakage and spills are cleaned up in a timely manner. **(T-0)**

22.5.2.3. All containers are clearly labeled to identify contents and indicate hazards. **(T-0)**

22.6. Fire Protection.

22.6.1. Facility Pre-Fire Plans. Facility pre-fire plans shall be developed for flammable and combustible liquid warehouses, laboratory and storage buildings. **(T-0)** These plans shall be maintained in the installation FES Flight and on vehicles designated by the Fire Chief. **(T-1)** Refer to AFI 32-2001, *Fire Emergency Services (FES) Program,* for additional information. The plans include the hazardous materials contained in installation facilities, their locations and emergency procedures to be followed.

22.6.2. Inside Rooms Requirements. For inside room storage capacity and required fire resistive ratings refer to 29 CFR 1910.106, Table H-13. Storage rooms shall not have an opening into any portion of a building used by the public. **(T-0)** At least one clear 3-foot wide

aisle shall be maintained in all inside storage areas. **(T-0)** Containers in excess of 30-gallon capacity shall not be stacked. **(T-0)** Dispensing shall be IAW paragraph **22.7.1.3** for Class I flammable liquids. **(T-1)** All other dispensing shall be by approved pump or self-closing faucet only. **(T-0)** Refer to National Fire Protection Association 30 for additional information.

22.6.2.1. At least one portable fire extinguisher having a rating of at least 40-B shall be located outside of, and within 10 feet of, the door opening into an inside liquid storage area. **(T-0)**

22.6.2.2. At least one portable fire extinguisher rated at least 40-BC shall be located within 30 feet of any Class I or Class II liquid storage area outside of a storage room but inside a building. **(T-0)**

22.6.2.3. Installed fire suppression systems shall be approved IAW UFC 3-600-01, *Fire Protection Engineering for Facilities*. **(T-0)** Additionally, consult the installation FES Flight for further guidance.

22.6.3. Storage Inside Buildings

22.6.3.1. Storage shall not physically obstruct a means of egress from the building or area and not be placed in such a manner that a fire would prevent safe egress from the area. **(T-0)**

22.6.3.2. If a flammable and combustible liquids storage building is used, it shall be one-story and devoted principally to handling and storing of flammable or combustible liquids. **(T-0)** The building shall have a 2-hour fire-rated exterior wall with no openings within 10 feet of stored material. **(T-0)**

22.6.3.3. At least one portable fire extinguisher with a rating of at least 12-B shall be located outside of, but not more than 10 feet from, the door opening into any room used for storage of flammable or combustible liquids. **(T-0)**

22.6.4. Storage Outside

22.6.4.1. At least one portable fire extinguisher rated at least 20-B shall be located 50 feet travel distance from any Class I or Class II liquid storage area outside of a storage room. **(T-0)**

22.6.4.2. Installed fire suppression systems shall be approved IAW UFC 3-600-01. **(T-0)** Contact the installation FES Flight for further guidance.

22.6.4.3. Welding, cutting or brazing shall be accomplished IAW **Chapter 27**. **(T-1)** Refer to **Chapter 27** and 29 CFR 1910.252, *Welding, Cutting and Brazing*, for additional guidance.

22.6.5. All laboratories shall have fire protection appropriate for their fire hazard classification. (T-0) Fire protection shall include, as a minimum, portable fire extinguishers, an alarm system and an evacuation and emergency plan. **(T-0)** For additional details regarding required fire protection requirements, refer to National Fire Protection Association 45, *Standard for Fire Protection for Laboratories Using Chemicals*.

22.7. Building and Equipment Requirements.

22.7.1. Electrical.

22.7.1.1. Electrical wiring and equipment located in inside storage rooms used to store Class I liquids shall meet requirements for Class I, Division 2 hazardous classified locations. **(T-0)** Refer to 29 CFR 1910.106 and National Fire Protection Association 70 for additional guidance.

22.7.1.2. Electrical equipment and wiring in inside storage rooms used to store only Class II and Class III liquids shall be suitable for general purpose use. **(T-0)**

22.7.1.3. Containers and portable tanks used for Class I liquids shall be electrically grounded and bonded during liquid transfer. **(T-0)** Positive measures shall be taken to eliminate any source of ignition: open flames, electrical, smoking, cutting and welding, hot surfaces, static, mechanical sparks, radiant heat or spontaneous ignition sources. **(T-0)**

22.7.2. Ventilation. Liquid storage areas where dispensing is conducted shall be provided with either a gravity or continuous mechanical exhaust ventilation system. **(T-0)** Areas in which flammable or combustible liquids are transferred from one container to another tank or container in quantities greater than 5 gallons shall be separated from other similar operations by 25-feet or by construction with a fire resistance of at least one (1) hour. **(T-0)** Drainage or other means shall be provided to control spills. **(T-0)** Adequate natural or mechanical ventilation shall be provided to maintain the concentration of flammable vapors at or below 10 percent lower explosive limit (LEL). **(T-0)** Mechanical ventilation shall be used if Class I liquids are dispensed within the room. **(T-0)** Refer to 29 CFR 1910.106 for additional information.

22.7.2.1. Exhaust air shall be taken from a point near a wall on one side of the room and within one (1) foot of the floor with one or more make-up inlets located on the opposite side of the room within one (1) foot of the floor. **(T-0)** The location of both the exhaust and inlet air openings shall be arranged to provide air movement across all portions of the floor to prevent accumulation of flammable vapors. **(T-0)**) Exhaust from the room shall be directly to the exterior of the building without re-circulation. **(T-0)**

22.7.2.2. Mechanical ventilation systems shall provide for a complete change of air within the room at least six (6) times per hour. **(T-0)** If a mechanical exhausting system is used, it shall be controlled by a switch located outside the door. **(T-0)** The ventilating equipment and any lighting fixtures shall be operated by the same switch. **(T-0)** The switch shall be illuminated or an electric warning pilot light shall be adjacent to the switch if flammable liquids are dispensed within the room. **(T-0)** The mechanical ventilation system for dispensing areas shall be equipped with an airflow switch or equally reliable method interlocked to sound an audible alarm upon failure of the ventilation system. **(T-0)**

22.7.2.3. Ventilation ducts and airflow requirements shall comply with National Fire Protection Association 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids.* **(T-1)**

22.7.3. Storage Cabinets. All flammable/combustible storage cabinets shall be listed/approved for the specific class of storage. **(T-0)** Not more than 120 gallons (460 liters) of Class I, Class II and Class IIIA liquids may be stored in a storage cabinet. The combined total of Class I and Class II liquids may not exceed 60 gallons per storage cabinet, nor more than 120 gallons of Class III liquids may be stored in a storage cabinet. Not more than three (3) such cabinets (120 gallons each) may be located in a single fire area except in an industrial area. Refer to

Attachment 1 for definition of a fire area. Additional cabinets may be located in the same fire area of an individual area if the additional cabinet, or group of more than three (120 gallons each) cabinets, is separated from other cabinets or group of cabinets by at least 100 feet. The total aggregate volume of Class I, Class II and Class IIIA liquids in a group of storage cabinets shall not exceed maximum allowable quantity of flammable and combustible liquids per control area based on the occupancy where the cabinets are located. **(T-0)** The maximum allowable quantities of liquids allowed in each control area shall not exceed the amounts specified in National Fire Protection Association 30, Table 9.6.1. **(T-0)** If a unit requires more than three (3) storage cabinets, it must coordinate with the FES Flight. **(T-1)** Refer to National Fire Protection Association 30, Table 9.6.1, for additional information. **Note:** The limit of three (3) cabinets in a single area can be increased where smaller cabinets are used. However, the maximum amount of flammable storage cannot exceed that which could be stored in three 120 gallons capacity cabinets (460 liters). **(T-0)**

22.7.3.1. HAZMAT Pharmacies and Other Areas that may Exceed Maximum Allowable Quantities Limit. In HAZMAT Pharmacies, buildings and/or portions of buildings where liquids are stored that may exceed maximum allowable quantities per control area shall be classified as High-Hazard Level 2 or High-Hazard Level 3, as established by National Fire Protection Association 30. **(T-0)**

22.7.3.1.1. High-Hazard Level 2. Contents that present a deflagration hazard or a hazard from accelerated burning. This includes Classes I, II and IIIA liquids that are used or stored in normally open containers or systems, or in closed containers or systems at gauge pressures 15 psi or greater.

22.7.3.1.2. High-Hazard Level 3. Contents that readily support combustion or that present a physical hazard. This includes Classes I, II and IIIA liquids that are used or stored in normally closed containers or in closed containers or systems at gauge pressures of less than 15 psi.

22.7.3.2. Cabinets shall be labeled with conspicuous lettering, "Flammable — Keep Fire Away." **(T-0)** Additional guidance for marking storage containers is contained in **Chapter 29,** *Mishap Prevention Signs and Tags.*

22.7.3.3. The cabinet is not required to be vented for fire protection purposes. However, the following shall apply:

22.7.3.3.1. If the cabinet is vented, for whatever reasons, the cabinet inlet shall be vented outdoors in a manner that will not compromise performance of the cabinet. **(T-0)**

22.7.3.3.2. If the cabinet is not required to be vented, the vent opening, as applicable, shall be sealed with bungs supplied with the cabinet or specified by the manufacturer of the cabinet. **(T-0)**

22.7.3.4. Storage cabinets that meet at least one of the following sets of requirements shall be acceptable for the storage of liquids.

22.7.3.4.1. Storage cabinets designated and constructed to limit the internal temperature at the center of the cabinet and 1 inch (2.5 centimeter [cm]) from the top of the cabinet to not more than 325º F (162.8º C), when subjected to a 10-minute fire

test that simulates the fire exposure of the standard time-temperature curve specified in American Society for Testing Materials E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, shall be acceptable. **(T-0)** All joints and seams shall remain tight and the door shall remain securely closed during the test. **(T-0)**

22.7.3.4.2. Metal storage cabinets constructed in the following manner are acceptable. The bottom, top, door and sides of the cabinet shall be at least No. 18 gauge sheet steel and double-walled, with 1 1/2 inches (38 mm) of air space. **(T-0)** Joints shall be riveted, welded or made tight by some equally effective means. **(T-0)** The door shall have a three-point latch arrangement and a doorsill raised at least 2 inches (50 mm) above the bottom of the cabinet to retain spilled liquid within the cabinet. **(T-0)**

22.7.3.4.3. Wooden cabinets constructed in the following manner are acceptable. The bottom, sides and top shall be constructed of exterior grade plywood at least 1 inch (25 mm) thick that shall not break down or delaminate under fire conditions. **(T-0)** All joints shall be rabbeted and fastened in two directions with wood screws. **(T-0)** Where more than one door is used, there shall be a rabbeted overlap of at least 1 inch (25 mm). **(T-0)** Doors shall be equipped with a means of latching and hinges shall be constructed and mounted in such a manner as to not lose their holding capacity when subjected to fire. **(T-0)** A raised sill or pan capable of containing 2 inches (50 mm) of liquid shall be provided at the bottom of the cabinet to retain spilled liquid within the cabinet. **(T-0)**

22.7.3.5. Grounding or bonding of flammable/combustible liquid storage cabinets is not required whenever the cabinet meets national fire codes and OSHA requirements for design materials and for quantities of liquids stored.

22.7.4. Inside Storage Rooms. Refer to National Fire Protection Association 30 for additional guidance.

22.7.4.1. Inside storage rooms shall meet specifications of American Society for Testing Materials E119 – 16a and the required fire-resistive rating for their use. **(T-0)** Openings to other rooms or buildings shall have noncombustible liquid-tight raised sills or ramps at least four (4) inches in height or, as an alternative, the floor in the storage area shall be at least four (4) inches lower than the surrounding floor. **(T-0)** Rooms shall be liquid-tight where walls join the floor. **(T-0)** An additional alternative to the sill or ramp is an open-grated trench inside the room draining to a safe location. Self-closing fire rated doors meeting requirements of National Fire Protection Association 80, *Fire Doors and Other Opening Protectives*, shall be used. **(T-0)** Where other portions of the building or other properties are exposed, windows shall be protected as required by National Fire Protection Association 80. **(T-0)** Wood of at least 1-inch nominal thickness may be used for shelving, racks, dunnage, scuffboards and floor overlay.

22.7.4.2. Class I liquids shall not be stored or handled within a building having a basement or pit where flammable vapors can travel, unless such area is provided with ventilation that will prevent the accumulation of flammable vapors. **(T-0)**

22.7.5. Storage Inside Buildings. When storage of flammable or combustible liquids is required and the storage is incidental and not the primary purpose of the area, storage shall

comply with National Fire Protection Association 30 (Refer to 29 CFR 1910.106. for additional information): **(T-0)**

22.7.5.1. Storage shall not physically obstruct a means of egress from the building or area and not be placed in such a manner that a fire would prevent safe egress from the area. **(T-0)**

22.7.5.2. Water reactive materials shall not be stored in the same room with flammable or combustible liquids. **(T-0) Exception:** Small quantities may be stored in laboratories. Refer to paragraph **22.6.1** and National Fire Protection Association 30 for additional guidance.

22.7.5.3. Base supply warehouses, Army and Air Force Exchange Service (AAFES) storage rooms and commissary storage areas shall be IAW 29 CFR 1910.106, Table H-14. **(T-0)** Buildings or portions of such buildings utilized for flammable and/or combustible storage shall be isolated by standard fire walls approved for the type and quantity of liquids being stored. **(T-0)** Materials which create no fire hazard may be stored in the same area.

22.7.5.4. When flammable or combustible liquid warehouse or storage is within 50 feet of a building or adjoining property line that may be built upon, the wall facing the building or property lines shall be a blank wall having a fire-resistance rating of at least 2 hours. **(T-0)**

22.7.5.5. The total quantity of liquids within a building is not restricted, but arrangement of storage shall comply with 29 CFR 1910.106, Table H-14 and Table H-15. **(T-0)**

22.7.5.6. Stacked containers of flammable liquids shall be separated by pallets or dunnage, where necessary, to provide stability and to prevent excessive stress on container walls. **(T-0)** Refer to paragraph **22.6.2** for guidance on stacking containers.

22.7.5.7. Portable tanks stored over one tier high shall be designed to nest securely, without dunnage. **(T-0)** Adequate materials handling equipment shall be available to handle tanks safely at the upper tier level. **(T-0)**

22.7.5.8. No stack shall be closer than three (3) feet to the nearest beam, chord, girder or other construction member and shall be at least three (3) feet below sprinkler deflector or discharge orifice of water spray or other installed fire protection systems. **(T-0)**

22.7.5.9. Aisles at least three (3) feet wide shall be provided for clear access to all doors, windows or fire department standpipe connections. **(T-0)**

22.7.6. Outside Storage. 29 CFR 1910.106, Table H-16 and Table H-17 provide maximum quantities and separation criteria for outside storage of flammable and combustible liquids. Refer to 29 CFR 1910.106 for additional information.

22.7.6.1. Maximum storage of 1,100 total gallons may be located adjacent to other buildings provided: (Reference National Fire Protection Association 30.)

22.7.6.1.1. A minimum distance of 10 feet is maintained between buildings and nearest container. **(T-0)**

22.7.6.1.2. The storage area is graded IAW paragraph **22.7.6.3** **(T-0)**

22.7.6.1.3. The storage area is protected against tampering or unauthorized entry where necessary and kept free of weeds, debris and other combustible material not necessary to the storage. **(T-0)**

22.7.6.2. Where the quantity stored exceeds 1,100 gallons, refer to 29 CFR 1910.106, Table H-17 for quantities and separation distances.

22.7.6.3. The storage area shall be graded to divert possible spills away from buildings or other facilities or shall be surrounded by a curb at least six (6) inches high. **(T-0)** When curbs are used, provisions shall be made for draining accumulations of ground or rainwater or spills of flammable or combustible liquids. **(T-0)** Drains shall terminate at a safe location and shall be accessible and operate under fire conditions. **(T-0)**

22.7.7. Incidental Storage of Flammable Liquids in Industrial Areas. Incidental storage shall be authorized only after the following requirements are met: (Reference National Fire Protection Association 30.)

22.7.7.1. Incidental storage shall be in industrial areas only. **(T-0)**

22.7.7.2. Storage shall be in metal cabinets stenciled, "FLAMMABLE—KEEP FIRE AWAY" (metal wall lockers meet this requirement). **(T-0)**

22.7.7.3. Storage shall be limited to 1 gallon (4 liters) of Class I or 10 gallons (40 Liters) of Class II and Class III liquids, not to exceed 10 gallons (40 liters) total per cabinet, in closed containers. (T-0) Storage shall be limited to a 5-day supply of flammables in a metal cabinet, and in closed containers not to exceed limits specified in paragraphs **22.6.2** and **22.7.6** **(T-0)** Each work center shall be limited to one cabinet. **(T-1)**

22.7.7.4. The installation FES Flight shall be consulted prior to establishing incidental storage areas in industrial shops. **(T-1)**

22.7.8. Laboratories. Many laboratory operations require special control flammable and combustible liquids to protect personnel and equipment. Two types of laboratories are covered by this section: general laboratories and health-related laboratories. Refer to National Fire Protection Association 30 for additional guidance.

22.7.8.1. A list of working supplies and operating instructions on handling flammable and combustible liquids shall be published. **(T-0)** The aggregate total outside of storage cabinets in any laboratory shall not exceed 10 gallons. **(T-0)** All quantities of flammable and combustible liquids in one laboratory in excess of 10 gallons shall be stored in an approved storage cabinet or in an approved storage room. **(T-0)** Flammable or combustible liquids shall not be stored or transferred from one vessel to another in any exit way, corridor or passageway leading to an exit. **(T-0)** A minimum of one approved storage room shall be available within any building housing a laboratory which regularly maintains a reserve storage capacity in excess of 300 gallons. **(T-0)** Refer to National Fire Protection Association 45 for additional guidance.

22.7.8.2. Flammable or combustible liquids shall not be brought into a laboratory, receiving area, storage area or storage facility unless design, construction and fire protection requirements are suitable for the hazard and quantity involved. **(T-0)** Container types and maximum capacities shall comply with National Fire Protection Association 45, Chapter 9, to include Table 9.1.2., as appropriate. **(T-0)** Plastic containers, if used to avoid

breakage problems posed by glass containers or contamination problems with metal containers, must be approved for the liquid used. **(T-0)** Containers used to draw from an original container must be marked to identify their contents. **(T-0)** Refrigerators or cooling equipment used to store or cool flammable liquids shall be approved for the material being stored or cooled and labeled or stenciled, "Approved for Flammable Liquid Storage." **(T-0)**

22.7.9. AAFES, Commissaries and Associate Retail Stores. In rooms or areas accessible to the public, storage of flammable and combustible liquids shall be limited to quantities needed for display and normal merchandising purposes, not to exceed two (2) gallons per square foot of gross floor area. **(T-0)** The gross floor area used for computing the maximum quantity permitted is that portion of the store actually being used for merchandising flammable and combustible liquids. Refer to National Fire Protection Association 30 for additional guidance.

22.7.9.1. Storage of Class IA liquids shall be prohibited in basement display areas and limited to one (1) gallon per square foot on any other floor. **(T-0)** In areas not protected, storage of Class IB, IC and II liquids on other than the ground floor shall be limited to one (1) gallon per square foot of gross floor area. **(T-0)** Protected shall mean protected with automatic sprinklers installed IAW National Fire Protection Association 13, *Standard for the Installation of Sprinkler Systems.* **(T-0)**

22.7.9.2. On floors above ground level, storage or display of Class I and Class II liquids shall be limited to 60 gallons in unprotected occupancies and 120 gallons in protected occupancies. **(T-0)**

22.7.9.3. Containers in a display area shall not be stacked more than three (3) feet or two (2) containers high, whichever is greater. **(T-0)**

22.7.9.4. Shelving shall be capable of supporting the load and containers on shelves must be arranged so they are not easily knocked off the shelves to the floor. **(T-0)**

22.7.9.5. Storage shall be IAW 29 CFR 1910.106, Table H-14. **(T-0)** Buildings or portions of such buildings utilized for flammable and/or combustible storage shall be isolated by standard fire walls approved for the type and quantity of liquids being stored. **(T-0)** Materials which create no fire hazard to the liquids may be stored in the same area.

22.7.9.6. If the storage building is located 50 feet or less from a building or adjacent property line that may be built upon, the wall facing the building or property lines shall be a blank wall having a fire-resistance of at least two 2 hours. **(T-0)** Refer to 29 CFR 1910.106 for additional information.

22.7.9.7. The total quantity of liquids within the building is not restricted, but the arrangement of storage shall comply with 29 CFR 1910.106, Table H-14. **(T-0)**

22.7.9.8. Stacked containers of flammable liquids shall be separated by pallets or dunnage, where necessary, to provide stability and to prevent excessive stress on container walls. **(T-0)**

22.7.10. Small Gasoline Engine Powered Equipment. This section applies to lawnmowers, snow blowers, generators, outboard marine motors, portable water pumps, small watercraft, powered gardening tools and other implements powered by gasoline engines, typically 5-

horsepower or less. Refer to the latest edition of the National Safety Council's *Accident Prevention Manual* and National Fire Protection Association 30 for additional guidance.

22.7.10.1. Equipment shall be serviced after use and prior to extended off-season storage: **(T-0)**

22.7.10.1.1. Equipment shall be stored IAW manufacturer's instructions. **(T-0)**

22.7.10.1.2. Storage facilities shall be protected against tampering or unauthorized entry and area around the facility shall be kept free of weeds, debris and other combustibles. **(T-0)**

22.7.10.1.3. Workplace storage facilities shall be inspected monthly by supervisor and/or building custodian. **(T-1)** The supervisor and/or building custodian shall document each inspection. **(T-1)**

22.7.10.2. Gasoline powered equipment shall not be stored in military family housing living areas, including basements, unless the storage room or area has walls and is separated from the living area by an un-pierced 1-hour rated fire-resistant partition and ceiling. **(T-1)** All storage areas must be inspected (one-time inspection) and approved by the installation FES Flight. **(T-1)** Subsequent inspections shall be accomplished IAW manufacturer's inspection and on an as required basis as determined by the installation FES Flight. **(T-1)**

22.7.10.3. Custodians of dormitories, multiple living quarters, assembly, institutional, AAFES, commissary and warehouse facilities shall store small gasoline powered equipment in an enclosed 1-hour fire-rated storage room. **(T-1)** Boiler rooms and other utility rooms shall not be utilized as storage areas. **(T-0)**

22.7.10.4. Storage in theaters, conference facilities, open messes, clubs, recreation facilities, dormitories, temporary quarters or multiple unit family housing buildings containing more than three dwelling units, and hotels is limited to 10 gallons or less of Class I and II liquids and 20 gallons or less of Class III liquids stored in an approved storage container or in safety cans. **(T-0)** Refer to 29 CFR 1910.106, Table H-13 for additional guidance on storage in inside rooms.

22.7.10.5. Storage of Class I, II and III liquids is limited to 10 gallons per resident unit. **(T-1)** Included are single residences and those dwellings containing not more than three (3) dwelling units with attached or detached garages.

22.8. Handling and Dispensing.

22.8.1. Containers. Containers and portable tanks shall meet handling, storage and dispensing requirements specified in this standard for the product concerned. **(T-1)** Refer to National Fire Protection Association 30 for additional guidance. Tanks and vats shall be installed so rupture or overflow is contained or controlled through dikes, sumps, etc., per 29 CFR 1910.106. **(T-0)**

22.8.1.1. The capacity of flammable and combustible liquid containers shall be IAW 29 CFR 1910.106, Table H-12, except that glass or plastic containers of no more than 1-gallon capacity may be used for Class IA or IB flammable liquids if: **(T-0)**

22.8.1.1.1. Such liquid would be rendered unfit for its intended use by contact with metal or would excessively corrode a metal container and create leaks. **(T-0)**

22.8.1.1.2. The user's process would require more than one (1) pint of a Class IA liquid or more than one (1) quart of a Class IB liquid of a single assay lot to be used at one time, or would require maintenance of an analytical standard liquid of a quantity not met by the specified standards of liquids available, and the quantity of the standard liquid required in any one control process exceeds one-sixteenth the capacity of the container allowed under 29 CFR 1910.106, Table H-12 for the class of liquid. **(T-0)**

22.8.1.2. Flammable liquids shall be kept in covered containers when not in use. **(T-0)** Refer to National Fire Protection Association 30 for additional information.

22.8.1.3. Storage of flammable and combustible liquids shall be prohibited in office occupancies except when required for maintenance and operation of buildings and equipment. **(T-0)** Such storage shall be the smallest quantity required, in approved self-closing metal containers stored in a storage cabinet or in safety cans or an inside storage room not having a door that opens into that portion of the building used by personnel. (T-0) Maximum quantities shall meet the requirements of the storage cabinet, container or room IAW paragraph **22.7.3** and National Fire Protection Association 30, Table 9.6.1. **(T-1)**

22.8.2. Storage Inside Building.

22.8.2.1. Containers shall remain tightly sealed except when transferred, poured or applied. **(T-0)** Employees shall remove from the storage container only that portion required to accomplish a particular job. **(T-0)**

22.8.2.2. Flammable paints, oils and varnishes in 1 to 5 gallon containers, used for building maintenance purposes, may be stored temporarily in closed metal containers outside approved storage cabinets or rooms if kept at the job site for less than 10 calendar days.

22.8.3. Outside Storage. All containers having flammable or combustible materials shall be protected from heat sources to prevent the contents expanding and pressurizing the container, which could rupture the container. **(T-0)** Open flame or smoking shall not be permitted within 50 feet of flammable or combustible liquid storage areas. **(T-0)**

22.8.4. Laboratories.

22.8.4.1. Flammable and combustible liquids shall not be positioned near Bunsen burners, hot surfaces, steam pipes, valves or other sources of heat. **(T-0)**

22.8.4.2. Refer to AFI 48-158, *Occupational Exposure to Hazardous Chemicals in Laboratories*, for additional information regarding flammable, combustible and hazardous materials handling in laboratories.

22.8.5. Small Gasoline Engine Powered Equipment.

22.8.5.1. Fueling operations shall be conducted in outside areas free from ignition sources. **(T-0)** Fuel tanks shall not be filled or drained inside buildings or other facilities where fuel vapors or other explosive gases can accumulate.

22.8.5.2. Operators shall not refuel a running engine or one that is hot from recent use. They shall allow a minimum of five (5) minutes cooling time before starting refueling operations. **(T-1)**

22.8.5.3. Fueling and/or refueling operations shall be accomplished using a safety can with pouring spout or an appropriate sized funnel. **(T-1)** Care shall be taken not to spill fuel onto hot surfaces. (T-0) Spilled fuel shall be cleaned up before attempts are made to start equipment. **(T-0)**

22.8.5.4. Equipment shall be serviced after use and prior to extended off-season storage to ensure equipment is:

22.8.5.4.1. Thoroughly cleaned. **(T-0)**

22.8.5.4.2. Functioning properly. **(T-0)**

22.8.5.4.3. The fuel tank is drained. **(T-0)**

22.8.5.5. Cleaned and drained small gasoline powered equipment may be stored during the off-season in inspection and testing facilities, munitions maintenance facilities, fire stations, shops and maintenance facilities. However, this equipment shall not be stored in hangars, nose docks, corrosion control, fuel cell repair or missile assembly and repair facilities. **(T-1)** When stored, the equipment shall be isolated from potential ignition sources. **(T-0)**

22.8.6. Handling Flammable and Combustible Liquids at Final Point of Use. Flammable and combustible liquids shall be drawn from or transferred into vessels, containers or portable tanks within a building only through a closed piping system, from safety cans, by means of a device through the top, or from a container or portable tanks by gravity through an approved self-closing valve. **(T-0)** Transferring by means of air pressure on the container or portable tanks is prohibited. **(T-0)** Refer to 29 CFR 1910.106 for additional information.

22.8.6.1. Only approved safety containers shall be used for transporting and dispensing flammable liquids in quantities of five (5) gallons or less. **(T-0)**

22.8.6.2. Flammable liquids shall be kept in covered containers when not actually in use. **(T-0)**

22.8.6.3. Means shall be provided to clean up and remove spills. (T-0) Refer to the appropriate SDS for spill clean-up procedures and PPE required.

22.8.6.4. Class I liquids shall be used only where there are no open flames or other sources of ignition within the area or possible path of vapor travel. **(T-0)**

22.8.6.5. Safety cans or other portable containers of flammable liquids having a flashpoint at or below 80° F shall be red in color with additional clearly visible identification in the form of a yellow band around the container and the contents conspicuously stenciled or painted in black. **(T-0)** If the contents are stenciled or painted in yellow, then the yellow band is not required to be around the container. **Exception:** Shipping containers. Refer to National Fire Protection Association 30 for additional guidance.

22.8.6.6. Disposal. Hazardous materials shall normally be removed and disposed of by a commercial disposal specialist who must comply with published environmental regulations. **(T-0)** Contact the installation environmental management office for assistance. Also refer to AFI 32-7042, *Waste Management*, for additional information.

Table 22.1. Classifications of Flammable and Combustible Liquids.

Designation	Class	Subclass Definition
Flammable	Class I	Any liquid with flashpoint below 100°F; 37.7°C.
	Class IA	Includes liquids having flashpoints below 73°F; 22.7°C and having a boiling point below 100°F; 37.7°C
	Class IB	Includes liquids having flashpoints below 73°F; 22.7°C and having a boiling point at or above 100°F; 37.7°C.
	Class IC	Includes liquids having flashpoints at or above 73°F; 22.7°C and below 100°F; 37.7°C.
Combustible	Class II	Includes those liquids with flashpoints at or above 100°F; 37.7°C and below 140°F; 60°C.
	Class III	Includes those liquids with flashpoints at or above 140°F; 60°C.
	Class IIIA	Includes those liquids with flashpoints at or above 140°F; 60°C and below 200°F; 93.3°C.
	Class IIIB	Includes those with flashpoints at or above 200°F; 93.3°C.

Chapter 23

CONFINED SPACES

23.1. Scope. This chapter addresses the identification, hazards, requirements and procedures of confined spaces in the Air Force. A confined space is a space large enough and configured so an employee can bodily enter and perform assigned work, has limited or restricted means for entry or exit, and is not designed for continuous human occupancy. Examples include aircraft fuel cells, silos, tanks, pits, manholes, vaults, storage bins, etc.

23.1.1. Construction Activities. Employees engaged in construction activities at a worksite with one or more confined spaces shall comply with 29 CFR 1926, Subpart AA, *Confined Spaces in Construction.* **(T-0)**

23.1.2. Hazards. Personnel entering or working in confined spaces may encounter a number of potentially serious hazards. These hazards may include atmospheric hazards such as oxygen deficiency insufficient to support life, oxygen-enriched levels that increase the danger of fire or explosion, flammable or explosive atmospheres and materials, or toxic gases or materials. In addition, the confined space may include electrical, mechanical, engulfment or entrapment hazards that must be locked out, or controlled by other means of securing hazardous energy. Many of these hazards are not readily apparent, nor detectable by odor, or by sight, which may result in workers entering confined spaces without adequate consideration of potential dangers. Workers must consider that all confined spaces may contain unfavorable and unsafe conditions and shall not enter or work in these spaces until tests, evaluation, and prescribed requirements of this standard and any locally-developed procedures are performed to ensure safe conditions exist prior to entry and are maintained during the entire work period. **(T-0)**

23.2. Responsibilities.

23.2.1. Major Commands (MAJCOM), Direct Reporting Units (DRU) and Field Operating Agencies (FOA) with a safety staff that has responsibility for confined space programs will:

23.2.1.1. Ensure program oversight through a variety of means that may include inspections, evaluations and Staff Assistance Visits, to include assistance with resolution of identified deficiencies. **(T-1)**

23.2.1.2. Ensure subordinate units' confined space programs are formally reviewed as part of Safety Program Evaluations. **(T-1)** The review shall include the number and type of confined spaces, the installation's major issues/challenges and the number of entry permits and Master Entry Plans approved. Results of this review will be to determine conformance of the confined space program. **(T-1)**

23.2.1.3. Standardize Master Entry Plan documentation to fit command needs as required.

23.2.2. Installation Occupational Safety (SEG). The Chief of Occupational Safety/Occupational Safety Manager will:

23.2.2.1. Serve as the focal point for implementation of this standard. **(T-1)**

23.2.2.2. Coordinate the installation confined space program. **(T-1)**

23.2.2.3. Lead the installation Confined Space Program Team. **(T-1)**

23.2.2.4. Ensure any occupational safety representative on the Confined Space Program Team is trained in confined space program requirements. **(T-1)** This training shall include a formal confined space course and a hands-on portion. **(T-0)** Formal training may be accomplished via computer-based training, available through the AFCEC Virtual Learning Center under the Advanced Distribution Learning System Gateway, the OSHA Course 226, *Permit-Required Confined Space Entry*, or other MAJCOM-approved computer-based training. Hands-on training will cover the requirements of this guidance and specific local issues and conditions. **(T-1)** Training shall be documented in the individual's on-the-job training (OJT) records. **(T-1)** The AFCEC Virtual Learning Center Computer-based Training, *Confined Space General Worker: Entrant, Attendant, and Supervisors Course*, has been developed to ensure all personnel involved in confined space operations are trained on confined space program requirements. Each MAJCOM or installation may develop and present training in methods (power point presentations, training plans, etc.) other than computer-based training.

23.2.2.5. Maintain confined space records provided by the organization, whether located on or off the installation (e.g., geographically separated units) for no less than one year. **(T-1)** Records will include a listing of all permit-required and non-permit confined spaces. **(T-1)** Listing, at a minimum, shall include unit and location of the confined space. **(T-0)** A map of the confined spaces may be included, but is not mandatory. Additionally:

23.2.2.5.1. Verify all possible means have been employed in an effort to reduce the hazard classification of the space. **(T-0)**

23.2.2.5.2. Verify organizational entry supervisors are trained, qualified and experienced to authorize permit-required confined space entries. **(T-0)**

23.2.2.5.3. Verify organizational procedures and confirm appropriate rescue teams and equipment are immediately available prior to planned entry. **(T-1)**

23.2.2.6. Evaluate the effectiveness of unit procedures implemented to protect the entrants. **(T-1)**

23.2.2.7. In conjunction with BE, assist entry supervisors and functional managers in the selection of PPE. **(T-1)**

23.2.2.8. Assist, as required, training entry supervisors who issue entry permits and authorize entries into permit-required confined spaces. **(T-1)**

23.2.2.9. When required, assist the functional manager in identifying ways of obtaining training for confined space entry team members. **(T-1)**

23.2.2.10. Upon request, train organizational confined space entry team members on the requirements contained in this standard. **(T-1)**

23.2.2.11. Review and recommend approval of non-routine entry permits which are not contained in an organization Master Entry Plan to the Confined Space Program Team. **(T-1)**

23.2.3. Installation Fire Chief will:

23.2.3.1. Ensure the FES Flight representative(s) on the Confined Space Program Team is (are) trained in confined space requirements. Each individual shall have attended a formal confined space course. **(T-1)**

23.2.3.2. When requested, assist the functional manager in identifying ways of obtaining training for entrants, entry supervisors, attendants and rescue teams to include basic first aid and CPR. **(T-1)**

23.2.3.3. Assist in identification and selection of required equipment, to include PPE and full-face piece demand self-contained breathing apparatus-certified by National Institute for Occupational Safety and Health for a minimum service life of 30 minutes or a combination full-face piece pressure supplied-air respirator with auxiliary self-contained air supply, for rescue teams. **(T-1)**

23.2.3.4. Review and approve non-routine entry permits that are not contained in an organization Master Entry Plan. **(T-1)**

23.2.3.5. Be a Confined Space Program Team member. **(T-1)**

23.2.4. Installation Bioenvironmental Engineering (BE) will:

23.2.4.1. IAW AFI 48-137, *Respiratory Protection Program*, is the OPR for the installation respiratory program and is the sole authority for selecting appropriate respiratory equipment and enrolling all personnel who may enter confined spaces into the installation respiratory protection program. **(T-1)**

23.2.4.2. BE representative on the Confined Space Program Team must be trained in confined space requirements prior to or upon being assigned to the Confined Space Program Team. **(T-1)** This training may be obtained from several sources including the BE Apprentice course, the BE Officer course or another confined spaces formal training course. **(T-1)**

23.2.4.3. Provide local training on the use, calibration (user) and care of atmosphere testing and monitoring equipment annually. **(T-1)** Certify organizational personnel, as required, to test confined spaces. **(T-1)** If unable to support this requirement, BE should assist in identifying a training resource. In isolated cases where organizational personnel are not available, provide appropriate atmospheric testing and monitoring for permit-required confined spaces operations. **(T-1) Note:** BE shall not test or monitor a confined space for a contracted confined space operation. **(T-1)** The contractor is required to conduct its own exposure monitoring during permit-required confined space operations. **(T-1)**

23.2.4.4. Review and approve non-routine entry permits which are not contained in an organization Master Entry Plan. **(T-1)**

23.2.4.5. Assist in training personnel for confined space duties. **(T-1)**

23.2.4.6. Evaluate potential worker exposure related to confined spaces IAW AFI 48-145, *Occupational and Environmental Health Program.* **(T-1)**

23.2.4.7. Assist functional managers and entry supervisors in the selection of proper PPE. **(T-1)**

23.2.4.8. Assist entry supervisors in the interpretation of monitoring results. **(T-1)**

23.2.4.9. If certified organizational personnel are not available:

23.2.4.9.1. Evaluate confined spaces for hazardous atmospheres and Immediately Dangerous to Life and Health (IDLH) conditions as necessary to meet mission requirements. **(T-0)**

23.2.4.9.2. Sample the atmosphere in the confined space as often as required to ensure changing conditions do not result in hazardous atmospheres. **(T-0) Note 1:** If isolation of the space is not feasible, because the space is large or is part of a continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working. **(T-0) Note 2:** Construction activities dealing with permit-required confined spaces will require sampling of the atmosphere in the confined space continuously as required by 29 CFR 1926, Subpart AA. **(T-0)**

23.2.4.10. Be a member of the Confined Space Program Team. **(T-1)**

23.2.5. Confined Space Program Team. The primary purpose of the Confined Space Program Team is to assist commanders and functional managers in developing and administering confined space programs. Confined Space Program Team membership includes representatives from installation Occupational Safety office, BE, FES Flight and the functional manager, commander or their designated representative. The Confined Space Program Team will:

23.2.5.1. With the participation of the functional managers, commanders, or their designated representative, assist in the identification, evaluation and classification of all confined spaces. **(T-0)**

23.2.5.2. Develop and provide a Confined Space Program Team train-the-trainer program for entry supervisors and personnel who perform confined space operations. **(T-1)** If limited resources prohibit the Confined Space Program Team from providing this program, the Confined Space Program Team shall identify acceptable external training sources. **(T-1)**

23.2.5.3. Assist in developing local controls and procedures for confined space entries. **(T-1)**

23.2.5.4. Assist with developing a Master Entry Plan when requested by the functional manager or commander. **(T-1)** The requesting unit, not the Confined Space Program Team, would have the lead for the development of the Master Entry Plan. The Master Entry Plan, a part of the overall written confined space program, will serve as approval for recurring entries having the same conditions and entry requirements when signed by representatives of installation Occupational Safety office, FES Flight and BE. **(T-1)** The Master Entry Plan allows functional managers and commanders to designate entry supervisors to issue entry permits. Permits shall not be issued when unexpected conditions exist that have not been anticipated or allowed for in the Master Entry Plan, unless the condition can be eliminated or controlled. **(T-1)** If hazardous conditions develop after entry that cannot be eliminated or controlled, the entry shall be terminated, the permit revoked and retained for one year, and Occupational Safety office, FES Flight and BE shall be contacted before proceeding. **(T-0)**The Master Entry Plan will:

23.2.5.4.1. Describe the acceptable entry conditions, including atmospheric conditions, under which permits may be issued. **(T-1)**

23.2.5.4.2. Designate as many entry supervisors as needed for the organization. **(T-1)**

23.2.5.4.3. Identify types and locations of spaces to be entered and types of tasks or operations to be performed. **(T-1)**

23.2.5.4.4. List either by reference or direct statement in the Master Entry Plan the procedures to be used for entry, e.g., shop Operating Instruction (OI) that cover specific tasks. **(T-1)**

23.2.5.4.5. Account for around-the-clock operations, when appropriate. **(T-1)**

23.2.5.4.6. List PPE, monitoring and rescue equipment, and conditions under which it shall be used. **(T-1)**

23.2.5.4.7. Designate frequency and type of atmospheric monitoring. **(T-1)**

23.2.5.4.8. List other controls required, e.g., lockout and/or tagout, ventilation. **(T-1)**

23.2.5.4.9. List chemicals and quantities authorized for use. List expected exposure levels based on air sampling results. **(T-1)** Based on exposure levels, perform reassessments of the confined spaces IAW requirements in paragraph **23.2.5.4.7** **(T-1)**

23.2.5.4.10. List conditions under which the space may be reclassified as described in paragraph **23.5.4.11**. **(T-1)**

23.2.5.4.11. Provide procedures for amending the Master Entry Plan. **(T-1)**

23.2.5.4.12. Require verification of the condition of all monitoring equipment and PPE. **(T-1)**

23.2.5.4.13. Be maintained by the entry supervisor at the worksite. **(T-1)**

23.2.5.4.14. Include provisions for entry during potential emergency situations. **(T-1)**

23.2.5.4.15. Establish emergency rescue procedures for each permit-required confined space. **(T-1)** Include provisions for entry during potential emergency situations to include IDLH conditions. Refer to paragraph **23.6** for additional guidance. **(T-1)**

23.2.5.4.16. Establish communication procedures and identify communication equipment to be used during entries. **(T-1)**

23.2.5.4.17. Require the ready availability of rescue, atmospheric testing and safety-related equipment such as lifting or retrieval devices, respiratory equipment and other equipment, as necessary, for the entry as determined by the permit system. **(T-1)**

23.2.5.4.18. Require adequate attachment points outside the confined space for tying-off or otherwise securing retrieval lines for all authorized entrants. **(T-1)**

23.2.5.4.19. Require an equivalent method for rescue when retrieval lines themselves may constitute an entanglement hazard or otherwise cannot be used. **(T-1)**

23.2.5.4.20. Require availability of a rescue team. If the installation FES Flight is not available, verify availability of a rescue team or other emergency rescue team. **(T-1)**

The operation shall be halted if the primary rescue team becomes unavailable until the primary team returns or a secondary trained and qualified team is available. **(T-1)**

23.2.5.4.21. Require a reliable method, e.g., telephone, radio, etc., for summoning the rescue team and ensure it is operable, on hand or easily accessible. **(T-1)**

23.2.5.4.22. Require functional manager or shop supervisor brief entry supervisor(s) on their duties prior to performing the operation. **(T-1)**

23.2.5.5. Determine atmospheric monitoring requirements.

23.2.5.6. Evaluate and approve Master Entry Plan s. **(T-1)**

23.2.5.7. Review the installation confined space program at least annually. **(T-1)** The review will include a review of all Master Entry Plan; an assessment of training, rescue procedures and qualifications of entry supervisors; a review of expired and/or revoked entry permits; any noted issues/changes during entry to non-permit required confined spaces; and any changes to Air Force or MAJCOM confined spaces guidance. **(T-1)** Additionally, a discussion shall be held regarding current Occupational Safety, BE and FES Flight issues, including surveillance and spot inspection findings for the last period, identifying any known vulnerabilities and establishing control measures for each. **(T-1)**

23.2.5.8. Establish procedures with the contracting office to review all construction projects to identify, record and classify confined spaces. **(T-1)**

23.2.5.9. Use AF Form 1024, *Confined Space Entry Permit*, or may authorize the use of an automated product or letter format for the Master Entry Plan. Refer to paragraph **23.10** for additional information. **(T-1)**

23.2.5.10. Ensure non-permit confined spaces are reviewed whenever entry is made IAW paragraph **23.5.6.2** **(T-1)**

23.2.5.11. Discuss the installation's confined space program to include any changes to identified confined spaces (additions/deletions), unit Master Entry Plans, an assessment of training, rescue procedures, qualifications of entry supervisors, completed and revoked entry permits, organizational reviews of non-permit confined spaces and other issues/challenges of the program. **(T-1)**

23.2.5.12. The Confined Space Program Team will meet at least annually to discuss the installation's confined space program. **(T-1)**

23.2.5.13. The Confined Space Program Team will develop a status report to include, as a minimum, the number and type of confined spaces, the installation's major issues/challenges during the past 12 month period, the number of personnel trained on confined space operations and the number of entry permits and Master Entry Plans approved. **(T-1)**

23.2.5.14. As a minimum, all documents requiring Confined Space Program Team approval will gain approval from the primary membership, as well as the appointed Confined Space Program Team member from the owning unit. **(T-1)**

23.2.5.15. If no Air Force personnel will enter installation confined spaces, the installation Occupational Safety office may act in place of the installation Confined Space Program Team (no Confined Space Program Team required) provided they:

23.2.5.15.1. Maintain a current list of all installation confined spaces. **(T-1)**

23.2.5.15.2. Ensure only contractor personnel are allowed to enter confined spaces. **(T-1)**

23.2.6. Installation Wing Staff. Each organization that requires entry into confined spaces is responsible for its related portions of the confined space entry program, with assistance from the Confined Space Program Team. **(T-1)**

23.2.7. Commanders and/or Functional Managers will:

23.2.7.1. Ensure a written Master Entry Plan and confined space program are developed, implemented and approved by the Confined Space Program Team (only required for permit-required confined space programs). Serve as a member or designate a representative to the Confined Space Program Team for management of confined spaces within the functional manager's control. **(T-1)**

23.2.7.2. Ensure all personnel assigned duties and responsibilities that support permit-required confined space program tasks are properly trained, equipped and qualified. **(T-0)** Training may be accomplished via the Computer-Based Training (CBT) Compact Disk-Read Only Memory, *Confined Space Series General Worker: Entrant, Attendant, Supervisor,* OSHA Course 226, *Permit-Required Confined Space Entry,* or equivalent, or by the installation Confined Space Program Team. Ensure training is documented on an AF Form 55 or an equivalent authorized computerized information management system. **(T-1) Note:** Recommend personnel entering non-permit confined spaces receive the same training as personnel entering permit required spaces, or at a minimum, confined spaces awareness training to recognize a confined space.

23.2.7.3. Ensure required equipment is procured to support entry into confined spaces. **(T-0)** Equipment shall be available and properly maintained (operational). **(T-0)**

23.2.7.4. Ensure a current list of all confined spaces, both permit-required and non-permit, under the control of the organization or function, is maintained. **(T-0)**

23.2.7.5. Provide a copy of the list of all confined spaces, permit-required and non-permit, to the installation Confined Space Program Team and Environmental Management office. **(T-1)** The list shall include, at a minimum, the number of spaces (quantity), type (with every entry point uniquely identified and listed) and exact location (e.g., grid coordinates, Global Positioning Satellite coordinates, if available, highlighted maps, if necessary). **(T-1)**

23.2.7.6. Designated entry supervisors. **(T-1)**

23.2.7.7. Ensure all non-permit confined spaces under their control are reviewed whenever entry is made to ascertain that no changes occurred which would affect the original classification. **(T-1)** If necessary, assistance may be obtained from the installation Confined Space Program Team to reevaluate the confined spaces. If changes occur, provide an updated list to appropriate agencies. **(T-1)**

23.2.7.8. Identify, evaluate and classify all the unit's confined spaces, with the participation of the installation Confined Space Program Team. **(T-1)**

23.2.7.9. Obtain BE approval for purchase of monitoring equipment for units requiring atmospheric testing and monitoring equipment. **(T-1)** Each unit shall maintain a list of personnel trained and qualified to conduct atmospheric testing of confined spaces. **(T-1)** BE testing and monitoring support does not apply to contractor confined space entries. Contractors shall conduct their own exposure monitoring during entry operations. **(T-0)**

23.2.7.10. Ensure identified confined space program shortfalls, e.g., equipment, manning, funding, etc., are up-channeled and coordinated with the appropriate MAJCOM and higher headquarters. **(T-1)**

23.2.8. Prior to start of entry, the operations Entry (On-site) Supervisor will:

23.2.8.1. Be responsible for authorizing entry, overseeing entry operations and for terminating entry if a change in conditions warrant. **(T-0)**

23.2.8.1.1. Issue entry permits consistent with the Master Entry Plan. **(T-1)**

23.2.8.1.2. Revoke the permit and contact installation Occupational Safety office when any entry condition is not consistent with the Master Entry Plan. **(T-1)**

23.2.8.2. Determine acceptable conditions are present at a permit-required space where entry is planned. **(T-0)**

23.2.8.3. Ensure a qualified person (trained in the operation of direct-reading oxygen, flammability and toxicity monitoring equipment) evaluates and classifies the confined space IAW **Table 23.1** **(T-0)**

23.2.8.4. Coordinate assistance from Occupational Safety office, BE or FES Flight, as required. **(T-1)**

23.2.8.5. Ensure workers are properly trained and qualified in safe operating and emergency procedures (a minimum of one person shall be trained in basic first aid and CPR), use of protective equipment and how to egress. **(T-0)** Ensure workers who are ill or are on medication that may affect their ability to safely perform assigned tasks are excused from the operation. **(T-0)** Refer to paragraph **23.2.10.4**

23.2.8.6. Brief workers on hazards of entry, e.g., chemicals that were in the tank, effects of inhalation of vapors, safety and health hazards inherent in cleaning or internal confined space operations, etc. **(T-0)**

23.2.8.7. Inspect work area, tools and equipment to identify and correct hazards. **(T-1)**

23.2.8.8. Select appropriate PPE with help from Occupational Safety office, FES Flight and BE. **(T-1)** Ensure availability, condition and use of all protective clothing and other PPE necessary for safe entry. **(T-0)** Ensure personnel working in a confined or enclosed workspace that contains exposed energized parts (locked out and tagged out when possible) are provided and use protective shields, protective barriers or insulating materials as necessary to avoid inadvertent contact with these parts. **(T-0)** Entry supervisor shall brief that doors, hinged panels, etc., shall be secured to prevent their swinging into a worker and causing the worker to contact exposed energized parts. **(T-1)** Refer to National Fire Protection Association 70E, *Standard for Electrical Safety in the Workplace*, for additional guidance.

23.2.8.9. Ensure respiratory equipment is in safe operating condition and personnel are trained on proper procedures for use. **(T-0)**

23.2.8.10. Ensure all valves are isolated, locked out and blinded or blanked to prevent anything from being accidentally pumped into the confined space. **(T-0)**

23.2.8.11. Ensure all electrical power sources and electrical equipment meet safety requirements for the atmosphere in the confined space. **(T-0)** Also, ensure all electrical power is de-energized, locked out and made electrically safe IAW AFI 32-1064, *Electrical Safe Practices.* **(T-0)**

23.2.8.12. Establish emergency procedures to rescue persons incapacitated in the confined space. **(T-0)** These will include:

23.2.8.12.1. Ensuring ready availability of rescue and safety-related equipment, such as lifting or retrieval devices, respiratory equipment and others necessary for the entry, as determined by the permit system. **(T-0)**

23.2.8.12.2. Ensuring adequate attachment points outside the confined space for tying-off or otherwise securing retrieval lines for all authorized entrants. **(T-0)**

23.2.8.12.3. Providing an equivalent method for rescue when retrieval lines themselves may constitute an entanglement hazard or otherwise cannot be used. **(T-0)**

23.2.8.12.4. Determining availability of a rescue team. **(T-0)** If the installation FES Flight is not available, verify availability of a rescue team or other emergency rescue team. **(T-1)** The operation shall be halted if the rescue team becomes unavailable. **(T-0)** Ensure on-site standby of the rescue team for permit-required confined space entry that is IDLH. **(T-0)**

23.2.8.12.5. Ensuring the means, e.g., telephone, radio, etc., for summoning the rescue team is operable, on hand or easily accessible. **(T-0)**

23.2.8.13. Ensure qualified personnel conduct atmospheric monitoring prior to allowing entry. **(T-0)** Ensure sample test readings are taken in the top third, middle third and lower third of the confined space. **(T-0)** Ensure oxygen, flammability, e.g., Lower Explosive Limits/Lower Flammable Limits (LEL/LFL) and combustible dust (as determine by the Confined Space Program Team IAW 29 CFR 1910.146), and toxicity are monitored as specified in paragraph **23.3.3.8** **(T-0)**

23.2.8.14. Be the last person to sign the entry permit after all conditions are met. **(T-0)** If necessary, perform entrant or attendant duties when properly trained. **(T-0)** Be permitted to transfer duties of the entry supervisor to another qualified supervisor during the course of entry operations and ensure the new supervisor signs or initials the entry permit when transfer is complete. **(T-0)** If space on the permit is not adequate, maintain a list of workers as a separate document and attach it to the entry permit form. **(T-1)** Ensure the entry permit is maintained at the site where the entry is planned along with appropriate signage informing anyone in the immediate area of the potential hazard. **(T-0)** When the entry supervisor changes, the entire entry team shall be briefed of the change. **(T-1)** **Note:** The entry permit shall be posted at the entry portal of the permit-required confined space. **(T-1)**

23.2.8.15. Provide an attendant for each permit entry as required by this standard. **(T-1)** The entry supervisor can authorize an attendant to cover more than one permit entry, provided the duties described in paragraph **23.2.9** are effectively performed for each permit space monitored and the attendant is within view of all spaces. **(T-1)**

23.2.8.16. Ensure appropriate vehicle and pedestrian guards, barriers or other means to protect the entry party and attendants from traffic hazards. **(T-0)** Also, provide the same protection to non-entering personnel from confined space hazards and/or potential falls. **(T-0)**

23.2.8.17. With assistance from Occupational Safety, BE or FES Flight, as appropriate, determine and evaluate the source (e.g., removal of residue from the space, repair of leaking valve or pipe in the space, etc.) of any suspected atmospheric condition found at the time of entry. **(T-1)** Make appropriate provisions in case the severity of this hazard could increase while workers are in the space. **(T-0)**

23.2.8.18. Revoke the entry permit, terminate the entry and secure the site when becoming aware of a prohibited or unexpected condition. **(T-0)** Ensure a new entry permit is processed through the Confined Space Program Team prior to reentry. **(T-1)**

23.2.8.19. Ensure workers entering a permit-required confined space are provided a harness and lifeline that does not hinder extracting the person from the space. **(T-0)** They shall also ensure the lifeline is securely attached to the harness and adequate points outside the confined space are available and used to secure the other end of the lifeline. **(T-0)** When use of a lifeline would present additional hazards, it shall not be used and other rescue means will be discussed/used and reported to the Confined Space Program Team. **(T-1)**

23.2.8.20. Ensure workers are aware that work on energized electrical equipment is prohibited unless approved by the installation CE IAW AFI 32-1064. **(T-0)**

23.2.9. Confined Space Attendants will:

23.2.9.1. Maintain an accurate accounting of all entrants (name and number) in the permit-required space. **(T-0)**

23.2.9.2. Remain outside the permit space at all times unless replaced by an equally qualified attendant. **(T-0)** Do not attempt rescue involving entry unless qualified in rescue entry procedures; and the rescue team has been notified and assistance has arrived. **(T-0)** Make rescue efforts by means of the lifeline until assistance arrives. **(T-0)**

23.2.9.3. Maintain continuous communication with all authorized entrants within the permit-required space by voice, radio, visual observation or other equally effective means. **(T-0) Note:** If it is not possible for one attendant to maintain communications with each entrant because of the entrant's workstation in the space, the supervisor will make other arrangements to ensure the attendant is continuously aware of the location and condition of any entrant who is out of direct communication range. **(T-0)**

23.2.9.4. Have authority to order entrants to exit the confined space at the first indication of a non-permitted condition, an unexpected hazard, indication of a toxic reaction (e.g., unusual conduct by the entrants) or if a situation outside the space could pose a hazard to the entrants. **(T-0)**

23.2.9.5. Know the procedure and have the means to summon immediate emergency assistance, if required. **(T-0)**

23.2.9.6. Remain at the attendant's post and not leave for any reason (except self-preservation) unless replaced by an equally qualified individual. **(T-0)** Order the entrants to exit the space if the attendant must leave and there is no replacement. **(T-0)**

23.2.9.7. Keep unauthorized persons from entering the permit-required space. **(T-0)**

23.2.10. Confined Space Entrants will:

23.2.10.1. Be provided guidance and direction on all procedures, safeguards and emergency egress and/or rescue procedures associated with the entry. **(T-0)**

23.2.10.2. Follow all safe work procedures required by supervisory personnel and installation Occupational Safety office, BE and FES Flight. **(T-1)**

23.2.10.3. Notify the entry supervisor when hazards exist that have not been previously identified and eliminated or reduced to an acceptable entry condition. **(T-0)**

23.2.10.4. Notify the entry supervisor if they are ill or on medication of any type. **(T-0)**

23.2.11. Shop Supervisor will:

23.2.11.1. Annually assess the section's or unit's known confined space workplace(s) to determine if hazards are present, or are likely to be present, which necessitate use of PPE. **(T-1)**

23.2.11.2. Include specific confined spaces requirements and safety training in the Job Safety Training Outline and document training IAW AFI 91-202. **(T-1)**

23.2.11.3. Ensure personnel are trained and certified in use, calibration (user) and care of atmospheric testing and monitoring equipment. **(T-0)** Maintain a list of personnel trained and qualified to conduct continuous atmospheric testing of confined spaces. **(T-1)** Refer to paragraph **23.3.8** for additional guidance.

23.3. General Requirements.

23.3.1. Confined Space Program Responsibility. The installation Occupational Safety office is responsible for coordinating the installation confined space program. **(T-1)** Each organization that requires entry into confined spaces under their control is primarily responsible for its related portions of the confined space entry program. **(T-1)** This responsibility is accomplished in close coordination with the Confined Space Program Team. **(T-1)** Refer to paragraph **23.3.10** for additional guidance.

23.3.2. Identification of Confined Spaces. Commander will ensure the functional manager, in coordination with the Confined Space Program Team, shall identify, evaluate, test and classify each confined space within the organization. **(T-1)** If permit-required confined spaces are identified that workers and other personnel may enter, the functional manager or commander shall ensure a written confined space program consistent with requirements of this standard is implemented. **(T-1)**

23.3.2.1. Entry into a confined space means the action by which a worker passes through an opening into a confined space. Entry occurs when any part of the entrant's body breaks

the plane of an opening in the space. Refer to 29 CFR 1910.146., *Permit Required Confined Spaces,* for additional guidance.

23.3.2.2. Confined space means a space that meets all conditions in paragraphs **23.3.2.2.1** through **23.3.2.2.3** below:

23.3.2.2.1. Is large enough and so configured that a worker can bodily enter and perform assigned work.

23.3.2.2.2. Has limited or restricted means for entry or exit (for example: tanks, vessels, storage bins, hoppers, aircraft belly/lower lobe, vaults and pits are spaces that may have limited means of entry).

23.3.2.2.3. Is not designed for continuous worker occupancy.

23.3.3. Initial Testing and Evaluation of Confined Space Conditions. Functional managers and entry supervisors, in coordination with the Confined Space Program Team, must test and evaluate prior to classifying a confined or enclosed space. **(T-0) Note:** Obvious hazardous spaces, e.g., sanitary sewer manholes, could automatically be classified as permit required without the need for initial testing. Initial testing for classification of confined spaces shall be accomplished by a technically qualified individual. **(T-0)** Classification documentation shall be maintained, as a minimum, by the shop supervisor. If the initial testing and evaluation documentation is lost, a retest shall be accomplished. **(T-0)** Such evaluations will include, but not necessarily be limited to, the following considerations:

23.3.3.1. The contents or previous contents of the space that may result in the presence of flammables, toxic materials or oxygen-deficient or oxygen-enriched atmospheres. **(T-0)**

23.3.3.2. The location and configuration of the space, including restricted access, obstructions, remoteness, etc., which may inhibit or interfere with movement (ability of entrants to self-rescue), ventilation, rescue efforts or firefighting efforts. **(T-0)**

23.3.3.3. Potential hazards from the external environment, such as proximity of liquid oxygen (LOX) storage operations; petroleum, oil and lubricants storage areas; sewer and waste water treatment processes; and underground disposal sites, which could affect the atmosphere or other conditions within the confined space. **(T-0)**

23.3.3.4. The types of operations conducted within the space, particularly those that produce toxic materials, flammables, oxygen depletion or enrichment or ignition sources. **(T-0)**

23.3.3.5. Fixtures, devices or equipment within the space that may create or contribute to hazardous conditions including piping systems, conduits, ducts, machinery, pressurized lines, etc. **(T-0)**

23.3.3.6. The presence of other hazards such as slippery surfaces, deteriorated or unstable ladders, irritant or caustic materials, etc., that may create a serious safety hazard in a confined space environment. **(T-0)** Pay attention to the condition of permanently-installed ladders, such as those with metal rungs embedded into concrete walls of manholes or other structures. **(T-0)**

23.3.3.7. The boundary spaces and their contents to ensure fire or explosion is not caused by the operation being conducted. **(T-0)**

23.3.3.8. Initial testing shall be performed from outside the space. **(T-0)** Testing of the space may be performed by drop tests or insertion of sample probes and hoses into the space. Testing shall be performed in the following sequence:

23.3.3.8.1. Oxygen Content. Combustible gases are tested after tests for oxygen content because the threat of fire or explosion is more immediate and more life threatening, in most cases, than exposure to toxic gases or vapors. **(T-0)**

23.3.3.8.2. Flammable Hazard. Many combustible gas indicators and/or explosimeters (explosion meters) require oxygen for proper operation (generally 10- to 30-percent oxygen by volume). **(T-0)** Corrections for known flammable components, if different from the calibration gas, shall be made IAW the manufacturer's instructions. **(T-0)** For the detection of JP-8 and other kerosene-based fuels, a photo-ionization detector shall be used. **(T-1)**

23.3.3.8.3. Toxic Materials. For the determination of initial confined space classification, chemical substances known or expected to be present shall be measured and evaluated for their potential to produce a hazardous atmosphere, as defined in **Attachment 1, Terms** (Hazardous Atmosphere). **(T-0) Note 1:** If a chemical substance does not have an occupational and environmental exposure limit, other sources of information, such as SDS, National Institute for Occupational Safety and Health (National Institute for Occupational Safety and Health) documents consensus standards, Air Force documents, etc., may be used to establish an acceptable atmospheric concentration and any other atmospheric condition that is immediately dangerous. **Note 2:** Test results may vary from inside the space to the entry area of the confined space. To effectively determine the overall status/classification of the space, consideration must be given to taking measurements to the fullest extent into the confined space without entering the space. **(T-1) Note 3:** Testing Stratified Atmospheres. When monitoring for entries involving a descent into atmospheres that may be stratified, the atmospheric envelope should be tested a distance of approximately four feet (1.22 meters) in the direction of travel and to each side. If a sampling probe is used, the entrant's rate of progress should be slowed to accommodate the sampling speed and detector response. **(T-0)**

23.3.4. Classification of Confined Spaces. Confined spaces are classified based on measurements of oxygen content, flammability and toxicity by testing. Refer to **Table 23.1** which is based upon existing or potential confined space hazards. Confined spaces are also classified relative to material contained in the space that could cause engulfment or are configured in a manner that could result in entrapment and/or asphyxiation. All personnel will assume confined spaces are permit-required until proven otherwise by means of testing, evaluation and/or inspection. **(T-0)** A trained and qualified worker will conduct testing prior to any entry into permit-required confined spaces. **(T-0)**

23.3.4.1. Permit-required confined spaces may contain hazards that are immediately dangerous to life or health (IDLH) or have a potential for or contain a hazardous atmosphere as defined in **Attachment 1, Terms** (Hazardous Atmosphere).

23.3.4.2. A non-permit confined space contains no hazardous atmosphere or potentially serious safety hazard, and entrants will not perform any work that could cause a hazardous atmosphere. **(T-0)** The space does not have a potential for engulfment, is not configured

in a way that would cause entrapment or asphyxiation, or does not contain any other serious safety hazard. Permits, signs and attendants are not required. **Note:** The use of special protective equipment and modified work procedures are not required by this standard, but may be required by other Air Force directives.

23.3.4.3. If permit-required confined spaces are identified and workers or other personnel have a need to enter, the commander or functional manager will ensure a written confined space program is developed and implemented consistent with the requirements of paragraph **23.3.10** **(T-0)** If the commander or functional manager determines that workers or other personnel will not enter permit-required confined spaces under his or her control, and they have been prohibited from entering, a written program is not required. In this case, the commander or functional manager must still ensure the requirements of paragraphs **23.3.2**, **23.3.3**, **23.3.5** and **23.8** are met. **(T-0)**

23.3.5. Posting Signs. Where confined spaces are designated as permit-required and could inadvertently enter, the supervisor will ensure personnel are informed of the existence, location and the danger of the permit space by posting danger signs. A sign stating, *DANGER — PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER* or a commercial equivalent that meets specifications and design established in **Chapter 29,** *Mishap Prevention Signs and Tags*, is appropriate. **(T-0)** Confined spaces where personnel cannot inadvertently enter, such as those protected by heavy manhole covers, locks or that require tools to open, do not need to be posted.

23.3.6. Approved Equipment. Before purchasing equipment to support the confined space entry program, supervisors will coordinate with the appropriate member of the Confined Space Program Team. **(T-1)** The supervisor will ensure testing and monitoring equipment used in confined spaces is approved for use in Class I, Division 1 and the appropriate group atmosphere, as defined in National Fire Protection Association 70, *National Electrical Code*, Article 500, *Hazardous (Classified) Locations*. **(T-0)** Only direct reading equipment with current calibration shall be used. **(T-0)** The supervisor will also ensure equipment meets required standards as determined by an appropriate Nationally Recognized Testing Laboratory as listed in the OSHA Nationally Recognized Testing Laboratory Program—Underwriters Laboratories, Factory Mutual Research Corporation, etc. **(T-0)** Group classifications are provided in National Fire Protection Association 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*.

23.3.7. Testing of Confined Spaces. Verification testing shall be accomplished prior to entry into permit-required confined spaces. **(T-0)** A trained and qualified individual will conduct testing prior to any entry into permit-required confined spaces. **(T-0)** If a hazardous atmosphere is identified during pre-entry testing, use forced ventilation to try to clear the hazard for a period of not less than 15 minutes before testing again. **(T-0)** If the hazardous atmosphere remains, repeat the process. **(T-0)** If the hazard remains, use engineering controls to eliminate the hazard or make a determination about the need for entry under hazardous conditions. **(T-0) Note:** Continuous forced ventilation is recommended when practical and when it will not interfere with work practices.

23.3.8. Calibration of Monitoring Equipment. Monitoring equipment used to evaluate confined spaces shall be calibrated by the Testing, Measurement, Diagnostic and Evaluation

Lab at an interval established by manufacturer's instructions or technical orders. **(T-1)** Some monitoring equipment, e.g., colorimetric tubes, does not require calibration. Equipment that comes with manufacturer-approved calibration devices and does not require Testing, Measurement, Diagnostic and Evaluation calibration is also acceptable. Monitoring equipment that requires calibration, but cannot be calibrated by testing, measurement, diagnostic and evaluation, shall be sent to the manufacturer for calibration. **(T-1)** The user will field check and span-gas test equipment IAW the manufacturer's instructions immediately before testing the confined space. **(T-0)** Workers will not use equipment that cannot be calibrated or which fails the field check or span-gas test, until it is repaired and the calibration and/or field check is successfully accomplished. **(T-0)**

23.3.9. Atmospheric Monitoring. Many operations may generate hazardous conditions and may require atmospheric monitoring as the work progresses to ensure safe conditions are maintained. The frequency and types of testing are dependent upon prevailing conditions and the nature of the operations. No single rule can be established for all operations and conditions. The entry supervisor, with assistance from the Confined Space Program Team, shall establish the frequency and type of tests for atmospheric monitoring and shall enter these requirements on the Master Entry Plan and the entry permit. **(T-1)** If isolation of a permit space is not possible because the space is large or is part of a continuous system (e.g., a sewer), pre-entry testing must be performed to the extent feasible and entry conditions must be continuously monitored in areas where authorized entrants are working. **(T-0)** Additionally, continuous monitoring of oxygen levels, flammability, e.g., LEL/LFL and combustible dust, flammable vapor levels and toxicity levels shall be accomplished for all permit-required confined space operations. **(T-0)** The entry supervisor, with appropriate assistance as stated above, shall carefully evaluate the following types of operations for continuous atmospheric monitoring:

23.3.9.1. Work that may generate hazardous concentrations of toxic materials. (Examples: welding, cutting, brazing, soldering, etc.) **(T-0)**

23.3.9.2. Application of preservatives, paints, epoxies, solvents, etc., which may involve hazardous concentrations of toxic or flammable vapors. **(T-0)**

23.3.9.3. Cleaning operations, sludge removal, etc., which may produce or cause release of hazardous concentrations of toxic or flammable vapors. **(T-0)**

23.3.9.4. Any other operations that may produce or release toxic, flammable or asphyxiating atmospheres or material into the space. **(T-0)**

23.3.10. Written Permit-Required Space Program. Commanders or functional managers in organizations with confined spaces under their control that have been identified, evaluated and classified as permit-required will develop a written program. **(T-0)** This document will include:

23.3.10.1. General operating and entry procedures applicable to all confined spaces within the organization, which will include the following elements: **(T-0)**

23.3.10.1.1. Measures in place to prevent unauthorized entry (signs, method of training, etc.). **(T-0)**

23.3.10.1.2. Methods used to identify and evaluate the hazards of permit spaces before personnel enter them (site visits, review of historical data, etc.). **(T-0)** The entry permit shall list specific hazards and controls. **(T-0)**

23.3.10.1.3. The requirements and procedures for safe permit space entry operations, including, but not limited to, specifying acceptable entry conditions; isolating the permit space; purging, inerting, flushing or ventilating the permit space as necessary to eliminate or control atmospheric hazards; providing pedestrian, vehicle or other barriers as necessary to protect entrants from external hazards; and verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry. **(T-0)**

23.3.10.1.4. Required equipment, to include testing and monitoring, ventilating, communications, PPE, lighting, barriers or shields, egress ladders, rescue and emergency equipment, and any other equipment necessary for safe entry and rescue from permit spaces. **(T-0)**

23.3.10.1.5. Procedures established to evaluate acceptable entry conditions through pre-entry and periodic testing and, if required, continuous monitoring. **(T-0)**

23.3.10.1.6. Identify the persons by name, duty title and duty section who will have active roles as entrants, attendants, entry supervisors, rescue team members and persons who test or monitor the atmosphere in a permit space. **(T-1)**

23.3.10.1.7. Procedures for summoning rescue and emergency services, for rescuing entrants from permit spaces, for providing necessary emergency services to rescued employees and for preventing unauthorized personnel from attempting a rescue. **(T-0)**

23.3.10.1.8. Procedures for the preparation, issuance, use and cancellation of entry permits for permit required spaces. **(T-0)**

23.3.10.1.9. Procedures to coordinate entry operations when personnel assigned to different organizations or Air Force and contractor personnel are working simultaneously as authorized entrants in a permit space. **(T-1)**

23.3.10.1.10. Procedures necessary for concluding the entry after entry operations have been completed, such as securing the permit space and canceling the permit. **(T-0)**

23.3.10.1.11. Procedures to review entry operations when there is reason to believe that the measures taken under the permit space program may not protect personnel and revise the program to correct deficiencies found to exist before subsequent entries are authorized. **(T-0)** Examples of circumstances requiring review of the permit space program are any unauthorized entry of a permit space, detection of a permit space hazard not covered by the permit, detection of a condition prohibited by the permit, the occurrence of an injury or near-miss during entry, a change in use or configuration of a permit space and worker complaints about program effectiveness. **(T-0)**

23.3.10.1.12. Method to review the permit space program, using the completed and canceled permits, and to revise the program as necessary to ensure personnel are protected from permit space hazards. **(T-0)**

23.3.10.2. If Air Force personnel will not enter the permit spaces, functional managers must still meet requirements of paragraphs **23.3.2**, **23.3.3**, **23.3.5** and **23.8** **(T-1)**

23.3.11. Alternate entry procedures are not allowed in Air Force controlled facilities or operations. **(T-1)**

23.3.12. Entry into telecommunications only controlled spaces are governed by **Chapter 30,** *Communication Cable, Antenna and Communication Systems.* However, the requirements of this chapter (paragraphs **23.3** – **23.7**) also applies to telecommunications confined spaces.

23.4. Confined Spaces Classification—Atmospheric Conditions. (Reference **Table 23.1** below). The presence of one or more of the conditions identified under Hazardous Atmosphere (second column below) constitutes a hazardous atmosphere, which, by itself, requires the confined space to be classified as permit-required. **(T-0)** When all the conditions under Non-Hazardous Atmosphere (third column below) are met, the confined space does not contain a hazardous atmosphere and may be classified as a non-permit space as long as there is no condition in the space that could cause engulfment, a configuration that could result in entrapment or asphyxiation, or other serious safety hazard. (**Note:** See **Attachment 1, Terms** [Permit-Required Confined Spaces]). **(T-0)** Some test equipment, e.g., photo ionization detectors, provide readings in parts per million, not as a percent of LEL. Personnel using such equipment shall be able to convert test data from parts per million to percent of its LEL, and back, as required. **(T-1)**

Table 23.1. Confined Spaces Classification—Atmospheric Conditions.

CONDITION	HAZARDOUS ATMOSPHERE	NON-HAZARDOUS ATMOSPHERE
Flammability	Flammable gas, vapor or mist in excess of 10 percent of its lower explosive limit (LEL), or Airborne combustible dust at a concentration that meets or exceeds its LEL (See **Note 1**)	Flammable gas, vapor or mist less than or equal to 10 percent of its LEL, or Airborne combustible dust at a concentration less than its LEL.
Oxygen	Atmospheric oxygen concentration less than 19.5 percent (148 mm Hg) or greater than 23.5 percent (greater than 179 mm Hg). (See **Note 2**)	Atmospheric oxygen concentration range from the minimum of 19.5 percent and the maximum of 23.5 percent (148 – 179 mm Hg).
Toxicity	An atmospheric concentration of any chemical substance which is capable of causing death, incapacitation, impairment of ability to self-rescue, injury or acute illness due to its health effects or which could result in an exposure or dose in excess of its occupational and environmental exposure limit. See **Note 3**)	An atmospheric concentration of any chemical substance which is not capable of causing death, incapacitation, injury, impairment of ability to self-rescue or acute illness due to its health effects.
Other Condition	Any atmospheric condition that is immediately dangerous to life or health (IDLH) or local conditions that could be potentially hazardous or life threatening. (See **Note 4**)	No atmospheric IDLH condition present.

Note 1: Based upon a total atmospheric pressure of 760mm Hg (sea level).
Note 2: This concentration may be approximated as a condition in which the dust obscures vision at a distance of five (5) feet or less.

Note 3: Exposure at or above levels determined to be safe solely to prevent long-term adverse health effects is not considered a hazardous atmosphere on that basis alone and in itself would not constitute a permit-required confined space classification. However, other OSH standards, TOs, etc. may apply for exposure to chemical substances at levels greater than the occupational and environmental exposure limit.
Note 4: Immediately Dangerous to Life or Health – as referenced in National Institute for Occupational Safety and Health (National Institute for Occupational Safety and Health), *Registry of Toxic Effects of Chemical Substances*, Manufacturing Chemists data sheets or other recognized authorities. (Note: See **Attachment 1, Terms** [Immediately Dangerous to Life or Health]). Local conditions could present potentially hazardous or life threatening situations such as extreme temperatures, noise, animals (rat droppings, potentially dangerous insects, wild animals, etc.). The installation Confined Space Program Team will notify units of potentially hazardous or life threatening conditions in the local area. **(T-0)**

23.5. Specific Requirements.

23.5.1. Entry Into Confined Spaces. Entry supervisors will ensure workers enter a permit-required confined space only after an AF Form 1024, *Confined Spaces Entry Permit*, or an approved entry permit which contains the minimum requirements of the AF permit has been obtained. **(T-0)** The permit is an authorization and approval in writing that specifies the location and type of work to be accomplished. It certifies an evaluation of all existing hazards and the necessary protective measures have been taken to ensure the safety and health of each worker. Refer to paragraph **23.10** for additional information for AF Form 1024.

23.5.1.1. Rescue procedures and equipment are critical. Entrants shall be provided guidance and direction on confined space entry and rescue requirements, and the entry supervisor will sign the entry permit as the person responsible for the entry. **(T-0)**

23.5.1.2. Each completed entry permit, including those canceled or revoked, shall be retained for one year by the organization responsible for the entry and be available for review. **(T-0)** Any problems encountered during an entry operation shall be noted on the permit so necessary revisions can be made to the confined space program. **(T-0)**

23.5.1.3. Entries into non-permit required confined spaces are allowed without attendants and entry permits. **(T-1)** Refer to Note in paragraphs **23.5.6.1** and paragraph **23.5.6.2** for additional requirements.

23.5.2. Testing and Classification of Confined Spaces. Testing and classification of confined spaces shall be done by a qualified person trained and certified IAW requirements in paragraphs **23.3.3**, **23.3.4** and **23.3.7** **(T-0)** Initial testing shall be performed from outside the space. **(T-0)** Testing into the interior of the space may be performed by drop tests or insertion of sample probes and hoses into the space. Testing shall be performed in the sequence outlined in paragraph **23.3.3.8** **(T-0)**

23.5.3. Entry Into Known Immediately Dangerous to Life and Health (IDLH) Conditions Permit-Required Confined Spaces. Entry supervisors will not permit entry into and work in known IDLH spaces under normal operations. **(T-0)** Continuous monitoring is required in a known IDLH space. **(T-0)** Entry supervisors will authorize entry only when the following conditions are met:

23.5.3.1. Continuous efforts to reduce the hazard within the confined space by isolation, ventilation or other techniques result in a lower classification of the confined space. **(T-0)** If efforts to reduce the hazard to a lower classification are unsuccessful, entry into known IDLH spaces is authorized only in cases of extreme emergencies such as rescue efforts, emergency repairs, etc. **(T-0)** The rescue team shall be available at the scene for permit-required confined space entry under IDLH conditions. **(T-1)**

23.5.3.2. The permit for entry into a known IDLH confined space is approved by the Confined Space Program Team prior to space entry. **(T-1)**

23.5.3.3. The permit authorizes entry into a specific confined space for a specific purpose, by specific work crews, and for a work period, which normally will not exceed a single shift. **(T-0)** If multiple shifts are necessary, either a new entry permit shall be completed or the Confined Space Program Team may approve a continuation of the initial permit with a new entry supervisor and crewmembers. **(T-0)** Rescue team entry is exempt from this requirement. **(T-0)**

23.5.3.4. Personnel entering confined spaces with known or suspected IDLH conditions will wear a positive pressure self-contained breathing apparatus or a supplied-air respirator with escape self-contained breathing apparatus. **(T-0)** Additionally, personnel shall be equipped with a harness suitable for extraction of the person, which does not hinder extraction, a lifeline securely attached to the harness and other necessary PPE suitable for the conditions and exposures. **(T-0) Note:** When use of a lifeline would present additional hazards, other alternatives must be considered. **(T-0)** Refer to AFI 48-137 for additional respiratory guidance.

23.5.3.5. Emergency rescue personnel, equipped with the above-listed equipment and any additional equipment necessary for a rescue, are stationed immediately outside the entry to the confined or enclosed space. **(T-0)**

23.5.3.6. Communications by sight or voice or both are established and maintained between the person entering the space and attendant personnel outside the space. **(T-0)**

23.5.3.7. Only explosion-proof or intrinsically safe equipment is used where flammable or explosive atmospheres are present. **(T-0)** Refer to National Fire Protection Association 70, Article 504, *Intrinsically Safe Systems,* and Article 501, *Class I Locations*, for additional guidance.

23.5.3.8. A qualified BE or Occupational Safety representative, based on the nature of the IDLH condition, shall be present during all known IDLH confined space entry and work periods and shall serve as safety consultant to the person in charge of entry. **(T-1)**

23.5.3.9. A qualified on-site rescue team shall be present during all known IDLH space entries, where the atmosphere inside the space contains flammable or explosive contaminants or is oxygen-enriched. **(T-0)**

23.5.4. Entry Into Permit-Required Confined Spaces. Permit-required confined spaces contain atmospheres or conditions that are, or may reasonably be expected to become, hazardous but are not IDLH. Refer to **Table 23.1** Flammables, toxic materials or deviations of oxygen levels within a permit-required space may be due to the materials and conditions within the space or

result from operations in the space. Refer to paragraph **23.3.9** for additional guidance on atmospheric monitoring.

23.5.4.1. An entry permit must be approved by installation Occupational Safety office, BE and FES Flight prior to entry, if not already identified on the Master Entry Plan. **(T-1)**

23.5.4.2. Permits, issued by an entry supervisor under a Master Entry Plan, will permit entry into a specific confined space, for a specific purpose, by a specific work crew, for a period not to exceed a single shift or as determined jointly by the Confined Space Program Team. **(T-1)** Rescue team entry is exempt from this requirement. **(T-0)**

23.5.4.3. Prior to entry into a contaminated space, the entry supervisor will identify the cause or source of the contamination and remove it to the maximum degree possible by cleaning, ventilating or other such treatments. **(T-0)** If the situation is time critical, notify the installation Confined Space Program Team immediately. **(T-1)** Otherwise, notify the Confined Space Program Team as soon as time permits. **(T-1)**

23.5.4.4. Where operations conducted within the space introduce, or have the potential to introduce, additional hazards within the space, the entry supervisor will ensure these hazardous conditions and operations are covered by the permit and take action consistent with the nature of the operations to control the hazards and maintain safe conditions within the space. **(T-0)** Refer to paragraph **23.3.9** for added guidance on atmospheric monitoring.

23.5.4.4.1. When an airborne exposure may exceed an allowable standard or toxic materials are present or may be introduced into the space, the entry supervisor will contact BE staff to determine necessity for respiratory protection equipment. **(T-1)** The BE staff will provide assistance in selecting the appropriate National Institute for Occupational Safety and Health-approved equipment and any other PPE necessary to protect workers. **(T-1)** Refer to AFI 48-137 for additional guidance. **Note:** While the primary concern is the inhalation hazard, additional PPE may be required to protect against skin contact and absorption.

23.5.4.4.2. Entry supervisors will ensure only explosion-proof or intrinsically safe equipment is used where flammable or explosive atmospheres are present. **(T-0)** Refer to National Fire Protection Association 70, Articles 501, 504, and 513 for additional guidance.

23.5.4.5. Entry supervisors will ensure personnel entering a permit-required confined space are suited with a harness and lifeline that will not hinder extraction of the person from the space. **(T-0)** They will also ensure the lifeline is securely attached to the harness and adequate attachment points outside the confined space are available and used. **(T-0)** **Note:** When the space is so configured that use of a lifeline would present additional hazards, they shall not be used. **(T-0)** However, continuous communication between the entry supervisor and all entrants within the confined space shall be maintained (via voice, radio, visual observation or other equally effective means). **(T-0)** The entry supervisor is responsible for making the final decision about non-use of the lifeline. **(T-0)** Contact the Confined Space Program Team for additional guidance. **(T-1)**

23.5.4.6. The entry supervisor will identify and notify an emergency rescue team, either organizational or the installation FES Flight, when an entry is planned. **(T-1)** **Note:** Entry shall not be made until the emergency rescue team is notified and their availability has been

verified. **(T-0)** The entry will be immediately terminated and entry permit cancelled when the emergency rescue team, for any reason, becomes unavailable. **(T-0)**

23.5.4.7. The entry supervisor will ensure an attendant is provided for all permit-required confined space entry operations. **(T-0)** The attendant will remain outside the space and will establish and maintain communications with the entrants. **(T-0)** The attendant will know the procedures and have the capability and means to contact the rescue team or summon emergency assistance if the rescue team is not stationed immediately outside the confined space. **(T-0)**

23.5.4.8. When initial testing indicates ventilation is required to remove contaminants and/or provide adequate oxygen levels, the entry supervisor will ensure ventilation is provided during entry and occupancy of the space. **(T-0)**

23.5.4.9. When operations conducted inside the confined space could cause an IDLH atmosphere without industrial ventilation, the entry supervisor will ensure ventilation (general dilution or local exhaust) is used to maintain the atmosphere within the limits specified on the entry permit. **(T-0)**

23.5.4.10. For routine recurring tasks in permit-required confined spaces, such as sewers, lateral fuel pits, dikes, communication vaults, etc., where the spaces may be entered on a regular basis, a Master Entry Plan will be developed and approved by the installation Occupational Safety office, FES Flight and BE. **(T-1)** All Master Entry Plans shall be reviewed by the above representatives and the organizational representatives at least annually, to ensure conditions have not changed. **(T-1)** The entry supervisor will prepare an entry permit using the Master Entry Plan as a guide. **(T-1)** The entry supervisor will authorize entry into the confined space by signature on the entry permit and will ensure the following conditions are met:

23.5.4.10.1. There is no known potential for an IDLH atmosphere or an engulfment hazard. **(T-0)**

23.5.4.10.2. Entrants are trained in routine recurring operations practices and procedures required for such entries. **(T-0)**

23.5.4.10.3. Work operations are governed by TO, OI or similar directives, e.g., AFI 32-1064, *Electrical Safe Practices,* and UFC 3-560-01, *Operation and Maintenance: Electrical Safety.* **(T-1)**

23.5.4.10.4. The space is tested for atmospheric hazards and the results are properly recorded on the entry permit. **(T-0)**

23.5.4.10.5. The permit is revoked if testing required by this section shows conditions in the space are more hazardous than contemplated under the permit. **(T-0)** The entry supervisor will stop operations and ensure a new permit is issued. **(T-0)** Retain the revoked permit for one year. **(T-1)**

23.5.4.10.6. The permit is revoked when any conditions of the permit are not followed or enforced. **(T-0)**

23.5.4.11. The entry supervisor may request the Confined Space Program Team perform an evaluation to reclassify a permit-required confined space to a non-permit confined space at the time of a specific entry provided all hazards justifying the permit-required confined

space classification have been totally eliminated. **(T-1)** Control of a hazardous atmosphere, e.g., through forced ventilation, is not the same as its elimination. For example, a chemical tank that at one time contained a hazardous atmosphere, prior to draining it of its contents, purging any residual chemical content with water and venting the space after purging is complete, would be eligible for reclassification as long as the hazardous atmosphere remains totally eliminated. Entry into confined spaces, where a non-hazardous atmosphere is maintained through continuous forced ventilation, is a permit-required entry. The intent for reclassifying a permit-required confined space applies primarily to those spaces containing physical hazards, e.g., hazardous energy sources or engulfment hazards. Detailed provisions for reclassifying a space shall be addressed in the Master Entry Plan, if one is in use. **(T-1)** Such reclassification would allow entry without a permit, without personnel being suited with a harness and/or lifeline and without an attendant, provided:

23.5.4.11.1. Testing is accomplished prior to entry with the results showing the space is free of all hazards. **(T-0) Note:** If entry is required to eliminate the hazards or perform verification testing in the permit space, the entry must be made with an entry permit IAW this standard. **(T-0)** Once the hazards have been eliminated, the space may be reclassified as non-permit as long as the hazards remain eliminated. **(T-0)** Elimination is achieved by completely protecting the space against the release of hazardous energy or material into the space. **(T-0)**

23.5.4.11.2. The actual or potential atmospheric hazards are eliminated, and continuous monitoring is used to ensure the atmosphere remains free of hazards. **(T-0)** That all hazards within the space are eliminated without entering the space at the time of testing, and any non-atmospheric hazards remain eliminated. **(T-0)**

23.5.4.11.3. That during routine work, the entrant does not take tools or introduce material into the space that could themselves cause a hazard. **(T-0)**

23.5.4.11.4. The entrant does not perform any work that would cause a hazardous condition. **(T-0)**

23.5.4.11.5. The entry permit is revoked whenever any test, monitoring instrument or observation shows conditions are developing in the confined space more hazardous than allowed under the permit. **(T-0)** When this occurs, the entry supervisor will remove entrants, secure the area and prevent entry until an approved entry permit is issued. **(T-0)**

23.5.4.11.6. The entry supervisor documents the basis for the reclassification on a separate sheet, attaches it to the entry permit and signs or initials next to the statement. **(T-0) Note:** Routine or repetitive entries for daily inspections of lateral fuel pits are examples of work tasks that may qualify for reclassification.

23.5.5. AF Form 592, *USAF Hot Work Permit*. Whenever workers perform hot riveting, welding, cutting or burning, or heating operations within a confined space, they will obtain an AF Form 592 from the installation FES Flight. **(T-1)** Refer to **Chapter 27,** *Welding, Cutting and Brazing*, and **Table 27.2** for additional information. If hazards may be introduced into the confined space by the "hot work," BE shall be contacted to evaluate the potential hazards and recommend ventilation procedures. **(T-1)** Also, workers will:

23.5.5.1. Inspect, test, operate and maintain welding and cutting equipment such as hoses, connections, torches, etc., IAW provisions of **Chapter 27,** applicable TOs and manufacturers' instructions. **(T-1)**

23.5.5.2. Not take compressed gas cylinders or gas manifolds used in welding and cutting operations into a confined space. **(T-0)**

23.5.5.3. Turn off gas supplies at the cylinder or manifold outside the space when equipment is unattended or unused for substantial periods of time, such as at breaks or lunch periods. **(T-0)** At shift changes (30 minutes or more) or overnight, turn off gas supplies and remove torches and hoses from the space. **(T-0)** Immediately remove open-ended hoses from the space when torches or other devices are removed from the hose. **(T-0)**

23.5.5.4. Not take electric arc units or machines into a confined space. **(T-0)** Place such units outside the space. **(T-0)**

23.5.6. Entry Into Non-Permit Confined Spaces. These confined spaces are not considered hazardous and have no reasonable probability to become hazardous. These spaces are defined as confined because of design, may have limited openings for entry and exit, and may have limited space (lateral fuel pits under five [5] feet deep and dikes less than six [6] feet high around fuel storage tanks).

23.5.6.1. Entries into non-permit confined spaces are allowed without attendants and entry permits upon confirmation of a non-hazardous atmosphere by means of internal atmospheric testing. **Note:** Even though the confined space is classified as a non-permit confined space when using typical criteria to evaluate hazards such as atmospheric, engulfment or entrapment, the space may contain other physical hazards. Hazards such as slippery surfaces or deteriorated pipe ladders may make self-rescue difficult for the entrant. Also, fuel pits less than five (5) feet deep with jet fuel accumulation due to line leaks may present a hazard to repair crews. In cases where no entry permit is required, it may still be appropriate for entrants to use a body harness to facilitate rescue operations, for an attendant to be assigned to monitor the entry process or other special procedures developed to protect entrants.

23.5.6.2. Non-permit confined spaces will be reviewed, to include atmospheric air monitoring and evaluation of any other potential hazards, prior to each entry to determine if changed conditions in or around the space could have introduced a hazardous atmosphere or other hazards that make the space a permit-required confined space, thus changing the classification of the space to permit-required. **(T-1)** Refer to paragraph **23.3.9** and **Table 23.1** for requirements on atmospheric monitoring. **Exception:** Well-ventilated, frequently-entered non-permit confined spaces such as aircraft engine inlets/intakes/exhausts and avionics bays can normally rely on a visual review prior to each entry, unless a changed condition in or around those spaces could have introduced an atmospheric or other non-visual hazard, in which case, atmospheric monitoring is warranted. **Note:** If no entry is performed during a 12-month period, no review is necessary.

23.6. Emergency and Rescue Procedures.

23.6.1. Responsibilities. The Master Entry Plan or confined space entry permit will include emergency and rescue procedures consistent with each operation that requires entry into a

permit-required confined space. **(T-1)** The entry supervisor will coordinate with the installation Occupational Safety office, BE and FES Flight when required to enter non-routine permit-required confined spaces not included in the Master Entry Plan, and to establish emergency rescue procedures prior to entry. **(T-1)** Means of rescue include: self-rescue, a centrally located rescue team (installation FES Flight or an installation established team) and a rescue team. Aircraft fuel systems personnel will follow this standard and applicable technical data for responsibilities, qualifications, training, and rescue procedure requirements for working in permit-required confined spaces. **(T-1)**

23.6.1.1. Self-Rescue. Employees are trained to exit from the confined space IAW requirements in paragraph **23.7.2.2.3.1** **(T-0)**

23.6.1.2. Centrally Located Rescue Team. The installation FES Flight provides emergency rescue services but will not normally provide on-site standby rescue services for entry into permit-required confined spaces on an Air Force installation as the FES Flight is not manned to support these operations. The supervisor in charge of entry shall ensure a standby rescue team is in place prior to beginning operations in permit-required spaces that are IDLH. **(T-0)** Additionally, this supervisor will contact the installation FES Flight prior to entering a permit-required confined space to coordinate emergency rescue assistance and ensure its availability within a reasonable period of time (normally within 5-7 minutes). **(T-1)** The entry supervisor shall ensure these procedures are included during planning for permit-required confined space operations that are IDLH. **(T-0)**

23.6.1.3. Rescue Team. When confined space permit-required work is performed outside the installation or the installation FES Flight is unable to support the operation, the entry supervisor/authority will ensure a rescue team is available and, if not, the confined space work shall be rescheduled. **(T-1)** For permit-required confined spaces that are IDLH, the rescue team will standby on the scene of the operation. **(T-1)** Rescue teams shall consist of trained personnel equipped with appropriate PPE, including respiratory protection equipment necessary for entry into confined spaces, and with rescue and retrieval equipment suitable for the confined spaces involved. **(T-0)** Installations/organizations may contract for rescue team support. (**Note:** Within aircraft maintenance, the fuel systems shop/work center maintain their own rescue team IAW TO 1-1-3, *Inspection and Repair of Aircraft Integral Tanks, and Fuel Cells.*) Fuel systems personnel will conduct rescue efforts IAW Master Entry Plan (Emergency and Rescue Procedures) approved by installation Confined Space Program Team. Refer to paragraph **23.6.1** and TO 1-1-3 for additional guidance. **(T-1)**

23.6.1.3.1. Rescue teams will be trained to the level determined by OSHA Requirements, to provide rescue in the confined spaces that they are assigned. **(T-0)** The fire member of the CSPT will validate that rescue training, equipment and procedures meet all requirements for rescue. **(T-1)** In addition, the entry supervisor will ensure they are locally trained in the correct performance of rescue functions assigned to them. **(T-0)** Training, as a minimum, will include use of retrieval and rescue equipment and proper wear and use of any PPE, including airline respirators or self-contained breathing apparatus that may be required during actual rescues. **(T-1)** Refer to paragraph 23.7.3 for additional guidance.

23.6.1.3.2. During permit-required confined space entry operations, entry supervisors shall ensure all members of the rescue team are trained and current in cardiopulmonary resuscitation (CPR). **(T-1)** The rescue team shall be available at the scene for permit-required confined space entry under IDLH conditions. **(T-0)**

23.6.1.3.3. The appropriate Confined Space Program Team members will assist rescue teams as required in the selection of equipment. **(T-1)**

23.6.2. Inspection of Safety Equipment. Prior to a confined space operation, entry supervisors will ensure inspection, testing, maintenance and documentation of safety and rescue equipment is accomplished IAW **Chapter 14,** *Personal Protective Equipment (PPE),* TO 00-25-245, *Operations Instructions - Testing and Inspection Procedures for Personnel Safety and Rescue Equipment,* and manufacturer's instructions. **(T-1)**

23.6.3. Alternate entry procedures are not allowed in Air Force controlled facilities or operations. **(T-1)**

23.7. Training.

23.7.1. General Information. Each organization shall develop a structured and effective training program to include a hands-on portion that establishes safe work practices and techniques. **(T-1)** A CBT, titled *Confined Space Series General Worker: Entrant, Attendant, and Supervisor Course,* the OSHA Course 226, *Permit-Required Confined Space Entry* or other MAJCOM-approved CBTs are available for personnel who have not attended a formal training course. Each MAJCOM may develop and present training using methods (PowerPoint presentations, training plans, etc.) other than CBT, if approved by the Occupational Safety office and BE. This will allow for type specific training for each weapons system. Personnel assigned duties as entry supervisors, attendants and entrants will complete general permit-required confined space program hands-on training in addition to AFCEC's CBT or OSHA Course 226, *Permit-Required Confined Space Entry*. **(T-1)** Entry supervisors shall complete rescue training described in paragraph **23.7.3.2** **(T-1)** All training associated with confined spaces shall consist of initial training and annual training thereafter. **(T-1) Exception:** Training shall be conducted if an existing requirement changes and/or a new confined space or equipment is added. **(T-0) Note:** Recommend personnel entering non-permit confined spaces receive the same training as personnel entering permit required spaces, or at a minimum, confined spaces awareness training to recognize a confined space.

23.7.1.1. The installation or unit training program shall include the specific hazards to be encountered. **(T-1)** The trainer shall obtain installation Occupational Safety office, FES Flight and BE approval on all training lesson plans prior to their use and when changes are made to the plans. **(T-1) Note:** The CBT listed in paragraph **23.7.1** may be included as part of the installation or unit training program.

23.7.1.2. Entry supervisors shall ensure all personnel authorized confined space entry or assigned as attendants or rescue personnel are trained. **(T-0)** Entry supervisors shall ensure workers are aware of appropriate procedures and controls for entry and that unauthorized entry into such spaces is forbidden. **(T-0)** **Warning:** Entry supervisors shall ensure personnel are aware/warned that unauthorized entry can be fatal. **(T-0)** Many confined space hazards are impossible to detect without specially designed equipment. Refer to paragraph **23.7.5** for additional guidance on documenting training.

23.7.1.3. Each worker shall be trained prior to being assigned permit-required confined space duties. For additional guidance refer to paragraph **23.7.2** **(T-0)**

23.7.1.4. Additional training is required when workers have a change in assigned duties or when permit-required confined space operations present a hazard for which a worker has not previously been trained. **(T-0)** Additional training is also required when there have been deviations from established entry procedures or when a worker displays inadequacies in the knowledge or use of these procedures. **(T-0)**

23.7.2. General Confined Space Program Training Requirements.

23.7.2.1. Confined Space Program Team. Confined Space Program Team members will perform the duties and responsibilities outlined in paragraph **23.2.5** **(T-1)** At least one representative from the installation Occupational Safety office, BE and FES Flight shall receive formal permit-required confined space training. **(T-1)** These individuals shall make up the installation's Confined Space Program Team. **(T-1)** The Occupational Safety office, BE, FES Flight and other installation units can train as many personnel as they desire, but those designated as members of the Confined Space Program Team must be trained. **(T-1)** Completion of OSHA's *Permit-Required Confined Space Entry*, Course 226/226A, or similar course taught by a recognized training organization, meets this requirement.

23.7.2.2. Entrants. Entrants will perform the duties and responsibilities outlined in paragraph **23.2.10** **(T-0)** Entry supervisors will ensure all entrants are trained in the following subjects:

23.7.2.2.1. Hazard Recognition. Prior to entering a permit-required confined space containing a potentially hazardous environment, entrants shall be provided guidance and direction on the nature of the hazards, to include type, signs or symptoms, effects of exposure and the need to perform appropriate testing to determine if it is safe to enter. **(T-0)**

23.7.2.2.2. Personal Protective Equipment (PPE). Entrants shall be trained and qualified on the proper use of all PPE and protective shields and barriers. **(T-0)** Consult BE with questions or guidance on PPE. **(T-1)**

23.7.2.2.3. Self-Rescue. Entrants will:

23.7.2.2.3.1. Exit from the confined space as rapidly as they can whenever an order to evacuate is given by the attendant, an automatic evacuation alarm is activated or workers recognize the warning signs of exposure to substances whose presence in the confined space is known or expected. **(T-0)**

23.7.2.2.3.2. Recognize the toxic effects or symptoms of exposure to anticipated hazardous materials they are using. **(T-0)**

23.7.2.2.3.3. Relay an alarm to their attendant and attempt self-rescue immediately on becoming aware of the effects discussed in paragraph **23.7.2.2.3.1** **(T-0)** The entrants must communicate with the attendant as necessary to enable the attendant to monitor their exit. **(T-0)**

23.7.2.2.4. Special Work Practices or Procedures. Entrants shall be provided guidance and directions on all modifications or alterations of normal work practices that are necessary for confined space work. **(T-0)**

23.7.2.2.5. Equipment. Entrants shall be trained in the use and care of other equipment, such as monitoring, ventilating, lighting, communications, rescue and emergency equipment and like equipment used in and around confined spaces work areas. **(T-0)**

23.7.2.3. Entry Supervisor. Entry (on-site) supervisors in charge of permit-required confined space operations and who authorize entry will meet entrant training requirements, in addition to the following: **(T-0)**

23.7.2.3.1. Recognize effects of exposure to hazards reasonably expected to be present. **(T-0)**

23.7.2.3.2. Perform duties and responsibilities outlined in paragraph **23.2.8** **(T-0)**

23.7.2.4. Attendant. Entry supervisors will ensure the attendant is trained to perform the duties and responsibilities in paragraph **23.2.9** and on the same requirements as entrant or rescue personnel if the attendant is expected to perform those functions. **(T-0)**

23.7.3. Rescue.

23.7.3.1. All personnel with responsibility for rescue from confined spaces shall receive hands-on training initially (prior to assignment to rescue duties) and annually thereafter. **(T-0)** This training will include removing simulated victims, such as dummies, mannequins or actual persons, from actual or representative confined space that have openings and portals similar to the types from which a rescue may be performed. **(T-0)**

23.7.3.2. Entry supervisors will ensure all rescue team members are trained in all items listed in paragraph **23.7.2.2** for entrants, as well as: **(T-0)** **Note:** The fire chief is responsible for the currency of the FES Flight's primary and secondary rescue teams' members. **(T-1)**

23.7.3.2.1. Rescue duties and responsibilities. **(T-0)**

23.7.3.2.2. Use of retrieval and rescue equipment. **(T-0)**

23.7.3.2.3. Proper wear and use of PPE. **(T-0)**

23.7.3.2.4. CPR and Self-Aid/Buddy Care. **(T-1)**

23.7.4. Confined Space Tester and/or Monitor. The person designated to conduct tests of confined space atmospheric conditions must be trained in the operation, calibration and care of the specific testing equipment used. **(T-0)** The person conducting the tests must be fully trained and certified as qualified to interpret the results. **(T-0)** The tester shall meet the training requirements of an entrant if entry is required to conduct the tests. **(T-0)**

23.7.5. Documentation of Training. All confined space training for entry supervisors, entrants, attendants, testers and/or monitors and rescue team members shall be certified, documented and kept up-to-date. **(T-0)** The documentation shall contain each individual's name and dates of training or retraining and either the initials or signature of the trainer and/or instructor. **(T-0)** Documentation will indicate the type of training conducted, e.g., general awareness, formal, rescue, attendant, entrant, entry supervisor or tester/monitor. Training shall be documented on an AF Form 55, *Employee Safety and Health Record*, or an equivalent information technology system for safety related items such as CPR or respirator use, or on an authorized computerized information management system. **(T-1)** Training records shall be available for review by the Confined Space Program Team during annual program assessments or periodic reviews. **(T-1)**

23.7.6. Annual Review. The installation Confined Space Program Team will review and assess units' training programs and rescue team training at least annually. **(T-1)** The review/assessment will include documentation, exercises, course material and training methodologies. **(T-1)** The Confined Space Program Team will provide a copy of the annual assessment to the user organization. **(T-1)** Annual review may be incorporated into other annual reports conducted by members of the Confined Space Program Team, e.g., annual safety reports.

23.8. Contractor Requirements.

23.8.1. General. When an organization arranges to have a contractor perform work in a designated confined space, permit-required or non-permit required, the contract will be so informed. When the work involves a permit-required confined space entry, the organization shall:

23.8.1.1. Notify the contractor that work will be performed in a permit-required confined space and ensure the information is included in the Statement of Work or equivalent contracting tool. **(T-1) Note:** IAW AFI 91-202 and AFFARS Clause 5352.223-9001, *Health and Safety on Government Installations*, the installation contracting officer shall ensure all required elements including safety and health are identified in the Performance Work Statement, Statement of Work and/or other equivalent contracting tools. **(T-1)** It is the contractor's sole responsibility for compliance with the OSHA (Public Law 91-956). **(T-0)**

23.8.1.2. Ensure the fire chief coordinates on the confined space entry contract and either approves or disapproves use of the rescue team supplied by the installation FES Flight. **(T-1)**

23.8.1.3. Brief the contractor on contents of the space and known hazards that make the space permit-required. **(T-0)**

23.8.1.4. Brief the contractor on precautions and procedures implemented by the organization to protect Air Force workers. **(T-0)**

23.8.1.5. Establish a procedure to ensure an after-action brief is completed with the contractor at the conclusion of the contract, where the contractor can provide information regarding hazards encountered or created in the space(s). **(T-0)**

23.8.1.6. Contact the Administrative Contracting Officer if an unsafe act or procedure is performed by the contractor. **(T-1)**

23.8.2. Specific. Coordinate entry operations and procedures with the contractor and agree upon the permit space entry system to be used when both Air Force organizational and contractor personnel will be working in a permit-required confined space. **(T-1) Note 1:** Contractor program must meet Air Force confined space program requirements, as a minimum, before Air Force personnel may enter a contractor permit-required confined space. **(T-0)** The Confined Space Program Team shall approve entry of Air Force personnel into contractor permit-required confined spaces. **(T-1) Note 2:** For construction activities, refer to paragraph **23.1.3**

23.8.3. If only contractor personnel will enter installation confined spaces, a Confined Space Program Team may not be necessary. Refer to paragraph **23.2.5**

23.9. MAJCOM Mandatory Aircraft Confined Spaces. (Reference **Table 23.2** below). The following figure identifies confined spaces contained within each aircraft weapons system as defined by the MAJCOM Occupational Safety office. This is not an all-inclusive list and is subject to change based on modifications in procedures and weapons system design. **Warning:** Proper classification of a confined space depends heavily on the activity that occurs within the space. Therefore, while confined spaces with no hazards inherent within or introduced into the space are categorized as Non-Permit Required in the table below, all have the potential to contain a hazard that could change the classification to Permit-Required.

23.9.1. If activity in the space introduces or generates any hazards, the installation Confined Space Program Team must be notified to assess the classification. **(T-1)** The installation Confined Space Program Team may upgrade the classification to Permit-Required for that activity if there is potential to create a hazard.

23.9.2. Some confined spaces contain fuel lines that are normally intact and not designed to release fuel into the space. In general, most of these spaces are classified as Non-Permit Required in the table below on the basis that leaks of fuel are a rare event and the entrant would be able to detect the presence of fuel prior to entry. If there is any indication of fuel leakage (odor, visual evidence), the space must be upgraded to Permit-Required. **(T-0)** Entrants are strongly encouraged to sample air for fuel vapor before entry into Non-Permit Required confined spaces containing fuel lines as an additional means to verify no leakage has occurred. Check with BE for assistance in selecting fuel vapor detection equipment.

23.9.3. In some confined spaces, lines containing nitrogen in liquid or gaseous form pass through the space. These lines are normally intact and not designed to intentionally release nitrogen into the space. In general, most of these spaces are classified as Non-Permit Required in the table below on the basis that nitrogen leaks are a rare event and the entrant can verify the integrity of the nitrogen distribution system prior to entry. Any evidence of potential nitrogen leakage, e.g., pressure drops or maintenance history, drives an immediate upgrade of the space to Permit-Required. Additionally, due to the odorless and colorless properties of nitrogen, entrants into Non-Permit Required confined spaces where nitrogen lines or bottles are present must continuously monitor for oxygen levels while in the space to verify no leakage has occurred. **(T-1)** Refer to TO 1-1-3 for additional guidance.

Table 23.2. MAJCOM Mandatory Aircraft Confined Spaces.

Aircraft Permit Required or Non-Permit Required Confined Spaces	
Aircraft Type	**Confined Spaces**
A-10/OA-10	Fuel Cell/Tanks (Permit-Required)
B-1	Aft Equipment Bay (Non-Permit Required) Fuel Tanks (Permit-Required) Overwing Fairings (Non-Permit Required)
B-2	Fuel Tanks (Permit-Required)
B-52	Fuel Tanks (Permit-Required) Wine Cellar (Non-Permit Required)
C-5	Cargo Compartment Underfloor/Bilge Area (Non-Permit Required) Wing Dry Bays (Non-Permit Required) Flap Pack Compartment (Non-Permit Required)

	Fuel Tanks (Permit-Required) Power Transfer Unit Compartments (Non-Permit Required) Center Wing Box (Non-Permit Required) RADOME Plug Access (Non-Permit Required) T-Tail, Vertical Stabilizer (Non-Permit Required) Wing Tip Box Beam (Non-Permit Required) AFT Hayloft (Non-Permit Required) Wing Leading Edges, Butt Line 120 to Outboard Pylon (Non-Permit Required) Wing Root Dry Bay (Non-Permit Required) In-Flight Refuel Manifold (RH W.S. 120 Dry Bay) (Non-Permit Required) Forward SPR Pod/Access (PTU Compartment) (Non-Permit Required) AFT Main Landing Gear Pod (left/right) (Non-Permit Required) Horizontal Stabilizer (Box Access) (Non-Permit Required)
C-17	Aft Main Landing Gear Pods, Left and Right (Non-Permit Required) Cargo Ramp Maintenance Tunnel (Non-Permit Required) Center Wing Dry Bay Area (Permit-Required) Fuel Tanks (Permit-Required) Fuselage and Wing Area (Non-Permit Required) Horizontal Stabilizer Access (Non-Permit Required) Under Floor Maintenance Tunnel (Permit Required) Uplock Assembly Area of Wheelwell (Non-Permit Required) Vertical Stabilizer Area (Non-Permit Required)
C-20	Fuel Tanks (Permit-Required)
C-21	None listed
C-32	E/E Bay, Forward of NLG (Non-Permit Required) Fuel Tanks (Permit-Required) Main Entry Bay, Avionics Access Into Aircraft (Non-Permit Required) Space Behind Aft Cargo Auxiliary Tank (Non-Permit Required) Space Behind Forward Cargo Auxiliary Tank (Non-Permit Required) Tail Cone Access Under Horizontal Stabilizer (Non-Permit Required)
C-37	Fuel tanks (PR)
C-130	Fuel Tanks/Cells (Permit-Required) Avionics (Non-Permit Required) Wing Dry Bays (Non-Permit Required) Benson Tanks (if installed) (Permit-Required)
C-135	Center Wing Equipment Bay (Non-Permit Required) Elevator Actuator Access (Hell Hole) (Non-Permit Required) Fuel tanks (Permit-Required) Lower Nose Compartment (Non-Permit Required) Water Tank (Non-Permit Required)
C- 40	Forward E/E Bay (Non-Permit Required) Fuel Tanks (Permit-Required) Tail Access Area Above Stabilizer Jackscrew (Non-Permit Required) Main EE Bay Access (Non-Permit Required)

	Snake Pit Area (Air Dist Bay) (Non-Permit Required)
CT-43	Aft Tail Cone Area (Non-Permit Required) Fuel Tanks (Permit-Required) Forward E/E Bay (Non-Permit Required)
E-3C	Aft Lower Lobe (Non-Permit Required) Battery Compartment (Non-Permit Required) Forward Lower Lobe (Non-Permit Required) Fuel Tanks (Permit-Required) Rotor Dome (Non-Permit Required)
E-8C	Fuel Tanks (Permit-Required)
F-15 (C, D and E Models)	#1 Cell Fuselage Tank (PR) #2 Cell Fuselage Tank (Feed Tank) (Permit-Required) #3A Cell (Feed Tank) (Permit-Required) Engine Intakes/Exhausts (Non-Permit Required)
F-16	F-1 Fuel Cell (Permit-Required) Engine Intake/Exhaust (Non-Permit Required)
F-117	Fuselage Fuel Tank (Permit-Required)
F-22A	F-2 Fuel Cell (Permit-Required) F-1B Fuel Cell (Permit-Required) F-1A Fuel Cell (Permit-Required)
HH-60	External Door/Fuel Tanks (Permit-Required) Fuel Cell (Permit-Required)
KC-10	Aft Accessory Compartment (Non-Permit Required) Aft Fuselage Compartment (Non-Permit Required) ARO Compartment (Non-Permit Required) Center Accessory Compartment (Non-Permit Required) Avionics Compartments (Non-Permit Required) Bladder Fuel Cells (Permit-Required) Engine Inlets (Non-Permit Required) Forward Accessory Compartment (Non-Permit Required) Forward Lower Compartment (Pool Room) (Non-Permit Required) Integral Fuel Tanks (Permit-Required) Fuselage Tank Access Compartment (Permit-Required)
QF-4	Fuel Tanks (Permit-Required)
T-38	Fuel Cell (Permit-Required)
U-2	Aircraft Tailpipe (Non-Permit Required)
UH-1N	Fuel Tanks (Permit-Required)
VC-25	Fuel tanks (Permit-Required)

23.10. Instructions for Completing the AF Form 1024, *Confined Spaces Entry Permit.* Paragraph **23.5.1,** *Entry Into Confined Space,* requires entry supervisors ensure workers obtain an AF Form 1024 prior to entering a permit-required confined space. The following guidance shall be used to complete the AF Form 1024 or equivalent. **(T-1)**

23.10.1. **Section 1-** Master Entry Plan. Mark the appropriate block indicating whether or not the entry permit was issued under a Confined Space Program Team-approved Master Entry Plan. **(T-1)** If not, SEG, BE and FES Flight will be coordinated with using Section 9 prior to entering a confined space. **(T-1)**

23.10.2. **Section 2-** General Information. Enter the location (Global Positioning Satellite coordinates if known) of the confined space and indicate if the space is located on or off the installation. Include a description of the space to be entered, along with the purpose for entry. Identify any technical order (TO) or operating instruction (OI) that covers the entry. Enter the date and duration (time issued and time expires) of the permit.

23.10.2.1. **Section 3-** Permit Space Hazards. Check hazard potential of the space. List hazards of the space on form; e.g., Oxygen-19 percent or Engulfment-Coal.

23.10.2.2. **Section 4-** Equipment Required for Entry and Work. List equipment by type and add any equipment not listed on the form.

23.10.2.3. **Section 5-** Rescue and Emergency Service. Identify and notify the rescue team. Include POC name, phone number and indicate the date and time when availability of the rescue service was confirmed. **(T-1)**

23.10.2.4. **Section 6-** Authorized. List the names of all attendants and entrants for this entry. If the entry supervisor(s) will enter the permit-required space, list them as entrants. Attach an additional separate sheet if needed to list additional entrants. **Note:** Entrants are not required to sign or initial next to their names.

23.10.2.5. **Section 7-** Preparation for Entry. Identify required preparations prior to entering the permit-required confined space. **(T-1)** Refer to the governing TO or OI as appropriate.

23.10.2.6. **Section 8-** Atmospheric Testing and Monitoring Record. The Confined Space Program Team will determine the appropriate testing frequency, which shall be entered for each type hazard involved. **(T-1)** Ensure each tester is qualified. **(T-0)** Enter the make/model for all testing equipment along with its calibration date. Attach an additional sheet of paper if needed to record results of entry testing or monitoring of the space's atmosphere.

23.10.2.7. **Section 9-** Authorized by Entry Supervisors. The entry supervisor must sign each entry permit to validate the form. **(T-0)** Entry permits issued from an approved Master Entry Plan do not require SEG, BE or FES Flight representative signatures or initials. However, these representatives will review and approve all non-routine entry permits not covered by an Master Entry Plan. **(T-1)**

23.10.2.8. **Section 10-** Entrant Time Log. Enter the name of each entrant and the time of each individual's entry and exit. Check the box if additional sheets are used to track entrant data.

23.10.2.9. **Section 11-** Remarks. To aid on-site communication, include the phone number, radio call sign, etc., where the FES Flight rescue (if used) can contact the entry supervisor should rescue services become unavailable. The entry supervisor will include the permit closing time, or time and circumstances if the permit was revoked because a prohibited condition occurred. **(T-1)**

23.10.3. **Section 3-** Hazards. Specify all probable hazards associated with the entry (e.g., oxygen enrichment, engulfment, mechanical, etc.).

23.10.4. **Section 4-** Hazard Controls. Specify exact items required, to include manufacturer and part number, and add any equipment not listed on the form.

23.10.5. **Section 5-** Preparation for Entry. Identify required preparations prior to entering the space. **(T-1)** Refer to Master Entry Plan, governing TO or OI as appropriate.

23.10.6. **Section 6-** Atmospheric Testing and Monitoring Record. Enter the make, model and serial number for all testing equipment along with its calibration and bump test date. **(T-1)** Indicate if continuous monitoring is required; if yes, document the frequency. **(T-1)** Consider the potential for stratified atmospheres that would facilitate additional testing/monitoring. Indicate if there is additional testing/monitoring or entrant paperwork; if yes, ensure it is attached. **(T-1)**

23.10.7. **Section 7-** Authorized Personnel. List the names of all entry supervisors, atmospheric monitors, attendants and entrants for entry. Enter the name of each entrant and the time of each individual's entry and exit in the Entry Time Log. If the entry supervisor(s) will enter the permit-required space, list them as entrants. **(T-1)** Attach an additional separate sheet if needed to list additional entrants. **Note:** Attendants and entrants are not required to sign or initial next to their names.

23.10.8. **Section 8-** Fire Emergency Services or equivalent. Identify and notify emergency response personnel. **(T-0)** Include POC name, contact information (phone number, radio call sign, etc.) and indicate the date/time when availability of emergency response personnel was confirmed.

23.10.9. **Section 9-** Coordination. SEG, BE and FES Flight will be coordinated with prior to entry. **(T-1) Note:** Coordination is not required if entry is covered by a Confined Space Program Team approved Master Entry Plan.

23.10.10. **Section 10-** Entry Time Log. Enter the name of each entrant and the time of each individual's entry and exit.

23.10.11. **Section 11-** Close-out / Cancellation. The entry supervisor will sign each entry permit to validate the form. **(T-1)** (For Construction Only—Personnel responsible for the confined space will brief the owner that all occupants of the space have exited and the permit has been closed). **(T-1)**

Chapter 24

AIRCRAFT FLIGHTLINE – GROUND OPERATIONS AND ACTIVITIES

24.1. Scope. This chapter addresses hazards and safe operating procedures on the flightline, to include activities in maintenance hangars and ground operations conducted on the flightline ramp. Refer to paragraph **1.5,** and AFI 91-202 for additional guidance on job hazard analysis (JHA) and job safety lesson plan. **Note:** A JHA is not required when existing guidance adequately covers all safety requirements of an operation or process.

24.2. Specific Requirements.

24.2.1. Guidance. Supervisors and managers shall follow AFI 91-202, aircraft-specific procedural TOs and other TOs and safety standards applicable to their areas of responsibility. **(T-1)**

24.2.2. Fire Prevention. Aircraft servicing and maintenance facilities shall conform to Air Force design criteria or equivalent Air Force-approved engineering guidance to minimize fire and explosion hazards. **(T-0)** Contractor aircraft maintenance facilities shall conform to this standard and National Fire Codes. **(T-0)** Refer to paragraph **24.17** for additional guidance on contractor operations.

24.2.3. Cardiopulmonary Resuscitation (CPR)/Self-Aid Buddy Care (SABC). Aircraft maintenance and support shop employees exposed to electrical hazards from energized aircraft electrical systems, aircraft components or aircraft equipment shall be provided CPR and SABC training. **(T-1)** This includes personnel who act as safety observers. Refer to paragraphs **1.8** and **1.9** for additional information.

24.2.3.1. Installation unit maintenance commanders and supervisors may identify other job tasks that require CPR/SABC training based on hazards associated with tasks performed. Unit CPR instructors may be trained by host installation medical personnel or certified through the American Red Cross or the American Heart Association. All personnel requiring CPR/SABC training shall remain current. **(T-0)**

24.2.3.2. AF Form 55, *Employee Safety and Health Record,* or an equivalent record shall be used to document CPR/SABC training unless other documentation is specified elsewhere. **(T-1)** Documentation shall be maintained by the work center supervisor. **(T-1)**

24.2.4. Lifting Devices. Improper handling and lifting of heavy parts can injure personnel and damage aircraft components. Maintenance personnel shall be familiar with the directives and general safety standards for equipment they use. **(T-1)** Engines and other heavy parts shall be handled with hoists, approved hoisting slings and similar equipment. **(T-1)** Safe load capacities shall be stenciled on all hoists and strictly observed by operating personnel. **(T-0)** Personnel shall not work under suspended loads. **(T-0)** Inspect hoisting equipment IAW **Chapter 12**, *Materials Handling Equipment*, technical orders (TOs), and/or the manufacturer‘s manual(s). Defective hoists shall be locked and/or tagged out of service and shall remain out of service until repairs are complete IAW paragraph **21.3.3**. **(T-0)** Weight testing of all lifting devices shall be IAW **Chapter 12** and/or applicable TOs. **(T-1)**

24.2.5. Compressed Air. Only qualified, trained and authorized employees shall operate air compressors and/or repair or adjust pressure-regulating equipment. **(T-0)** Compressed air shall

not be used to clean employees or clothing while on their body. **(T-0)** Compressed air used for breathing shall meet requirements of TO 42B-1-22, *Quality Control of Compressed and Liquid Breathing Air*, and AFI 48-137, *Respiratory Protection Program.* **(T-1)**

24.2.5.1. Compressed air shall not be used for cleaning purposes except when regulated to 30 psi or less, and then only when effective chip guarding, air diffuser, and face shield and safety goggles are used. **(T-0)** OSHA prohibits the use of compressed air for cleaning when cadmium, lead or chromium dusts may be present.

24.2.5.2. Before servicing or checking pressure for any aircraft systems or components, e.g., aircraft tires, air bottles or landing gear struts, mechanics shall:

24.2.5.2.1. Inspect all chucks and valve stems for serviceability to ensure safe servicing. **(T-1)**

24.2.5.2.2. Not over-inflate these components. **(T-1)**

24.2.5.2.3. Install pressure regulators to prevent over-pressurization of components. **(T-0)**

24.2.5.2.4. Wear proper PPE and eye protection IAW TO and local installation directives. **(T-0)**

24.2.5.2.5. Ensure appropriate equipment has been calibrated, as required. **(T-1)**

24.2.5.3. Air Lines and Fittings. Employees shall:

24.2.5.3.1. Avoid bending or kinking air hose lines. **(T-1)**

24.2.5.3.2. Place air hose lines where they minimize a tripping hazard and are protected against damage caused by equipment or vehicles rolling over them. **(T-0)**

24.2.5.3.3. Inspect air lines and fittings for defects before each use. **(T-1)**

24.2.5.3.4. Ensure non-interchangeable chucks and connections are used on high- and low- pressure equipment to preclude servicing low-pressure systems with high-pressure equipment. **(T-1)**

24.2.5.4. A drain pipe and valve shall be installed at the lowest point of the air receiver to remove accumulated oil and water. **(T-0)** The air receiver drain valve, if not automatic, shall be opened and receiver completely drained daily to prevent accumulation of excess fluids. **(T-0)**

24.2.6. Oxygen and Nitrogen (Liquid and Gaseous). Oxygen is not flammable, but supports combustion. Fire or explosion may result if oxygen contacts petroleum products, alcohol or other flammable or combustible materials. Oxygen systems subject to excessive pressures may result in rupture and explosion. Liquid oxygen (LOX) and liquid nitrogen (LN2) are extremely cold, can cause serious burns and can freeze skin upon contact. Nitrogen also depletes oxygen in unventilated, confined areas. Refer to **Chapter 26,** *Liquid Nitrogen (LN_2), Oxygen (LOX) and Cryogens*, for additional guidance.

24.2.6.1. Personnel Training and Safety. Only fully trained and qualified personnel shall operate oxygen and nitrogen equipment or service aircraft systems. **(T-0)** Servicing personnel shall understand the system being serviced, operation of their equipment and precautions and instructions for handling liquid or gaseous oxygen and nitrogen. **(T-0)** A

trainee may service only if directly supervised by a qualified supervisor or operator. **(T-1)** Personnel engaged in oxygen handling and servicing operations shall strictly adhere to pertinent safety standards and TOs. **(T-0)**

24.2.6.2. Mobile Servicing Units or Bottles. Mobile servicing units or bottles used to service aircraft or components shall be carefully positioned and not left unattended after hook-up or during servicing operations. **(T-1)**

24.2.6.3. Aircraft oxygen systems (both gaseous and liquid) shall be emptied/drained prior to entering a major maintenance cycle at either an Air Logistics Center, Contract Repair Facility or Contract/Depot Field team location. **(T-1)** Safeguards shall be taken while performing aircraft servicing or maintenance operations to prevent inherently or accidentally introducing ignition or combustible sources. **(T-1)** Refer to TO 00-25-172 for additional guidance.

24.2.7. Aircraft arresting systems may pose hazards to aircraft and vehicle operations and shall follow guidance in AFI 32-1043, *Managing, Operating, and Maintaining Aircraft Arresting Systems.* **(T-1)**

24.2.8. Confined Spaces. Supervisors shall ensure employees comply with requirements in **Chapter 23**, *Confined Spaces*, when entering confined spaces. Personnel will not enter confined spaces without training. **(T-0)**

24.2.9. Red Ball. Red Ball situations require urgent and priority action to prevent late takeoffs and ground aborts. Their time-critical nature requires qualified maintenance personnel be immediately available, e.g., in a truck nearby on the flightline or standby in a shop, during aircraft launch and recovery operations to troubleshoot, isolate and repair system malfunctions. Maintenance personnel shall not deviate from authorized maintenance procedures or violate any flightline requirements, e.g., flightline speed limits or safety requirements, during Red Balls.**(T-1)**

24.2.9.1. TOs, tools, rags, parts, unused supplies and checklists shall be accounted for before the aircraft is allowed to taxi/takeoff. **(T-1)**

24.2.9.2. Emphasis will be placed on FOD awareness/prevention during this critical maintenance operation. **(T-1)**

24.2.9.3. If aircraft engines are operating, a safety observer (maintenance or aircrew member) shall maintain interphone communications or remain in full view of the flight crew and be positioned to maintain overall surveillance of the aircraft and personnel performing maintenance. **(T-1)**

24.2.9.4. Weapons loaded aircraft shall be safed IAW applicable Mission Design Series (MDS) and/or weapons specific technical data. **(T-1)**

24.3. Flightline Potentially Hazardous Areas and Operations.

24.3.1. Flammable Fuel Vapor Areas. Supervisors shall ensure all personnel are aware of potentially flammable fuel vapor areas and the restriction against ignition sources in these areas. **(T-0)** Fuel vapors are heavier than air, settle to ground level and will enter below-ground areas. These areas include, but are not limited to, fuel pits below ground level, areas within 10 feet of aircraft fuel vent systems and fuel spills, hydrant pump houses and fuels laboratories. Spark arresters are not required on general or special purpose vehicles driving on the flightline

and around aircraft. However, these vehicles are not designed, certified or authorized to operate in flammable fuel vapor areas. Employees in flammable fuel vapor areas shall receive specialized training emphasizing hazards associated with these operations. **(T-0)** Refer to AFMAN 91-201, *Explosive Safety Standards*, paragraph 8.34.2., for requirements for spark arresters on general or special purpose vehicles within or near structures containing exposed explosives. Not rated/approved equipment shall be turned off or removed from the area during refueling operations and fuel cell/tank work, unless permitted by TO 1-1-3, *Inspection and Repair of Aircraft Integral Tanks and Fuel Cells*. **(T-1)** Only explosion-proof, intrinsically safe radios/equipment or equipment incapable of having sufficient energy to be an ignition source (approved by competent authority, e.g., HQ AFSEC, HQ Air Force Materiel Command (AFMC), HQ AFCEC) shall be used in and around flammable fuel vapor areas. **(T-0)** Refer to National Fire Protection Association 70, Article 501, Class I Locations, for additional information.

24.3.2. Electrical Receptacles. Exterior electrical receptacles on the flightline are protected from weather conditions, but are not authorized for use in hazardous areas as defined in National Fire Protection Association 70. If separation is not possible, receptacles in the immediate area of the fueling or defueling operations shall be de-energized using administrative devices IAW paragraph **29.8** **(T-1)**

24.3.3. Aircraft Maintenance Operations. Aircraft maintenance operations in hangars, shelters or docks (closed or semi-enclosed) on the flightline or outside maintenance areas, such as wash racks, shall be accomplished IAW Air Force guidance or recognized national consensus standards. **(T-1)** MAJCOMs/units operating in overseas or remote areas may supplement this standard to meet international or host country safety requirements or unique working conditions.

24.3.3.1. Electrical Devices and Power Equipment. All fixed and installed electrical devices and fixed power equipment in hangars, shelters or docks shall comply with Air Force design criteria or equivalent Air Force-approved engineering guidance. **(T-1)** Portable electrical equipment in Class I, Division 1 and Class I, Division 2 locations shall be explosion-proof or intrinsically safe and shall comply with National Fire Protection Association 70, *National Electrical Code* or shall be approved by competent authority, e.g., HQ AFSEC, HQ AFMC, HQ AFCEC, to show that the equipment is incapable of having sufficient energy to be an ignition source. **(T-0)** Items listed in TO 00-25-172, paragraph 3-9e, can be used in Class 1, Division 2 locations. Equipment not meeting this requirement may be temporarily approved by the installation fire chief prior to the use of the equipment. Approval shall be documented in writing, stating the area, nature, duration and the reason for the exception. **(T-1)** If the working environment has been tested and contains flammable fuel vapors, all maintenance activities shall be stopped until the hazardous condition is eliminated and a safe work environment restored. **(T-0)** Equipment in an area with a high potential for flammable fuel vapor release and that can be automatically energized when unattended shall be considered for explosion- proof or intrinsically-safe design. **(T-0)**

24.3.3.2. Smoking. Smoking is prohibited in aircraft maintenance facilities, flightline areas and weapons storage and maintenance areas unless designated by the installation Fire Emergency Services (FES) Flight in coordination with the Maintenance Group Commander or equivalent, Airfield Manager and/or the functional manager.

24.3.3.3. Aircraft Fuels Management and Servicing. Fuel system maintenance and servicing operations shall be IAW TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding*, **Chapter 18,** *Hydrocarbon Fuels*, and other applicable TOs. **(T-1)** Aircraft fuel cell and integral tank inspections and repairs shall be IAW TO 1-1-3. **(T-1)**

24.3.3.4. Cleaning Parts. Parts shall be cleaned with approved high flashpoint or nonflammable solvents or compounds whenever possible. **(T-1)** Do not clean aircraft parts, hangar floors, equipment or clothing with gasoline or unauthorized solvents. Operations requiring low flashpoint solvents shall be considered hazardous and performed in a facility or area compatible with the solvents. **(T-1)**

24.3.3.4.1. Flammable liquids shall be kept in approved containers, marked to identify contents and stored in buildings/areas specifically approved by the installation FES Flight. **(T-1)** Refer to **Chapter 22,** *Flammable and Combustibles*, for additional guidance.

24.3.3.4.2. Wiping cloths, oily waste and other combustible materials shall be disposed of IAW paragraph **24.11.2.2** **(T-1)**

24.3.3.4.3. Proper ventilation shall be maintained and proper protective clothing used when working with solvents. **(T-0)** Refer to AFI 90-821, *Hazard Communication (HAZCOM) Program*, and AFI 32-7086, *Hazardous Material Management*, when handling and using hazardous materials.

24.3.3.5. Welding on Aircraft. Welding on aircraft shall be done outside of hangars if possible. **(T-1)** An AF Form 592, *USAF Hot Work Permit*, shall be issued prior to aircraft welding operations. **(T-1)** Welding shall only be performed on aircraft system components IAW applicable aircraft technical data and **Chapter 27,** *Welding, Cutting, and Brazing*. **(T-1)** Welding operations in hangars shall meet the requirements of National Fire Protection Association 410, *Standard on Aircraft Maintenance*, Chapter 6. **(T-1)** Refer to American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance*, for industrial ventilation requirements during welding on aircraft.

24.3.3.6. Fire Extinguishers. Suitable fire extinguishers shall be placed throughout flightline and maintenance areas, within easy reach of the operator and close to ground power equipment. **(T-1)** Refer to TO 00-25-172, Table 3-1, for flightline operations fire extinguisher requirements and **Chapter 6,** *Fire Protection and Prevention*, for additional information.

24.3.3.7. Nondestructive Inspection (NDI). NDI operations involving ionizing radiation (normally X-ray operations) shall be conducted IAW TO 33B-1-1, *Nondestructive Inspection Methods, Basic Theory*. **(T-1)** The installation Radiation Safety Officer shall approve flightline X-ray procedures and locations. **(T-1)**

24.3.4. Hazardous Noise. Personnel assigned to the flightline may be exposed to hazardous noise levels. Supervisors shall ensure assigned personnel adhere to engineering controls, administrative controls and properly wear PPE. **(T-0)** Refer to AFI 48-127, *Occupational Noise and Hearing Conservation Program*, for additional guidance.

24.4. Additional PPE Requirements. The information below is specific to flightline operations and activities and is in addition to the PPE requirements of **Chapter 14.** Maintenance employees shall wear heat-resistant gloves and long-sleeve shirts to prevent burns when working around hot exhaust or tail pipes. **(T-1)**

24.4.1. Head Apparel. Hats or bump caps will not be worn in an engine intake danger zone, as defined by the specific aircraft TO, while engines are operating. For further details see AFI 21- 101.

24.4.1.1. Bump Caps. If bump caps are the chosen PPE for use after conducting a hazard assessment IAW paragraphs **14.3.1** and **14.3.2,** follow the guidance in paragraph **14.3.3**

24.4.1.2. Metal, plastic or leather hair fasteners and wigs shall not be worn during aircraft maintenance. A rubber band or hair net (with no metal parts) that holds the hair wrapped in a bun at the back of the head may be worn. Umbrellas are not permitted on the operational flightline except when assisting passengers on or off aircraft during inclement weather. Criteria in **Chapter 14** shall be used when aircraft or equipment TOs do not provide specific PPE guidance. **(T-1)** When in doubt, consult the installation Occupational Safety office and BE. **Note:** Helmets to protect employees from impact and flying objects must meet requirements in **Chapter 14**. **(T-1)**

24.4.2. Footwear. Protective footwear shall be provided and worn when there is a reasonable possibility of foot injuries. **(T-0)** Removable shoe cleats may be worn on the flightline under the following conditions: In areas where severe snow/ice conditions are common, organizations may permit use of removable shoe cleats to improve traction on ice/snow covered surfaces and prevent employee slips and falls. Organizations will obtain coordinated approval from their installation management, to include the FES Flight and Occupational Safety office. **(T-1)** Organizations should consider using non-metallic cleats to reduce the potential for spark- initiated fire. Organizations shall define the type(s) of footwear to be worn, the conditions and locations where such footwear may be worn, and procedures/controls to prevent cleats/spikes/studs becoming a FOD hazard. **(T-1)** Cleats will not be worn while working on or inside aircraft. Metal cleats will not be worn within 50 feet of fueling, defueling or fuel cell repair operations, or operations that involve flammable solvents, paints, etc.

24.4.3. Reflective Materials.

24.4.3.1. Vehicle and Equipment Marking. Vehicles, ground servicing and ground powered equipment shall be marked with reflective materials to the maximum extent authorized by appropriate TOs, such as TO 36-1-191, *Technical and Managerial Reference for Motor Vehicle Maintenance,* and TO 35-1-3, *Corrosion Prevention and Control, Cleaning, Painting, and Marking of USAF Support Equipment (SE).* **(T-1)** Fire extinguishers and all hazardous obstacles on or adjacent to the flightline shall be marked with reflective material. **(T-1)**

24.4.3.2. Bicycles. All bicycles (Air Force and privately owned) operated on the flightline during the hours of darkness shall be equipped with a suitable headlight (turned on and provides adequate illumination) and reflective markings front and rear. **(T-1)** Also see paragraph **24.13.5.3**

24.4.4. Jet Intakes. Mechanics entering jet intake sections shall wear appropriate PPE. **(T-0)** A pocket-less, zipper-less, button-less bunny-suit, cloth over-boots or stocking feet, boots

removed, for intakes only, shall be worn whenever physical entry into an aircraft intake or exhaust is required. **(T-0)** To minimize heat stress during high heat/humidity conditions, e.g., air temperatures above 85° F, employees in engine intakes may wear half-bunny suits and garments designed for use over trousers. When worn with a pocket-less T-shirt, these items provide the same level of FOD protection as a full bunny suit. Units using half-bunny suits shall have procedures in place to control use. **(T-1)**

24.4.5. LOX/LN_2 Transfers.

24.4.5.1. When transferring LOX, personnel shall wear the following PPE (all items shall be clean and free of grease, oil and fuel):

24.4.5.1.1. Head covering. **(T-0)**

24.4.5.1.2. Eye protection (goggles). **(T-0)**

24.4.5.1.3. Face shield (National Stock Number (NSN) 4240-00-542-2048) or locally purchased hard hat face shield combination. **(T-0) Note:** Face shield is secondary eye protection and must be worn in conjunction with primary eye protection (goggles). **(T-0)**

24.4.5.1.4. Gloves (loose fitting), leather, welder's gauntlet cuff (DLA-A-50022) (NSN 8415-00-268-7860), medium with gloves, cloth, work, cotton knit (DLA-A-55213) (NSN 8415-00-964-4760), medium as an insert; or

24.4.5.1.5. Gloves (loose fitting), leather (NSN 8415-00-268-7871) with glove inserts, wool (NSN 8415-00-682-6673) or equivalent. **(T-0)**

24.4.5.1.6. Apron (NSN 8415-00-082-6108). **(T-0)**

24.4.5.1.7. Coveralls, cotton white (mandatory) (NSN 8405-00-037-9274). **(T-0)**

24.4.5.1.8. Cuff-less trousers. **(T-0)**

24.4.5.1.9. Long sleeve shirt. **(T-0)**

24.4.5.1.10. Jacket (optional).

24.4.5.1.11. Shoes, which fit closely around the top, with rubber soles and heels. **(T-0)**

24.4.5.2. When transferring LN_2, personnel shall wear the following protective clothing and equipment (all items shall be clean and free of grease, oil and fuel): **(T-0)**

24.4.5.2.1. Head covering. **(T-0)**

24.4.5.2.2. Eye protection (goggles). **(T-0)**

24.4.5.2.3. Face shield (NSN 4240-00-542-2048). **(T-0)**

24.4.5.2.4. Gloves (loose fitting), leather, welder's gauntlet cuff (Federal Specification KKG486, Type II, NSN 8415-00-268-7860), medium with gloves, cloth, work, cotton knit, medium as an insert; or Gloves (loose fitting), leather (NSN 8415-00-268-7871) with glove inserts, wool (NSN 8415-00-682-6673). **(T-0)**

24.4.5.2.5. Apron (NSN 8415-00-082-6108). **(T-0)**

24.4.5.2.6. Coveralls (Refer to TO 00-25-172 for guidance on coveralls).

24.4.5.2.7. Jacket. **(T-0)**

24.4.5.2.8. Cuff-less trousers. **(T-0)**

24.4.5.2.9. Long sleeve shirt. **(T-0)**

24.4.5.2.10. Shoes, which fit closely around the top, with rubber soles and heels. **(T-0)**

Note 1: The above NSN data is for gloves, size "medium." Other sizes may be ordered as required, but all sizes must meet the criteria of the federal and military specifications identified above. **(T-1)**
Note 2: The wool glove insert and cotton knit cloth work gloves used as inserts can be used interchangeably with either welder's gauntlet cuff leather gloves or leather gloves specified above.
Note 3: A leather boot approximately eight (8) inches in height with close fitting top and rubber soles and heel is recommended, since LOX spills normally subject one's foot area to a freeze burn exposure hazard. This type footwear when equipped with a hard protective toe area is generally classified as a safety shoe or boot.

24.5. Aircraft Parking Requirements.

24.5.1. Strict adherence to standards ensures the safety of parked aircraft. Specific parking locations shall be designated for each aircraft IAW AFMAN 32-1084, *Facility Requirements*. **(T-1)** Generally, distances between parked aircraft, wingtip to wingtip, shall allow immediate access of emergency vehicles and permit free movement of equipment and materials. **(T-1)** Refer to AFMAN 32-1084 for specific aircraft wingtip distances. Refer to AFMAN 91-201 and TO 11A-1-33, *Handling and Maintenance of Explosives Loaded Aircraft,* for parking explosives loaded aircraft.

24.5.2. Temporary Parking. A qualified ground observer shall be used to warn oncoming traffic when temporarily parked aircraft extend into an active taxiway. **(T-1)** A suitable flag will suffice in daytime; however, when dark, a high-visibility reflective vest and red warning light shall be used. **(T-1)** A ground observer shall remain with the aircraft until moved to a safe location. **(T-1)** Vehicles parked on the flightline shall be parked with the driver's side door facing aircraft, ignition turned off, keys in the ignition and the gear lever in reverse (manual transmission) or park position (automatic transmission) and the brake set. **(T-1)** Chock all powered vehicles and all equipment mounted on wheels that do not have an integral braking system when left unattended on the flightline. Chocks will be placed in front of and behind a rear wheel, or one chock placed between the tandem wheels of dual (tandem) axle vehicles. **(T-1)**

24.5.3. Wheel Chocking. Aircraft wheel chocks, fabricated IAW MIL-PRF-32058, *Chock, Wheel-Track-Aviation, Adjustable Rope Type,* and/or the aircraft Dash 2 TO, shall be placed fore and aft of the main landing gear or as specified in applicable aircraft TOs. **(T-1)** Vehicle chocks shall meet Commercial Item Specification A-A-52475 or be made IAW TO 00-25-172. **(T-1)**

24.5.4. Clean Parking Areas. Maintenance equipment, workstands, loose aircraft parts and materials not actually required for work in progress or planned, shall be moved from the aircraft parking area to designated storage locations. **(T-1)** Equipment stored outside buildings shall

be tied down and/or chocked or brakes applied to prevent movement by wind or engine blast. **(T-1)** Mobile work platforms and stands shall be moored/tied down when in designated storage locations to prevent collision with aircraft, vehicles or other equipment. **(T-1)** Designated flightline support equipment storage areas shall be determined by the Aerospace Ground Equipment (AGE) Flight Commander and Airfield Manager and approved by the Maintenance Group Commander or equivalent in coordination with the installation Occupational Safety office. **(T-1)**

24.5.5. Taxi/Tow Lines. Taxi/tow lines shall be painted on ramp, taxiway and hangar parking areas to aid safe movement of aircraft and vehicle traffic. **(T-0)** Parking lines will have spots painted where the nose or forward wheel of the aircraft shall be positioned. **(T-0)** Hangars used for parking helicopters shall have parking lines and rotor blade lines painted on the floor to prevent the blades contacting hangar walls. **(T-0)** Lines are not required if: numerous types of aircraft use the same facility and multiple paint lines would be confusing, fixed objects are marked and identified, an aircraft parking plan is established, wing and tail walkers are used during hangaring operations and streamers are placed on rotors or wingtips. **Exception:** Under emergency conditions, streamers on helicopters when hangaring are not required. Nose docks or other maintenance facilities shall have spots painted where each aircraft wheel (forward, aft and outrigger) shall be positioned to prevent aircraft striking the building during docking and undocking. **(T-0)** Taxi/tow lines shall be painted on wash rack pavement to help position aircraft. **(T-0)**

24.5.6. Mooring or Tie-Down of Aircraft. Follow applicable aircraft TOs and use designated fittings on aircraft. **(T-1)** Square or bowline knots shall be used to provide secure rope fastenings. **(T-1)** Allow sufficient slack to prevent excessive stress on wings, fittings and rope from tire or strut expansion or deflation and contraction of tie-down ropes when wet. **(T-1)** Aircraft mooring points shall be placed directly over ground mooring points, or as close as possible. **(T-1)**

24.5.7. Aircraft Emergency Removal. Emergency procedures shall be developed to remove endangered aircraft in the event of fire, adverse weather or other emergency situations on the flightline or in hangars. **(T-1)** Refer to paragraph **24.14.15**

24.5.8. C-130 Aircraft. Personnel will not enter the plane of rotation of the propellers except by walking around the outside (number 1 or number 4) propeller arcs. **Exception:** If bleed air is not supplied to the aircraft, personnel may enter the plane of rotation for preflight inspections and maintenance actions.

24.6. Adverse Weather Conditions.

24.6.1. IAW **Chapter 3,** *Weather Safety*, each Air Force installation shall develop local procedures to notify key personnel and agencies with high risk activities impacted by observed or forecast weather conditions. **(T-1)** Specific weather thresholds and notification procedures will be documented in the installation weather support document. **(T-1)** Installations will establish a lightning safety program with a two-tiered notification system to minimize exposure to lightning hazards. **(T-1)** Refer to **Chapter 3** for further guidance.

24.6.2. The local base weather organization may, IAW the weather support document, initiate notification of adverse weather conditions (includes strong or damaging surface winds, heavy rain, heavy snowfall, freezing precipitation, thunderstorms, lightning, and hail) to

predetermined support agencies. Notification may also be initiated by a supporting operational weather squadron providing meteorological watch for the installation.

24.6.3. Safeguarding Aircraft. Sustained or gusty surface winds of 20 knots or greater can damage aircraft. When possible, aircraft shall be evacuated to safe weather areas when tornadoes, hurricanes or winds of 50 knots or greater are forecast. **(T-1)** Local damaging wind and severe weather safety plans shall be developed to include an evacuation plan and hangaring of installation and transient aircraft. **(T-1)** The option to evacuate is the installation commander‘s decision in coordination with the appropriate MAJCOM.

24.6.3.1. Taxiing Aircraft. Avoid taxiing aircraft during strong or damaging wind conditions defined by local weather support document. Taxi only at the discretion of the wing commander when the action will lessen the possibility of aircraft damage.

24.6.3.2. Outside Parking. If possible, park aircraft inside hangars during periods of strong or damaging winds. Light aircraft shall be given priority over heavy aircraft for parking inside hangars. **(T-1)** Aircraft parked outside shall be faced into the wind and tied down. **(T-1)** Wing spoilers shall be used when necessary to reduce airfoil lift. **(T-1)** Transient aircraft shall be parked inside hangars, if space permits, or tied down as directed by the Maintenance Group Commander or equivalent. **(T-1)**

24.6.3.3. When to Tow Aircraft. Light aircraft in docks or extending outside hangars shall be towed clear and parked IAW applicable aircraft TOs when winds exceed 30 knots (sustained or gusts). **(T-1)** Medium or heavy aircraft in docks or extending outside hangars shall be towed clear and parked IAW applicable aircraft TOs when winds meet or exceed 50 knots (sustained or gusts). **(T-1)** Refer to **Table 24.1** for additional information.

24.6.3.4. Working Materials. All maintenance equipment, workstands, loose aircraft parts, flightline fire extinguishers and materials not in use shall be removed from aircraft parking areas and stored in a safe area. **(T-1)** Equipment remaining outside shall be secured against wind movement. **(T-1)**

24.6.3.5. Personnel. Activities other than those required to safeguard aircraft shall be suspended and avoided when winds reach velocities of 40 knots or greater. **(T-1)**

24.6.4. C-5 and Wide-body Staircases. Caution is required when using C-5 staircase trucks during high wind conditions. Wide-body and C-5 staircases are designed to withstand a maximum wind velocity of 60 mph/52 knots. Wide-body staircase trucks may be used to upload/download passengers whenever wind velocity (including gusts) on the ramp area is at or below 40 mph/35 knots. C-5 staircase trucks may be used to upload/download passengers whenever wind velocity (including gusts) on the ramp area is at or below 29 mph/25 knots. If wind velocity (including gusts) on the ramp area exceeds 40 mph/35 knots, Air Terminal Operations Center senior controller/superintendent shall decide on a case-by-case basis whether the wide-body staircase will be used and then so direct. **(T-1)** C-5 staircases will not be used to upload/download passengers whenever wind velocity (including gusts) on the ramp area exceeds 29 mph/25 knots. **(T-1)** This standard applies whenever a wide-body or C-5 staircase truck is used on any aircraft.

Table 24.1. Adverse Weather High Wind Safeguards.

	Winds 20-30 Knots	Winds 31-50 Knots	Winds Over 50 Knots
Required Actions Personnel will adhere to locally established high wind safety precautions, plans, and checklists developed by each functional area and observed along with the guidance presented. Criteria for advisories varies from state to state; local procedures shall consider these factors.	Ensure all aircraft precautionary actions are taken IAW applicable TOs, Directives and Publications.	In addition to high wind precautions secure all materials and maintenance equipment.	In addition to high wind precautions, have all nonessential personnel move to shelter or remain in their duty section. **Warning:** Do not open canopy hatch or any access door or remove any covers when winds are in excess of 50 knots.
	Ensure all non-essential AGE and other loose equipment is removed from the flightline and secured (except fire extinguishers)	Hangar all aircraft with less than 15,000 pounds gross weight (i.e. engines removed, no fuel)	ALL AGE must be removed from flightline. Maximum number of aircraft shall be hangared.
	If aircraft is not being worked, ensure all RADOMES, canopies and access panels/doors are closed and secured.	Hangar all aircraft with canopies and/or RADOMES removed.	All non-essential personnel shall seek shelter or remain inside their duty sections.
	Ensure all protective covers are installed on aircraft.	Aircraft should be triple chocked and laced.	For winds in excess of 70 knots, moor aircraft IAW applicable TOs; clear ramp.
		Secure all equipment.	Consider evacuation of aircraft.

Note 1: This table shall be used as a guide in tying down, hangaring or evacuating aircraft.
Note 2: Installation Commander is the governing authority on the evacuation of installation aircraft.

24.7. Towing and Taxiing Aircraft.

24.7.1. Towing Operations. Refer to AFI 21-101, *Aircraft and Equipment Maintenance Management*, for vehicle operator's aircraft towing responsibilities and qualifications. A tow operation will consist of trained and qualified employees, thoroughly familiar with aircraft towing responsibilities including TO and local procedures/conditions, such as inclined ramps, emergencies, other local limitations and weather conditions. **(T-1)** For maximum safety, tow team employees shall not place themselves in the direct path of aircraft wheels nor ride on any external portion of an aircraft or tow vehicle. When connecting a tow bar to the tow vehicle, employees shall stand clear until the backing tow vehicle is in close proximity to the tow bar. **(T-1)** When connecting a tow vehicle to the aircraft, employees shall watch for any sudden tow vehicle movement. **(T-1)** Avoid backing aircraft when possible. MAJCOMs may authorize

movement of aircraft into hardened aircraft shelters while the aircraft engines are operating, provided a System Safety Engineering Analysis has been conducted. An System Safety Engineering Analysis shall be conducted for each type or generation shelter and type of aircraft to be moved into the shelter. **(T-1) Note:** Technical data takes precedence over this standard when differences exist in towing procedures.

24.7.2. Qualified Personnel. All aircraft tow team members shall be familiar with all published towing procedures for the aircraft being towed. **(T-1)** Supervisors shall conduct written proficiency tests on local procedures, if applicable, and an operating standards review at least annually. **(T-1)** Newly assigned aircraft maintenance specialists shall pass a proficiency test on the types of aircraft towed after completing supervised OJT. **(T-1)** Wing and tail walkers shall be familiar with all published towing procedures for the aircraft being towed but do not require annual proficiency training if their duties are restricted to these positions during towing operations. **(T-1)** Tow team supervisors shall ensure all team members are qualified per requirements above and shall clearly define duties and responsibilities at the time of the pre-tow briefing. **(T-1)** Refer to paragraphs **24.7.2.3**, **24.7.2.4**, **24.7.2.5** and **24.7.2.7** for additional information.

24.7.2.1. Tow Team Supervisor. The tow team supervisor shall be in complete command and will take a position that will ensure surveillance of the towing procedures and performance of other team members. **(T-1)** Normally, this will be the position of nose walker. The supervisor shall use a checklist covering safe movement of the towed aircraft. **(T-1)** Checklist steps shall be completed and towing personnel briefed before the aircraft is moved. **(T-1)** Only the supervisor shall be authorized to give the "all clear to move" order. **(T-1)** The supervisor will determine the safe distance, based on aircraft type and amount of allowable space to maneuver the aircraft; the tow vehicle operator can back the aircraft into its final position. **(T-1)** Hangaring aircraft is considered final positioning, which includes final entry. Refer to paragraph **24.7.2.8** for additional guidance on hangaring aircraft. Wing walkers and/or tail walkers shall be required when backing aircraft. **(T-1)** Refer to paragraph **24.7.18** for additional guidance.

24.7.2.2. Towing Team Assignments. Tow team size and where they are stationed shall be IAW applicable aircraft TO procedures. **(T-1)** Each shall have a tow team supervisor. **(T-1) Note:** Tail and wing walkers are not required when towing aircraft on unobstructed, established taxiways and runways or parking ramps where taxi or towing lanes are marked with guide lines.

24.7.2.3. Brake Person in Cockpit. A qualified person, authorized by the supervisor, shall be in the pilot's seat to operate aircraft brakes and follow the supervisor's signals. **(T-1)** If the brake operator is unable to maintain hydraulic pressure, another qualified person shall be stationed to watch and maintain the pressure. **(T-1)** The supervisor shall terminate the towing operation if brake pressure drops below safe operating limits. **(T-1)**

24.7.2.4. Tow Vehicle Operator. An authorized and qualified vehicle operator shall control the tow vehicle at all times during aircraft movement, operate the vehicle in a safe manner, follow team supervisor's instructions, obey any emergency stop instructions and stop the tow vehicle upon losing sight of or communication with the tow supervisor. **(T-1)** The vehicle operator shall face the direction of travel while seated and not look over his or her shoulder to face the direction of travel except while making minor changes during final

positioning. **(T-1)** Hangaring aircraft is considered final positioning (includes final entry) so minor changes are allowed. Positioning the aircraft an appropriate distance from hangar doors and backing the aircraft into the hangar is acceptable. The towing supervisor shall determine final positioning, based on aircraft type and maneuverability, and brief the towing crew. **(T-1)**

24.7.2.5. Wing Walker. A wing walker shall be stationed at each wingtip to ensure adequate aircraft clearance of any obstruction and shall signal the supervisor whenever the aircraft is in danger of colliding with an obstruction. **(T-1)** In such cases, towing shall be stopped until clearance is personally checked by the supervisor. **(T-1)** Wing walkers are not required when towing helicopters with rotor blades in parallel position (H-1 type helicopters parallel rotor blades in a fore and aft trail position). Wing walkers shall be familiar with all published towing procedures for the aircraft being towed but do not require annual proficiency training if their duties are restricted to these positions during towing operations. **(T-1)** Thorough pre-tow briefings by a qualified towing supervisor satisfy the training requirement. **Note:** When differences exist in towing procedures prescribed in this standard and applicable technical data for the specific aircraft, the technical data will take precedence. **(T-1)**

24.7.2.6. Nose Walker. The tow team supervisor also serves as the nose walker and shall maintain a safe position in front of the towing vehicle and have a clear view of both wing walkers, the vehicle operator and the person in the cockpit. **(T-1)** The nose walker shall have direct contact with the person in the cockpit by interphone or communications media specified in applicable aircraft TOs. **(T-1)** When tail and wing walkers are not required, the nose walker may ride in the tow vehicle cab if he can observe the path to be traversed and direct actions of the cockpit brake person and vehicle operator.

24.7.2.7. Tail Walker. A tail walker shall be used when the aircraft is turned sharply or backed into position. **(T-1)** A tail walker is required when backing aircraft into a HAS with permanent chocks installed. **(T-1)** Tail walkers shall be familiar with all published towing procedures for the aircraft being towed but do not require annual proficiency training if their duties are restricted to these positions during towing operations. **(T-1)** Thorough pre-tow briefings by a qualified towing supervisor satisfy the training requirement. **Note:** The tow team supervisor may eliminate the tail walker when moving small aircraft or in third generation HAS. Earlier generation HAS do not have sufficient clearance to allow eliminating the tail walker.

24.7.2.8. Final Positioning (Hangaring Aircraft). Some aircraft have MDS Specific TOs that address final positioning of hangaring aircraft. For aircraft not addressed in MDS Specific TOs, final positioning of hangaring aircraft is considered to be the last act of positioning the aircraft in its parking spot in a designated hangar. Final positioning may begin at the door of the hangar but is not considered complete until the aircraft is parked in its assigned parking spot for maintenance, training, etc. (final position).

24.7.2.8.1. There is no distance requirement for final positioning of an aircraft, i.e., the final two or three feet do not constitute final positioning. For smaller aircraft, the process may be simple and fairly quick. For bigger aircraft, that process may be a more arduous task. Also the amount of aircraft already hangared may play a major role in hangaring additional aircraft.

24.7.2.8.2. The tow team will consist of the team identified in paragraphs **24.7.2.1** through **24.7.2.7** for final positioning. **(T-1)**

24.7.3. Steerable Gear. Steerable landing gear, including outriggers, shall be set in tow position before the aircraft is moved and returned to original position after tow bar removal. **(T-1)** The tow supervisor shall instruct cockpit personnel to allow the nose gear steering wheel to turn freely and not attempt to steer or turn the nose wheel when the tow bar is connected to the aircraft. **(T-1)**

24.7.4. Employees Riding or Walking. Employees shall not cross a tow bar connected to both the aircraft and the tow vehicle, nor ride on the outside of a moving aircraft, tow bar or on the outside of tow vehicles unless an authorized seat is provided. **(T-1)** No one will try to board or leave a moving aircraft or tow vehicle. **(T-1)** The tow supervisor shall brief this information prior to towing. **(T-1)**

24.7.5. Night Crew Signals. Two luminous wands shall be issued to tow team members who require wands. **(T-1)** Tow team supervisors should use wands even if aircraft interphone contact is established with tow vehicle operator and cockpit brake person **(T-1)**. Wands or wingtip lights shall be used by other tow team members, as needed, to warn approaching aircraft traffic. **(T-1)** Refer to AFI 11-218, *Aircraft Operations and Movement on the Ground*, for night crew signaling practices. **Note:** Many units have established local policy on night crew signaling procedures. Local policy shall be written IAW the tenets of AFI 11-218. **(T-1)**

24.7.6. Control Tower Clearance. The tow team supervisor shall obtain control tower clearance before towing aircraft on or across a taxiway or runway, maintain radio contact with tower and inform the tower when tow is complete. **(T-1)** The primary means of communication shall be the aircraft radio, but, if not feasible, a radio-equipped escort vehicle, in direct radio contact with the control tower, shall accompany the aircraft throughout the towing operation. **(T-1)**

24.7.7. Towing Speed. Towing speed shall not exceed the walking speed of team members, with a maximum of five (5) miles per hour. **(T-1)**

24.7.8. Brakes. To prevent serious mishaps, aircraft brake systems shall be charged before each towing operation, and towing shall be stopped immediately if brake pressure drops below safe operating limits. **(T-1)** Aircraft with inoperative brakes will follow MDS-specific guidance procedures. **(T-1)** Aircraft without MDS-specific guidance for towing with inoperative brakes will comply with the following procedures:

24.7.8.1. Obtain squadron commander or designated representative approval prior to each tow. **(T-1)**

24.7.8.2. Maintain radio communication throughout entire towing operation. **(T-1)**

24.7.8.3. Additional personnel will chock walk the aircraft, positioned outboard of each landing gear strut requiring chocks. **(T-1) Note 1:** The aircraft maintenance organization will develop local procedures for aircraft without MDS-specific guidance and publish them in a local OI or supplement. **(T-1)** Procedures shall include main landing gear chock walk requirements. **(T-1) Note 2:** The same procedures above shall be followed when towing aircraft with inoperative brakes from a repair facility, i.e., to allow repairs on higher priority aircraft. **(T-1)**

24.7.9. Tow Bars. Only authorized equipment in good condition shall be used in towing operations. **(T-1)** Before moving any aircraft, the tow vehicle, tow bars and connections and other associated equipment shall be inspected for defects by the tow team supervisor. **(T-1)**

24.7.10. Chocks. Chocks shall be maintained near the tow vehicle or aircraft for emergency use throughout the towing operation and shall be properly placed before the tow vehicle is unhooked. **(T-1)** Chocks or other support equipment shall not be placed on or hung from any part of the aircraft exterior during towing or repositioning operations.

24.7.10.1. During inclement weather conditions, when towing or parking aircraft with snow, ice or frost present anywhere on the parking ramp or towing surface, use the heaviest tow vehicle authorized per aircraft technical data to prevent loss of aircraft or tow vehicle control during tow operations. Also, equip the tow vehicle with chains to maintain traction.

24.7.10.2. Conduct a RM assessment of proposed tow operation based on current runway and taxiway condition readings from local Airfield Management. The decision to proceed shall be approved by appropriate squadron command levels. **(T-1)**

24.7.11. Starts and Stops. Tow vehicle operators shall not stop and start suddenly when moving aircraft. **(T-1)** Aircraft brakes shall only be applied upon direction from tow supervisor. **(T-1)** Chocks shall be properly placed and the aircraft's brakes set before the towing vehicle is unhooked from the aircraft, **(T-1)**

24.7.12. Equipment, Stands and Similar Materials. The supervisor shall ensure all equipment, workstands, loose aircraft parts, fire extinguishers and all other materials are removed from the vicinity of an aircraft and properly stored. **(T-1)** Equipment or materials left outside shall be secured to prevent accidental movement by wind or jet or propeller blast. **(T-1)**

24.7.13. Entrance Doors, Ladders and Down Locks. Aircraft entrance doors shall be closed, ladders retracted or removed, and landing gear down locks installed to prevent possible employee injury and aircraft damage during towing operations, unless permitted by specific aircraft TOs. **(T-1)**

24.7.14. Struts and Tires. Towing team members will check nose and main landing gear struts and tires for proper inflation prior to towing any aircraft. **(T-1)** A visual check of tires and struts shall be adequate for towing purposes unless the applicable TO requires a gauge check.

24.7.15. Docks. The following precautions shall be taken when moving multi-engine aircraft with propellers (particularly into and out of docks):

24.7.15.1. Ensure ramps are clear of snow and ice at least 100 feet in front of dock doors and far enough on each side to accommodate all landing gear wheels. **(T-1)**

24.7.15.2. Open hangar doors enough to allow complete passage of the aircraft, both in width and height, with at least 10 foot wingtip clearance on either side. **(T-1)** Inflate or deflate tires as necessary to provide required clearances, but do not exceed minimum or maximum pressures. **(T-1)** If hangar construction does not permit such clearance, the doors shall be opened to the maximum limit. Wing walkers shall be used when an aircraft is placed in a hangar. **(T-1)** Also see paragraph **24.14.8.4** Under normal conditions, powered hangar or shelter doors shall be opened at least 10 feet. **(T-1)** Refer to **Chapter 21,** *Hazardous Energy Control*, for hazardous energy control requirements.

24.7.15.3. Maintain landing gear strut extension suitable for the aircraft and dock involved. **(T-1)**

24.7.15.4. Place propellers in an "X" position or position suitable for the aircraft and dock combination. **(T-1)**

24.7.15.5. Keep hydraulic brake pressure at or above safe minimum values in applicable TOs. **(T-1)**

24.7.15.6. Station two (2) team members to observe the top clearance of propeller blades. **(T-1)**

24.7.16. Towing Vehicle Inspections. Tow vehicle operators shall inspect all towing equipment to ensure it is serviceable and functioning properly before starting any tow operation. **(T-1)** Inspection shall be documented on AF Form 1800, *Operator's Inspection Guide and Trouble Report.* The tow team supervisor is responsible for the entire towing operation and shall ensure the tow vehicle is free of defects or extraneous material that may interfere with safe operation before the tow bar is hooked to the aircraft. **(T-1)** The unit vehicle control plan shall ensure a qualified operator inspects each tow vehicle designated for emergency response use each shift to ensure the cab and bed are clear of extraneous materials and the vehicle is safe for use. **(T-1)** All other tow vehicles shall be inspected using the same criteria prior to use. **(T-1)** Towing connections shall be inspected before each use. **(T-1)** Pintle assemblies and towing connections shall be secured with a pintle hook safety or cotter pin that will positively lock towing connections. **(T-1)** Tow vehicles with safety defects shall be removed from service until repaired. **(T-1)**

24.7.17. Approach of Towing Vehicle. The tow vehicle driver will stop at least 50 feet from the aircraft to be moved and shall proceed only when directed by the tow team supervisor. **(T-1)**

24.7.18. Towing Clearance. The tow vehicle shall remain at least 50 feet from other aircraft or vehicles and at least 150 feet when towing aircraft with faulty brakes. **(T-1) Caution:** The wingtip path on sweptback wing aircraft extends beyond the straight line wingtip path during turns, based on the degree of turn and the degree of sweep on the wings. In some cases the aircraft tail path may also exceed wingtip path. Equipment, vehicles and other aircraft may appear to be clear of the intended path, while actually impeding it.

24.7.19. Towing Aircraft Without Cockpit Access. Chocks shall be immediately available for emergency use when moving cocooned aircraft without seat, brakes or with closed and sealed canopies. **(T-1)**

24.7.20. Engine Operation. As a general rule, aircraft shall not be towed with engines operating. However, civilian contract air carrier jet engine transport aircraft may be towed or pushed short distances with engines operating IAW Federal Aviation Administration-approved procedures in operations and maintenance handbooks. Copies of these procedures shall be carried on the aircraft. **(T-1)** Air Force aircraft may only be pushed back with engines running during non-routine or abnormal operational requirements using push-back procedures supported by engineering analysis and the aircraft Dash 1 TO.

24.7.21. Taxiing Operations. A marshaler shall be used. **(T-1)** Personnel shall remain clear of taxiing aircraft until the aircraft has come to a complete stop. **(T-1)** Aircraft shall not be taxied

closer than 100 feet to an active runway where aircraft are operated unless taxiing on an established taxiway. Wing walkers shall be used when taxiing within 25 feet of obstructions. **(T-3)** Wing Commanders may waive this provision for locally based aircraft if taxi lines and permanent obstructions are marked or other aircraft are parked on parking spots or lines. Aircraft shall not be taxied within 10 feet of an obstruction, except during contingency operations when compliance would restrict the mission; or from alert, readiness or protective shelters. **(T-3)** A plainly visible centerline shall be painted along the exit path and a marshaler shall be used; or when operating locally based aircraft from parking spots specifically designed for those aircraft. **(T-1)** Parking spots shall have a minimum 10-foot wingtip clearance between aircraft, taxi routes clearly marked and support equipment placed in designated locations. **(T-1) Caution:** The wingtip path on swept-back wing aircraft extends beyond the straight line wingtip path during turns, based on the degree of turn and the degree of sweep on the wings. Equipment, vehicles and other aircraft may appear to be clear of the intended path while actually impeding it.

24.7.21.1. Aircraft Taxiing Requirements. Aircraft canopy and windshield shall be clean before aircraft taxi and position lights ON from before engine start until engine shutdown. **(T-1)** T-38 and C-21 aircraft and aircraft in approved sound suppressors are exempt during daylight hours. **Note:** Exercise care not to blind ground crew members when taxiing with landing lights on. Refer to AFI 11-218, *Aircraft Operations and Movement on the Ground*, for further guidance.

24.7.21.1.1. Doors and Hatches. Unless a specific requirement exists, no aircraft shall be taxied with open doors or hatches. **(T-1)** Personnel shall secure doors and hatches IAW operating instructions and checklists before starting engines, taxiing or actual flight. **(T-1)** Aircraft commanders shall brief all personnel on board not to leave or enter the aircraft while it is moving. **(T-1)** If a door warning light comes on during taxiing, the aircraft shall be completely stopped, if operational or airfield constraints allow, and the cause determined. **(T-1)**

24.7.21.1.2. Communications. Aircraft shall not be taxied without clearance. Radio contact shall be maintained with the control tower throughout taxi operations. **(T-1)** Taxi speeds in uncongested areas shall be reasonable, with aircraft and personnel safety the determining factors. Follow guidance in Dash 1 handbooks for taxi operations under varying wind conditions.

24.7.21.2. Crossing Behind Aircraft. Personnel, vehicles and towed aircraft shall remain clear of taxiing traffic and will not pass within 200 feet behind aircraft with engines running. **(T-1)**

24.7.21.3. Ramp Areas. Aircraft parked in ramp areas shall be taxied only after an "ALL CLEAR" signal is given by the ramp supervisor. **(T-1)**

24.7.21.4. Signaling at Night. At night, ground crewmembers shall use two illuminated wands for signaling taxiing aircraft IAW paragraph **24.7.5** Refer to AFI 11-218 for further guidance. **(T-1)**

24.7.21.5. Taxiing Near Other Aircraft. Pilots and taxi-qualified technicians shall use minimum power when leaving a row of parked aircraft and taxi in a way that prevents propeller or exhaust blast endangering personnel, parked aircraft or property. **(T-1)** The

minimum safe distance behind a jet aircraft at 100 percent power setting is where the jet blast does not exceed 35 miles per hour and 38° C / 100° F. Refer to applicable aircraft TOs for the recommended safe distance.

24.7.21.6. Jet Run-up Areas. Caution signs, constructed IAW **Chapter 29,** *Mishap Prevention Signs and Tags*, shall be posted at entrances, gates and approaches to jet run-up areas. **(T-1)**

24.8. Aircraft Jacking Operations.

24.8.1. General Requirements:

24.8.1.1. All personnel involved in jacking operations shall be thoroughly familiar with TOs and handbooks for the aircraft involved and follow procedures in these publications. **(T-1)** Jacks shall be: operated, maintained, inspected and tested IAW applicable TOs or handbooks; inspected before use to verify lifting capacity, proper functioning of safety locks, conditions of pins and general serviceability; and inspected with documentation maintained by work section supervisor. **(T-1)** If integrity of jack is questionable, the jack shall be removed from service and the supervisor notified. **(T-1)**

24.8.1.2. Employees shall follow specific aircraft TO jacking procedures. **(T-1)** Non-essential workstands and equipment shall be removed from under the aircraft before jacking. If the aircraft weight-and-balance condition has been affected by removing heavy items, weight shall be added to reestablish the proper center of gravity before jacking. **(T-1)** Employees shall not remain in aircraft being raised or lowered, unless directed by TO (i.e., to observe leveling instruments). TO prescribed jack pads, jack pad fittings and correct jack screw adapters and extensions shall be installed prior to jacking. **(T-1)** Chocks shall be removed and brakes released before the aircraft is raised or lowered. **(T-1)**

24.8.1.3. Safety stands of suitable capacity shall be installed under aircraft wings and tail after the aircraft is jacked and leveled if equipment failure or an unbalanced condition could occur. **(T-1)**

24.8.1.4. Personnel shall not pass under, climb or walk on any portion of the aircraft when the entire aircraft is supported by jacks, except to support jacking activities or when operationally necessary to perform maintenance. The area around jacked aircraft shall be secured and warning signs posted. **(T-1)** Personnel not directly involved in jacking operations or performing maintenance on jacked aircraft shall remain outside the posted area. **(T-1)** Depot maintenance facilities may post signs at work area, hangar and flightline entrances in lieu of securing and signing individual aircraft

24.8.1.5. Engines and other major components, such as wing panels and stabilizers, that affect aircraft center of gravity or are identified as stress areas, shall not be changed or removed on jacked aircraft with landing gear clear of the ramp or floor except IAW aircraft TOs.

24.8.1.6. The ram locknut will lower under its own weight or be turned down by hand as the ram is extended and shall remain against the lift tube cylinder during jacking procedures. **(T-1)** Other types of jacks, if equipped with locking pins or nuts, shall be set immediately after jacking is complete. **(T-1)** Refer to TO 35A2-1-1, *General Inspection Procedures and Overhaul Instructions – For Hydraulic Jacks*, for specific instructions.

24.8.2. Specific Requirements:

24.8.2.1. Outside Jacking. Aircraft may be jacked outside hangars when wind conditions permit. When aircraft wind velocity specifications are not available, 13 knots (15 miles per hour) shall be used as a safe maximum velocity for outside jacking. **(T-1)** Jacking shall be done on a level surface. **(T-1)** High tail surfaces of some aircraft require special consideration when exposed to even moderate wind. Maintenance employees shall be familiar with appropriate aircraft TOs before jacking. **(T-1)**

24.8.2.2. Hangar-Dock Jacking. Hydraulic pumping units for aircraft jacks shall not be operated in aircraft hangars unless authorized by the Maintenance Group Commander or equivalent, occupational safety representative and installation fire chief. When authorized, hydraulic pumping unit design shall ensure all electrical equipment, sparking contacts, hot surfaces and other possible ignition sources are at least 18 inches above floor level. **(T-0)** Refer to National Fire Protection Association 410 and National Fire Protection Association 70, *National Electrical Code*, for additional guidance. Hydraulic pumping units shall be placed at least 25 feet from the aircraft in an area free of combustible material and the pumping unit engine properly grounded. **(T-1)**

24.8.2.3. Releasing Jacks. Maintenance employees shall ensure the area beneath the aircraft is clear of equipment, cribbing and personnel, and verify the aircraft is ready for lowering before releasing jack pressure and lowering the aircraft. **(T-1)** Employees shall ensure the landing gear is completely down and locked in position with all ground locking devices installed. **(T-1)** Only employees required to operate jacks and free the struts will remain near the aircraft while lowering. The aircraft shall be lowered slowly and evenly to the surface. **(T-1)** Employees should exercise care when removing jacks to prevent aircraft skin or structure damage. Jacks shall be removed by first turning down the jack screw extension then depressing the ram into the cylinder. **(T-1)** Personnel will not place any part of their hands on top of the ram to avoid injury while depressing the ram.

24.8.2.4. Landing Gear Retraction Tests. Landing gear retraction tests shall be directed orally, using an interphone system for communication between a ground observer outside the aircraft and the landing gear operator. **(T-1)** Use of hand signals is acceptable if the interphone system is inoperable and the ground observer maintains direct visual contact with both the wheel well/gear swing areas and the landing gear operator at all times. The ground observer will ensure the wheel well and gear swing areas are clear of personnel and equipment prior to and during all testing. **(T-1)**

24.8.2.4.1. Fire Fighting Equipment. Maintenance employees will ensure suitable portable firefighting equipment is readily available and properly positioned. **(T-1)** After aircraft departure, fire extinguishers used to support that aircraft shall be removed from the ramp. **(T-1)** Refer to Chapter 6 for additional guidance.

24.9. Aircraft Engine Operations.

24.9.1. Engine starts and run-ups present hazards to personnel and other aircraft. Personnel near an engine start or run-up shall wear, at a minimum, hearing protection as prescribed by BE. **(T-1)** Eye protection shall be required if conditions exist where flying debris is present, e.g., unimproved/austere runways or aircraft backing maneuvers. **(T-0)** The fire hazard is high because fuel vapors may be ignited by exhaust flames. Rotating propellers are dangerous to

personnel and can cause extensive equipment damage. Except for turboprop aircraft, personnel will not hand-pull the propeller of a recently operated engine. The ignition switch for reciprocating or electric start engines shall be in the OFF position when engines are not operating and the master battery switch shall be turned off when no longer required. **(T-1)** For C-130 aircraft, personnel will not enter the plane of rotation of the propellers except by walking around the outside (number 1 or number 4) propeller arcs. (**Exception:** If bleed air is not supplied to the aircraft, personnel may enter the plane of rotation for preflight inspections and maintenance actions.) Personnel shall not stand in line with the stripe that designates the plane of propeller operation. Radio contact with the control tower shall be maintained during engine operation or taxiing or with job control during engine runs when the control tower is not operating. **(T-1)** Maintenance Operations Center (MOC) shall be prepared to request FES Flight or medical services assistance as needed. **(T-1)**

24.9.1.1. Aircraft Chocks. Aircraft shall be properly chocked and parked IAW applicable TOs and job guides before starting engines. **(T-1)** Functional managers will ensure only chocks approved by MIL-PRF-32058 and/or the specific aircraft Dash 2 TOs are used. **(T-1)** When aircraft engines are in operation, chocks shall be removed with the utmost caution after the proper signal has been given. **(T-1)** Employees will approach the aircraft from the safest direction, considering location of propellers, jet intakes and exhausts. **(T-1)**

24.9.2. Personnel on Exterior Portions of Aircraft. Personnel shall not be allowed on external portions of an aircraft during engine start or when taxiing. Qualified employees may stand on TO designated areas only during instruction on ground operation procedures and necessary adjustments. Qualified employees may service hydraulic fluid and engine oil or make minor adjustments on multi-engine aircraft with engines operating if engines on the wing being worked are shut down and engines on the opposite wing are in idle. Interphone or radio contact shall be maintained with the cockpit operator, if possible, or the employees shall be under direct observation of another crewmember, team member or fire guard with direct cockpit communication. **(T-1)** Aircraft equipped with anti-collision lights, the lights will be on prior to engine start until engine shutdown IAW AFI 11-218. **(T-1)**

24.9.3. Fire Guard. A qualified fire guard (need not be a certified firefighter) shall be positioned by the fire bottle(s)as required by the aircraft TO prior to starting aircraft engines. **(T-1)** This individual shall remain stand by in readiness until all engines are operating and fire danger is past, i.e., crew chief or team leader can release fire guard once engines are started and no fire danger exists. **(T-1)** If no fire guard is required by aircraft TO:

24.9.3.1. Aircraft with internal firefighting capability shall have a ground observer in position on interphone to monitor and report any problems, e.g., fire, fuel leaks, aircraft movement, and shall remain in position until released by the individual operating the engine. **(T-1)**

24.9.3.2. Aircraft without interphone capability shall have a fire guard stationed to observe the engine start process. **(T-1)** After start, the fire guard will remain in clear view of cockpit personnel and observe aircraft and area during engine operation. **(T-1) Warning:** Use extreme caution to ensure all personnel remain clear of propeller arc and/or jet intakes/exhaust during ground operation. **Exception:** Aircraft used by Aero Clubs may be started/operated without a fire guard if fire extinguishers are readily accessible during

engine starts, aircraft maintenance and refueling, and if it does not violate manufacturer's operating handbook procedures.

24.9.4. Qualified Personnel. Only personnel trained and certified IAW AFI 11-218 shall be authorized to start and run-up aircraft engines. **(T-1)** The engine run supervisor is responsible for inspecting the surrounding area to ensure it is clear of equipment, personnel and materials that might cause or be subject to FOD. Equipment or materials subject to engine blasts or being blown into other equipment shall be repositioned or secured. **(T-1)** Refer to AFI 21-101, *Aircraft and Equipment Maintenance Management*, for additional information.

24.9.5. Jet Engine Start Observers. A ground crewmember, in contact by interphone at all times with the person operating the engine control, shall be stationed in front and to one side of the engine being started. **(T-1)** On aircraft without interphone capability, a ground crewmember shall be stationed to observe the start and give necessary signals to the person in the cockpit. **(T-1)**

24.9.6. Cockpit Checklist. Employees starting, operating and testing aircraft engines shall use the appropriate cockpit checklist before, during and after the operation. **(T-1)**

24.9.7. Jet Engine FOD. Damage caused to jet engines by foreign objects and debris sucked through inlet ducts can be reduced by use of inlet duct run-up screens on certain aircraft types. Operational needs may require installation and removal of screens while engines are running. Ensure engine inlet run-up screens and anti-personnel guards are used IAW applicable system TOs. **(T-1)** Refer to AFI 21-101 for additional information on FOD prevention and FOD prevention programs.

24.9.8. Hearing Protection Devices. Crew and maintenance personnel shall wear approved hearing protection in noise hazard areas to prevent permanent hearing loss. **(T-0)** BE will determine noise hazard areas, protection requirements and adequacy of hearing protection. **(T-1)**

24.9.9. Rotary Wing Aircraft.

24.9.9.1. The collective pitch stick shall be locked in the full low position during engine run-up by ground employees. **(T-1)** Personnel and equipment shall be kept clear of rotary wing aircraft at least a distance equal to its length, to prevent injury and damage if a quick excessive throttle start swings the tail. **(T-1)**

24.9.9.2. Main rotor blades shall be tracked only with an experienced pilot at the controls. **(T-1)** Engine run-up shall not be attempted by fewer employees than specified in specific aircraft TOs. Personnel shall exercise caution when approaching the plane of rotation of main rotor blades because they droop at decreased speeds. **(T-1)**

24.9.9.3. All personnel shall remain in full view of the pilot or helicopter operator and keep a crouched position approaching or leaving a helicopter with rotating blades. **(T-1)** Personnel shall avoid the area from cockpit or cabin rearward unless authorized by helicopter operator to work in this location. **(T-1)** Keep unauthorized personnel at least 50 feet from helicopters with turning rotor blades.

24.9.9.4. Personnel shall use extreme caution to stay clear of main and stabilizing rotors when visibility is reduced by dust or other conditions. **(T-1)** Protective goggles shall be

worn by all personnel and other precautions taken as needed to minimize problems from reduced visibility. **(T-0)**

24.9.9.5. Adequate precautions shall be taken to protect personnel from flying objects caused by rotor downwash. **(T-1)** All loose gear within 100 feet of the area susceptible to rotor downwash shall be secured or removed. **(T-1)**

24.10. Jet Aircraft Requirements.

24.10.1. General safety standards for conventional powered aircraft also apply to jet aircraft, and ground handling of jet aircraft involves hazards not common to conventional types. Engine inlet suction and exhaust blast pose hazards to maintenance, support and flight crew personnel.

24.10.2. Suction Effect. Jet engine suction can ingest personnel, causing loss of life. Additionally, ingestion of tools or personal articles may cause extensive engine damage. Unless required by TO, crewmembers, maintenance employees and other personnel shall not approach closer than 5 feet from the side or rear or 25 feet from the front of engine intake ducts of running engines. Personnel may approach multi-engine aircraft, e.g., F-15, from the opposite direction of the running engine, but shall use extreme caution to prevent ingestion. **(T-1)** Maintenance and aircrew personnel who work on or near running jet engines will not wear loose clothing, hats or carry objects that might be sucked in the engine. All objects shall be removed from in front of or within intake ducts prior to starting engines. **(T-1)** Visiting personnel or observers shall be briefed on removing hats and carrying objects near jet engines. **(T-1)** Refer to paragraph **24.4** for additional information. Maintenance employees will not place hands or fingers on auxiliary air inlet doors as they operate automatically and may close. If open, access doors shall be secured or removed as they may be forced closed by engine suction. **(T-1)**

24.10.3. Exhaust Blast. Jet engine exhaust blast is hazardous to personnel and property. Local procedures shall be established to prevent personnel, vehicles and aircraft passing behind engines operating above idle speed or through hazardous jet blast areas IAW applicable aircraft TOs. **(T-1)** A ground or flight crew member shall be stationed alongside the operating engine to warn personnel and traffic to remain clear at least 25 feet in front and 200 feet to the rear of the aircraft, depending on the aircraft involved or as prescribed IAW applicable aircraft TOs and handbooks. **(T-1)** A blast fence shall be installed where needed to protect personnel and equipment from exhaust blast. **(T-1)** Tools, spare parts and other objects shall be removed from blast areas before any jet engine is started. **(T-1)** Refer to Engineering Technical Letter 07-3, *Jet Engine Thrust Standoff Requirements for Airfield Asphalt Edge Pavements*, for mandatory standoff distance required to prevent uplift forces from causing catastrophic failure of asphalt edge pavements.

24.10.4. Ejection Seats and Canopies. Accidental discharge of ejection seats, cockpit canopies and jettisonable hatches (e.g., A-10, B-2, and F-16) is hazardous to employees. Extreme heat or unintentional movement of actuating mechanisms can fire the ejection seat catapult or canopy remover. The following precautions will reduce accidental seat or canopy ejections for aircraft on the ground. **Note:** Anyone entering a cockpit or flight deck equipped with escape system components shall have aircraft cockpit and flight deck familiarization training prior to entry IAW AFI 21-101. **(T-1) Exception:** C-17 Aircraft, Flotation Equipment Deployment Systems – Electro-Environmental workers with task qualification training and annual

explosive safety training for time change compliance related to Flotation Equipment Deployment Systems meets the intent of paragraphs **24.10.4**, **24.10.4.1** and **24.10.4.3**

24.10.4.1. Maintenance employees will avoid accidental arming and firing when working near ejection seat catapults and ejection seat or canopy remover controls. **(T-1)** They will not carry combs, screwdrivers, pens, pencils, etc., protruding from pockets or clothing that may cause accidental or inadvertent arming and firing of ejection seat or canopy controls.

24.10.4.2. Crash Landings. Care shall be exercised to avoid snagging arming and firing mechanisms when removing crewmembers from crashed aircraft. **(T-1)** Cook-off, inadvertent actuation or residual pressure stored in lines and tubes of explosive egress components may pose hazards during rescue attempts.

24.10.4.3. Salvage Operations. Explosive Ordnance Disposal employees will ensure explosive devices are removed before any aircraft salvage operations begin. **(T-1)** Only qualified and certified egress employees will remove escape and/or egress system explosive components. **(T-1)** These items include cartridge-actuated devices and propellant-actuated devices, such as initiators, catapults, canopy removers, rocket packs, divergence rockets, gas generators, shielded mild detonating cord and flexible linear shape charges.

24.10.4.4. Transient Checklists. Transient alert organizations shall develop local checklists to ask pilots about explosive egress systems for aircraft not normally processed through their installations and shall follow specific TO procedures for aircraft being serviced. **(T-1)**

24.10.5. Pressure Testing. Cockpit pressure-testing shall not exceed TO allowed pressures.

24.10.6. Sharp Edges. Some jet aircraft control surfaces have sharp edges. Mechanics shall use caution when working on or near these edges. **(T-1)** During prolonged maintenance periods, sharp edges or corners of aircraft parts or equipment shall have suitable protective covers, where practical, or tape placed over them and red streamers attached to indicate the danger area. **(T-1)**

24.10.7. Entering Tail Pipe. IAW **Chapter 23,** based on the determination of the Confined Space Program Team, employees will evaluate the condition of tail pipes prior to entering, i.e., to inspect engine turbine wheel assembly. **(T-1)** This evaluation will include an atmospheric test prior to entry. **(T-1)** If the tail pipe was deemed to be a permit-required confined space, appropriate measures shall be taken before entry IAW **Chapter 23,** including use of a BE-approved respirator. **(T-1)** If the space was deemed non-permit required, the space shall be checked IAW **Table 23.1** to ensure the space is safe to enter prior to any work being started in the tail pipe. **(T-1)** A responsible individual shall be positioned adjacent to the tail pipe or entrance of the aircraft to prevent anyone entering the cockpit and to maintain communication with the person in the tail pipe. **(T-1)**

24.10.8. Handling Hydrazine. Firefighting and transient maintenance personnel may be exposed to hydrazine. Employees shall be trained IAW **Chapter 14,** AFI 90-821, and TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding*. **(T-0)** Training shall be documented IAW AFI 91-202 and on AF Form 55. **(T-1)**

24.11. Aircraft Cleaning.

24.11.1. General Requirements. To prevent falls, employees shall not climb or walk on wet aircraft surfaces. **(T-0)** Separate elevated work platforms and long-handle brushes shall be used to the maximum extent possible. **(T-0)** If absolutely necessary to walk on aircraft TO designated areas during washing, extreme care shall be exercised, and locally designed systems, such as sky-lines (horizontal life lines) and personal fall arrest systems, shall be used. **(T-0)** Refer to paragraph **24.16** Employees will wear PPE identified by BE to include, but not limited to, chemical-splash goggles, when using brightening agents, caustics, acids, phenolic compounds or other chemicals. Only authorized cleaning agents shall be used. **(T-0)** Appropriate footwear shall be worn to prevent falls from wet surfaces. **(T-0)** Refer to **Chapter 14** for additional PPE guidance. All PPE use, including respirators, shall be coordinated with BE. **(T-1)** Refer to AFI 90-821 for hazard communication requirements.

24.11.1.1. Flammable Solvents. Aircraft shall be cleaned IAW MDS-specific TOs. **(T-1)** Flammable solvents may be used only if authorized by TOs or IAW AFI 32-7086, and any other guidance, and shall be a coordinated, approved and well-planned operation involving the Maintenance Group Commander, or equivalent, and the installation Occupational Safety office, FES Flight and BEE. **(T-1)** All potential sources of ignition shall be prohibited within 50 feet of the operation and warning signs shall be posted. **(T-1)** Suitable auxiliary firefighting equipment shall be kept close at hand as determined by the installation FES Flight. **(T-1)** The aircraft shall be grounded at all times to prevent collection of static charges. **(T-1)** When an aircraft is washed or cleaned with flammable solvents and thunderstorms are within five (5) nm or less, the operation shall be suspended unless inside a facility with an approved lightning protection system. **(T-1)** Refer to paragraph **24.6** for additional information on adverse weather requirements.

24.11.1.2. Cleaning Material or Solvent Spills. The installation FES Flight shall be notified immediately of any flammable solvent spill and pollution control procedures IAW installation spill prevention control and reporting plans. **(T-1)**

24.11.2. Aircraft Cleaning Operations.

24.11.2.1. Maintenance personnel shall not clean aircraft parts, hangar floors, equipment or clothing with unauthorized solvents, e.g., gasoline, diesel, petroleum-based liquids, etc. Use approved high flashpoint or nonflammable substances or liquids whenever possible. Store flammable liquids IAW **Chapter 22.** See paragraph **24.3.3.4** for additional information on cleaning aircraft parts.

24.11.2.2. Wiping cloths, oily waste and other flammable materials shall be placed in suitable, self-closing metal containers in the work area. **(T-0)** At the end of each day or shift, these containers shall be emptied or removed to an approved location outside the shop for pickup and disposal. **(T-1)** Contact the installation Environmental Management office for waste disposal guidance. **Caution:** To prevent spontaneous combustion due to heat buildup, do not put soiled rags in sealed plastic bags. **Note:** Flammable and combustible wastes may be stored in vapor tight containers if required by the installation Environmental Management office.

24.11.2.3. Store small amounts of flammable solvents with adequate ventilation and fire extinguishers readily available. Keep storage areas cool (55° to 80° F) and free of spark or

heat-producing equipment. Absorbent material should be available to clean up spills. Refer to paragraph **24.15.3.3.1** for additional guidance.

24.11.2.4. Flammable and toxic vapors are common hazards with solvents. Electrically bond containers (metal to metal contact) when transferring flammable solvent.

24.11.2.5. Safe spill handling materials control the hazard. Vapor absorbent materials absorb vapors and flammable liquids so even if an ignition source is present, the spill will not burn.

24.11.3. Fire Control. Use Class B extinguishers for flammable solvents. In no case shall water be used. Employees using flammable solvents shall be trained and proficient in extinguisher use. **(T-0)** Extinguishers shall be sized for possible fires. **(T-1)** A gallon of spilled solvent can cover 25 to 50 square feet, but a small extinguisher may only extinguish 2 square feet. The FES Flight shall be consulted to ensure extinguishers with proper capacity are obtained. **(T-1)** Employees shall remain vigilant after a fire is extinguished because flammable solvent may still be present beneath the extinguishing material. **(T-1)** If an ignition source is present, the vapors can re-ignite. Safety cans and solvent storage cabinets shall have flash arresters to prevent flame from entering the container. **(T-1)**

24.12. Aircraft Tire Mounting and Servicing Operations.

24.12.1. Maintenance employees shall use tire dollies or mechanical devices when mounting, servicing or removing heavy aircraft tires. **(T-0)** Sufficient personnel are also necessary, in addition to mechanical aids, to safely handle heavy tires and wheels.

24.12.2. Tire cages shall be used when inflating tires in the shop to prevent injury to employees. **(T-0)** Extreme caution shall be used to avoid over-inflating tires. **(T-1)** Nitrogen or dry air supply lines shall be equipped with regulators to prevent over pressurizing the tire. Consult TO 4T-1-3, *Inspection, Maintenance Instructions, Storage, and Disposition of Aircraft Tires and Inner Tubes,* when using a remote tire inflator assembly kit. **Note:** The risk of personal injury and equipment damage increases greatly when employees do not use tire cage guards or tire inflation equipment properly, e.g., over-inflate a tire, use un-calibrated equipment, etc.

24.12.3. Only authorized safety tire inflation equipment shall be used for flightline or hangar tire inflation. **(T-1)** The relief valve shall be set at 100 psi (with a 10 percent tolerance) for tires with a maximum tire pressure under 80 psi. **(T-1)** Tires with an maximum tire pressure over 80 psi shall have the relief valve set at 20 psi over the maximum tire pressure (with a 10 percent tolerance). **(T-1)** For pressures exceeding 50 psi, inflator equipment servicing hose shall be a minimum of 10 feet in length. **(T-1)** This allows personnel to be positioned forward or aft of the tire and clear of potential wheel failure fragments.

24.12.3.1. The pressure supply source, especially when using high pressure gas cylinders, shall include a pressure reducing regulator set not more than 50 percent over the required tire pressure or a maximum inlet pressure of 600 psi, whichever is less. **(T-1)**

24.12.3.2. Only qualified precision measurement equipment laboratory (PMEL) personnel will adjust and/or calibrate tire inflation equipment. **(T-1)** Applicable equipment TOs shall be referenced for time requirements. **(T-1)**

24.12.4. Tire temperatures become more critical on faster and heavier aircraft. Nitrogen gas is preferred for inflating tires because oxygen in compressed air reacts with tire rubber at high temperatures and pressures. This causes deterioration, decreased tire life, and creates a blowout hazard. If compressed air is used, it shall be oil- and water-free. **(T-1)** Hose material shall be compatible with the servicing agent (air or nitrogen) used. **(T-1)** Two types of gaseous nitrogen are available in the Air Force supply system: oil-free nitrogen and oil-tolerant nitrogen.

24.12.4.1. Only oil-free nitrogen, also called water-pumped nitrogen, shall be used to inflate aircraft tires. **(T-1)** Guidance for portable, nitrogen (converter) supply system cart (PN AO40111000) shall be consulted. **(T-1) Warning:** Never inflate tires with nitrogen directly from supply cylinders.

24.12.4.2. Use local procedures to ensure oil-tolerant nitrogen, or oil-pumped nitrogen, is not used to inflate tires to prevent oil soaking the rubber. If compressed air (a legal alternative) is later used to inflate the tire, a combustible mixture will form on contact with the oil.

24.12.5. Aircraft Wheel Removal. Deflation is not required prior to removal if the tire will be reinstalled immediately following the maintenance task. All other removal actions require deflation prior to tire removal. Refer to TO 4T-1-3 for aircraft wheel removal task procedures.

24.12.6. Employee Training. Supervisors shall ensure employees servicing wheels are trained on procedures for each type of wheel serviced and will not allow untrained employees to service wheels. **(T-0)** See OSHA 3086, *Servicing Single Piece and Multi-Piece Rim Wheels*, a comprehensive pamphlet on servicing wheels at **http://www.osha.gov/Publications/osha3086.pdf**, and 29 CFR 1910.177, *Servicing Multi-piece and Single Piece Rim Wheels*, for additional requirements.

24.12.6.1. The supervisor shall ensure each employee demonstrates and maintains the ability to service aircraft wheels safely. **(T-0)** A employee is considered qualified and trained after completing the installation or unit's training program.

24.12.6.2. IAW 29 CFR 1910.177 and applicable TOs, the following tasks are required for employee qualification:

24.12.6.2.1. Deflation and demounting of tires.

24.12.6.2.2. Inspection and identification of wheel components.

24.12.6.2.3. Mounting and inflation of tires.

24.12.6.2.4. Use of tire cages and other tire mounting and servicing equipment.

24.12.6.2.5. Handling aircraft wheels.

24.12.6.2.6. Inflation of tire when wheel is mounted on aircraft or during in-shop maintenance.

24.12.6.2.7. Understanding the need to stand outside the trajectory of fragments in the event of an explosive separation during or immediately following inflation.

24.12.6.2.8. Installation and removal of wheels.

24.12.6.2.9. Use of appropriate PPE, e.g., goggles and/or face shield during tire inflation.

24.12.7. The supervisor shall evaluate each employee's ability to perform tasks safely and provide additional training as necessary to ensure each employee maintains proficiency. **(T-0)**

24.12.8. Tire Servicing Equipment. The supervisor shall ensure a restraining device is available for inflating tires on wheels. **(T-0)** The restraining device shall withstand the maximum force from a wheel separation at 150 percent of the maximum tire specification pressure for the type of wheel being serviced. **(T-0)** Restraining devices shall also prevent wheel components being thrown outside or beyond the device for any wheel positioned within or behind the device. Restraining devices shall be visually inspected prior to use each day and after any separation of wheel components or sudden release of contained air. **(T-0)** Inspections shall be annotated on AFTO Form 244, *Industrial/ Support Equipment Record*, or MAJCOM Safety Office approved substitute. **(T-1)** Restraining devices exhibiting defects listed below shall be removed from service and an AF Form 979, *Danger Tag*, tag attached until repaired and re-inspected: **(T-0)**

24.12.8.1. Cracks at welds, or cracked or broken components. Validate any suspected cracks at welds using NDI methods. **(T-1)**

24.12.8.2. Bent or sprung components from mishandling, abuse, tire explosion or wheel separation.

24.12.8.3. Pitting of components due to corrosion.

24.12.8.4. Other structural damage which would decrease restraining device effectiveness.

24.12.9. Accomplish a one-time NDI on all welds on locally manufactured restraining devices or commercially procured devices when integrity of welds has not been documented. Also, conduct NDI of welds whenever a tire/wheel failure in a restraining device causes visible or suspected damage, when a weld is found to be severely rusted or the integrity of a weld is in question.

24.12.10. Hoses shall be inspected periodically and replaced as required. **(T-1)**

24.12.11. Restraining devices requiring structural repair, component replacement or re-welding shall be removed from service until certified by the manufacturer or registered professional engineer as meeting TO strength requirements. **(T-1)**

24.12.12. The supervisor shall ensure an air-line assembly with the following components is used for inflating tires: **(T-1)**

24.12.12.1. Specified service chuck.

24.12.12.2. In-line valve with pressure gauge or pre-settable regulator (low/medium/high inflator/deflator kit).

24.12.12.3. Air hose, at least 10 feet long, between clip-on chuck and in-line valve so employee can stand outside fragment trajectory.

24.12.13. Current charts, TOs or manuals containing instructions for types of wheels being serviced shall be available in the service area. **(T-1)**

24.12.14. The supervisor shall ensure only tools recommended in the TO or manual for the type of aircraft wheel being serviced are used. **(T-1)**

24.13. Flightline Vehicle Operations.

24.13.1. General Requirements. Persons assigned flightline or related activities shall be knowledgeable of and comply with these requirements. **(T-1)** Carelessness, haste and disregard for safety standards are primary causes of incidents and near misses, aircraft and vehicle mishaps and personnel injuries on the flightline.

24.13.2. Responsibilities. Supervisors will monitor and evaluate their personnel to ensure compliance with this standard, DoD and Air Force directives, installation directives and other established guidelines. **(T-1)** Refer to AFMAN 24-306, *Operation of Air Force Government Motor Vehicles*, AFI 13-213, *Airfield Driving*, and AFI 31-218, *Motor Vehicle Traffic Supervision*, for additional guidance and information.

24.13.3. Operating Standards. The following vehicle traffic standards shall be observed when vehicles (including motorcycles, mopeds, bicycles or tricycles) are operated on the flightline. **(T-2)**

24.13.3.1. Speed Limits. No vehicle shall be operated at a speed in excess of that deemed reasonable and prudent for existing traffic, road and weather conditions. **(T-2)** Emergency vehicles will not automatically assume the right of way. AFMAN 24-306 lists the following flightline speed limits: **Note:** Vehicles responding to Red Balls (emergency flightline scenarios), exercises and precautionary landings are not authorized to exceed these limits. Refer to AFI 21-101, *Aircraft and Equipment Maintenance Management*, and paragraph **24.2.9** for additional guidance on Red Balls.

24.13.3.1.1. General purpose vehicles – 15 mph.

24.13.3.1.2. Special purpose vehicles, e.g., tractors, tugs, forklifts, sweepers, etc. – 10 mph.

24.13.3.1.3. Vehicles in close proximity to aircraft (within 50 feet) – 5 mph.

24.13.3.1.4. During reduced visibility or when snow and ice are present on paved surfaces, reduce speed to 10 mph maximum. Defer vehicle operation when possible and limit to mission essential.

24.13.3.1.5. Snow and ice removal vehicles will operate at a speed commensurate with safety during snow and ice control operations. **(T-1)**

24.13.3.1.6. “Follow Me” vehicles are permitted to exceed the normal 15 mph speed limit to accommodate aircraft taxiing speed.

24.13.3.1.7. During emergencies, all emergency response vehicles, e.g., aerospace rescue firefighting equipment, ambulances, Airfield Management and Security Forces, may exceed speed limits only with due regard for the safety of persons and property.

24.13.4. Aircraft, Equipment and Trailer Towing. Limit towing speed to 5 miles per hour for all aircraft and when towing 2 or more maintenance stands, and 10 miles per hour with one stand or equipment with solid wheels and/or castors. Limit tow speed for AGE, such as compressors, ground power units, oxygen carts and similar equipment to 15 miles per hour. Refer to paragraph **24.15.4** for additional information on AGE. Up to four type B1, B4, B5 and similar small stands may be towed as two sets of two in tandem on a double hitch or two in tandem on a single hitch. Type B3, J7 and similar large stands shall be towed singly on a center mounted hitch. **(T-1)** Four-wheeled units shall not be towed behind two-wheeled units. Large AGE, when towed in tandem, shall not block the driver’s vision of the last item being towed.

Safety locking devices or cotter pins shall be used to secure pintle hooks and trailer hitches. **(T-1)** Vehicle operators will not approach within 50 feet of an aircraft being towed.

24.13.5. Flightline Driving.

24.13.5.1. Private Motor Vehicles (PMV). The operator shall possess a valid state driver‘s license, an AF Form 483, with flightline endorsement and authorization (PMV pass/cone) from the Airfield Manager. **(T-1)** Airfield Management will ensure flightline training is provided to contractor personnel requiring flightline access. **(T-1)**

24.13.5.2. Motorcycles. Motorcycles, mopeds or scooters may be operated on the flightline. If authorized, PPE IAW AFI 91-207, *The US Air Force Traffic Safety Program*, shall be worn when operating a motorcycle. **(T-1)** No passengers are allowed. The operator shall complete a Motorcycle Safety Foundation Course IAW AFI 91-207. **(T-1)** Motorcycles shall have headlights on at all times, unless shining toward a moving aircraft at night or during reduced visibility, when it shall be turned off immediately so the pilot is not blinded or night vision affected. **(T-1)** Mopeds and scooters will have an operating headlamp and front and rear reflectors if authorized for night use. **(T-1)**

24.13.5.3. Bicycles and Tricycles. Bicycle or tricycle operators shall know requirements in this chapter and local directives. **(T-1)** Tricycles parked on the flightline will have a braking device engaged to prevent inadvertent movement. **(T-1)** For night use, bicycles and tricycles shall be equipped with an operating headlight and reflectors or reflective tape. **(T-1)** Bicycles and tricycles parked on the flightline at night shall be placed so they will not impede aircraft or traffic flow. **(T-1)**

24.13.5.4. Other Vehicles. Vehicles identified in AFI 91-207, *The US Air Force Traffic Safety Program*, include Government Vehicles Other, Low-Speed Vehicles and Off-Road Vehicles. If authorized to operate on the flightline, electrical, gas or gasoline-powered Government Vehicles Other, Low-Speed Vehicles and Off-Road Vehicles will follow AFI 91-207 PPE and training requirements, and all rules established for general and special purpose vehicles. **(T-1)** Government Vehicles Other, Low-Speed Vehicles and Off-Road Vehicles shall have forward and rear lamps if operated at night.

24.13.6. Entering or Leaving Flightline Driving Areas. All vehicles, except emergency and alert vehicles responding to an alert or emergency, shall stop prior to entering the flightline and accomplish an FOD check. **(T-1)** FOD Check signs shall be positioned at every entrance to ramp areas and flightline. **(T-1) Note:** This may be waived by the installation Commander. Traffic lanes on aircraft parking ramps are normally to the right of the aircraft. Unless prevented by local procedures, traffic flow on aircraft parking ramps shall be parallel to the noses of parked aircraft with the driver‘s side toward the aircraft. **(T-1)** Vehicles shall not be driven diagonally across the parking ramp, but at 90-degree angles to the driving lanes. **(T-1)**

24.13.7. Vehicle Parking. Vehicles shall not be backed or parked within 25 feet of any aircraft, unless authorized for operations such as loading or unloading, servicing or towing. A spotter shall be posted when backing a vehicle towards an aircraft. **(T-1)** Prepositioned wheel chocks shall be used to prevent vehicles backing into aircraft. **(T-1)** Prepositioning of chocks during backing of tow vehicle to tow bar (for the express purpose of towing the aircraft) is not required as long as all requirements of paragraph **24.7** are followed. Vehicle chocks shall be constructed

IAW Commercial Item Specification A-A-52475 or locally manufactured IAW TO 00-25-172. **(T-1)** Refer to paragraph **32.2.9** for additional backing/spotter guidance.

24.13.7.1. Unattended vehicles shall be parked with the driver‘s side facing the aircraft and so it will not interfere with aircraft being towed or taxied. **(T-1)** Ignition shall be turned off; keys left in the ignition; and the gear lever put in reverse gear for manual transmissions, and in ‘park’ for automatic transmissions. **(T-1)** All vehicles parked and left unattended will have brakes set or chocks placed in front of and behind a rear wheel, or one chock placed between the tandem wheels of dual (tandem) axle vehicles. **(T-1)** Only alert and emergency vehicles responding to an alert or emergency are exempt from these requirements. When authorized to leave vehicles idling IAW AFI 24-302, *Vehicle Management*, when extreme hot or cold temperature ranges exist, the wing commander, with approval from their MAJCOM, may permit leaving the vehicle running while unattended. **Note:** AGE towing vehicles may be placed in “park” (neutral for manual transmissions) with parking brake set and engine left running during equipment hitching and unhitching operations, and during FOD checks. To conduct a rolling FOD check, the vehicle operator MUST enter vehicle and “close ALL doors” prior to placing the vehicle in drive to rotate tires the minimum distance necessary to finish the FOD check. **(T-1)** AGE towing vehicles must be turned off when the driver seat is vacated for any other purpose. **(T-1)**

24.13.7.2. Wheeled AGE/maintenance equipment shall have brakes set, if available, or chocked. **(T-1)**

24.13.7.3. Vehicles shall not be parked or driven less than 25 feet in front or 200 feet behind aircraft with running engines, unless prescribed in applicable aircraft handbooks. Vehicles parked next to aircraft shall be clear of wingtips and clearly visible to personnel in cockpit. **(T-1)**

24.13.8. Passengers in Vehicle. Passengers shall be limited to the designed seating capacity of the vehicle during routine operations. **(T-1)** This includes pickup trucks and cargo vans with passenger seats as well as sedans, station-wagons and buses. When exigent circumstances or contingency requirements exceed the capability of available vehicles, commanders may, through appropriate written and documented risk assessments and compliance with installation/host installation guidelines, determine the appropriate means of transportation for existing vehicles. Passengers shall use available seat belts when the vehicle is in motion. **(T-1)** If deemed operationally necessary by the unit commander to ride in the bed of pickup trucks, occupants will sit only on the floor, not on wheel wells, with their backs against the cab and remain seated while vehicle is moving (see **Note** below). **(T-1)** Passengers in vans will remain seated, keep their arms and legs within the vehicle body, and keep side doors closed while the van is moving. **(T-1)** Passengers will not ride in doorways or sit on engine covers in metro vans/step vans. (**Note:** Personnel jumping or descending from the bed of pickup and stake bed trucks have caused a large number of injuries and the practice of riding in the bed of these type vehicles is highly discouraged.) However, commanders should identify in writing vehicles approved for transporting personnel in the bed of pickup or stake bed vehicles.

24.13.9. Restricted Visibility or Night Operations. Flashing or parking lights shall be used at night when vehicles are temporarily parked on any part of the aircraft ramp. **(T-1)** (**Note:** Due to possible battery and alternator concerns, MAJCOMs may substitute this requirement by

adding portable flashing lights.) This does not apply to vehicles parked in a designated parking area. Refueling and explosive loaded (laden) vehicles shall not be operated when visibility is less than 300 feet unless directed by wing or installation commander. PMVs and flightline vehicles, except emergency and alert vehicles, shall not be operated on the flightline with visibility less than 100 feet. A walking guide with a flashing or luminescent wand shall be used during emergency movement of alert vehicles when visibility is under 50 feet. **(T-1)** Vehicle operators shall ensure headlights do not point toward taxiing aircraft or towing operations to prevent blinding aircraft or tow vehicle operators. **(T-1)**

24.13.10. Control Tower Signs. Refer to AFI 13-213 for information.

24.13.11. Taxiing Aircraft. Except for *Follow Me* vehicles, vehicles shall not be parked in front of, driven into the path of taxiing aircraft or driven between a taxiing aircraft and its *Follow Me* guide vehicle or aircraft marshaler. All drivers operating vehicles on taxiways and parking ramps shall give way to taxiing aircraft. **(T-1)** Vehicles will exit taxiways by the shortest route. **(T-1)** Only as a last resort will the vehicle be driven off prepared surfaces to ensure adequate clearances for aircraft. A FOD check shall be accomplished when the vehicle is back on the taxiway. **(T-1)**

24.13.11.1. Vehicle headlights shining towards a moving aircraft at night shall be turned off immediately to prevent affecting the pilot's night vision and will remain off until the aircraft is out of range. **(T-1)** However, vehicle parking lights or emergency flashers shall be turned on so its position is known. Headlights shall be turned ON prior to moving the vehicle. **(T-1) Note:** Vehicles with daytime running lights will park in a safe location with ignition off, parking brake set and emergency flashers on. **(T-1)**

24.13.11.2. Taxiing aircraft shall be alerted when a vehicle cannot operate under its own power. **(T-1)** As a minimum, the vehicle operator will leave the vehicle parking lights or emergency flashers on during hours of darkness. Vehicles' two-way radio shall transmit: "*All parties BREAK, BREAK – This is (call sign) with an emergency for Airfield Management, Tower and Maintenance Operations Center.*" **(T-1)** Then state the problem and vehicle position on the airfield. Operators of other radio-equipped vehicles (Security Forces, CE, Logistics Readiness, etc.) will contact their control center to relay the information to the Airfield Management Dispatcher and tower. **(T-1)** For vehicles without a radio, stay with the vehicle and try to get attention of the taxiing aircraft.

24.13.12. *Follow Me* Vehicles. *Follow Me* vehicles for guiding aircraft shall be equipped with signs, easily visible at night, reading "*Stop*" and "*Follow Me*." **(T-1)** They shall have two-way radio communication on control tower frequencies. **(T-1)** When approaching the parking spot, the *Follow Me* vehicle operator should illuminate the "*Stop*" signal, move the vehicle from the intended path of aircraft travel, and position it laterally — clear of the aircraft wingtip. The marshaler, who may be the vehicle operator, will guide the aircraft to the parking spot using approved marshaling signals. **(T-1)** *Follow Me* vehicles may exceed the 15 mph flightline speed limit when necessary to accommodate the safe taxiing speed of aircraft. Tugs shall not be used as *Follow Me* vehicles. Refer to AFMAN 24-306 for additional information on *Follow Me* vehicles.

24.13.13. Forklift and Hi-Lift Truck Operation Around Aircraft. Forklifts and hi-lift trucks are used to move cargo to/from aircraft and for raising/lowering cargo/equipment between ground and aircraft. Only licensed drivers shall operate forklifts and hi-lift trucks. **(T-1)** Training and

licensing shall be IAW AFI 24-301, *Vehicle Operations*. **(T-1)** Forklift or hi-lift truck operators shall not exceed 10 mph on ramps or 5 mph within 50 feet of any aircraft. Hi-lift truck operators require special training, a responsibility of the using organization. **(T-1)** Refer to **Chapter 12** and AFMAN 91-201 for additional information.

24.13.13.1. Maneuvering Forklifts and Hi-Lift Trucks. A spotter shall assist operators in determining safe clearances when moving toward (forward or reverse) the aircraft. **(T-1)** Bumper blocks or vehicle chocks shall be used to prevent striking the aircraft. **(T-1)** The driver and spotter shall be able to communicate at all times. **(T-1)** The spotter shall use luminous wands to relay signals to the operator during the night, unless supplemental lighting (light cart) is used. **(T-1)** Spotters shall be used any time the cargo is raised or lowered. **(T-1)** Forklift carriage operation (e.g., raise/lower, tilt, side shift, etc.) is prohibited while the forklift is in motion. Cargo loading vehicles shall never be driven under an aircraft except when required by the specific aircraft cargo loading procedures. When traveling long distances and/or carrying bulky loads, the forklift shall be driven in reverse when the operator's field of vision is less obstructed. **(T-1)** Forks of parked forklifts shall be lowered flat on the ground to prevent injury to personnel working or walking in the area. **(T-1)** Parked and unattended vehicles shall have transmission placed in neutral/park, ignition switched off and handbrake set. **(T-1)**

24.13.13.2. Crating. Large unwieldy crates shall be equipped with rings for attaching tag lines. **(T-1)** Tag lines make handling safer and provide a means of securing crates in open areas. Tag lines shall be of sufficient length to permit the person holding the rope to stand clear of the load and avoid standing under the load. **(T-1)**

24.13.13.3. Stacking. Forklift drivers will not stack empty pallets higher than eye level. **(T-1)** Pallets stacked on forklift tines higher than eye level cause an unsteady load and are a potential source of injury or property damage. Forklift operators will have a spotter available when stacking cargo on trailers and 463L (pallet) equipment if vision is obstructed. **(T-1)**

24.13.13.4. Lift-Truck Forks. Forklifts shall not be used to tow trailers or push equipment unless designed for that operation by the manufacturer and technical data is followed. **(T-1)** Forklifts shall be equipped with operating horns and lights, when needed for safe operation. **(T-1)**

24.13.13.5. Hi-Lift Truck Cargo Bed Hydraulic System. The driver shall completely stop the truck before operating the cargo bed hydraulic system. **(T-1)** The truck shall be at least five (5) feet from the aircraft, before the bed is raised or lowered, to ensure adequate clearance. **(T-1)** 24.13.14. Hand Pallet Trucks Inside Aircraft. Hand pallet trucks are hydraulically-operated material handling devices used for moving heavy objects inside aircraft. Since hand pallet trucks do not have brakes, at least two (2) persons will operate this piece of equipment. **(T-1)** 1-inch by 12-inch shoring or equivalent protection shall be used to prevent floor damage when moving extremely heavy loads inside aircraft. **(T-1)** Care shall be taken to avoid damaging aircraft ceilings and sidewalls. **(T-1)**

24.13.14.1. Stowing Cargo on Aircraft. Cargo shall be loaded IAW aircraft loading TOs and handbooks to avoid exceeding weight and balance limits. **(T-1)**

24.13.15. Roller Pry Bar Use Inside Aircraft. When using roller pry bars to position heavy cargo inside aircraft, personnel shall be careful not to exceed maximum allowable floor strengths. **(T-1)**

24.13.16. Floor Load. Consult aircraft TOs to determine maximum allowable floor loads. Shoring shall be used when a load is expected to exceed the published limit. **(T-1)**

24.13.17. K-loaders and Roller-Equipped Trailers Around Aircraft. Guides/spotters shall assist the operator when approaching an aircraft to load or off-load cargo. **(T-1)** The operator shall bring the loader to a complete stop, set the brakes and place the cab transmission selector in neutral before operating the cargo deck hydraulic system. **(T-1)** To ensure adequate clearance, the loader shall be stopped or moved at least five (5) feet from the aircraft for preliminary deck alignment using the hydraulic system. **(T-1)** The operator shall maintain a 5 to 8-inch clearance between the rubber bumpers and the aircraft for further deck adjustments during on- or off-loading. **(T-1)**

24.13.18. Air Cargo Storing and Warehousing. Storage and warehousing of air cargo is similar to normal warehousing procedures. General safety standards for warehousing also apply to air cargo storage. Refer to **Chapter 12** for additional information.

24.13.19. Tractor Operations. Tractors with small flatbed warehousing trailers and airlift palletized cargo shall not exceed five (5) mph. All tractor-trailer combinations shall be equipped with lights when operating at night or during low visibility. **(T-1)** Signs reading "*Slow Moving Vehicle*" or the triangular slow moving vehicle emblem shall be displayed on these vehicles. **(T-1)** Passengers shall not be allowed to ride on tractors unless adequate seats are installed.

24.13.20. Trailers. No more than four (4) trailers, loaded or empty, shall be pulled by any tractor. **(T-1)** To avoid jackknifing, trailer trains shall be arranged with the most heavily loaded trailer next to the towing vehicle, the next heaviest second in line, etc. **(T-1) Exception**: Six A/M- 3H-6 palletized cargo trailers may be moved behind one prime mover.

24.13.20.1. Couplings. Tractor operators shall ensure couplings are secure before moving a trailer or train. **(T-1)** Pintle assemblies and towing connections shall be secured with a pintle hook safety locking device or cotter pin that will positively lock towing connections. **(T-1)**

24.13.21. Deicing Operations. Conduct deicing operations IAW TO 42C-1-2, *Anti-icing, Deicing and Defrosting of Parked Aircraft,* and aircraft-specific deicing TO guidance. Also, only licensed drivers shall operate deicing trucks. **(T-1)** Deicing basket operators shall act as vehicle spotter and remain in constant radio or interphone contact with the driver throughout the deicing operation. **(T-1)** Basket operators shall continually monitor clearances. **(T-1)** A ground spotter shall be used if the basket operator cannot adequately monitor clearances. **(T-1)** Pre-position chocks when using a deicer truck to perform maintenance and inspections, when backing towards aircraft or as directed by local procedures or aircraft TOs.

24.14. Aircraft Hangar Operations.

24.14.1. Hangaring Aircraft. The Maintenance Group Commander or equivalent shall ensure detailed local operating procedures for hangaring aircraft, including safety precautions, are prepared and coordinated with the installation Occupational Safety office and FES Flight. **(T-**

1) Include installation Weapons Safety Office coordination if hangaring weapons-loaded aircraft.

24.14.2. Aircraft Hangar, Shelter and Dock Facility Design Guidance. Consult National Fire Protection Association 70, Article 513, *Aircraft Hangars*, National Fire Protection Association 409, *Standard on Aircraft Hangars*, National Fire Protection Association 410, UFC 3-600-01, *Fire Protection Engineering for Facilities*, and associated Engineering Technical Letters for detailed design guidance. Engineering Technical Letters supplement UFC 3-600-01. Compliance with Engineering Technical Letters is required per AFI 32-1023, *Designing and Constructing Military Construction Projects*. Engineering Technical Letters take precedence in conflicts with national fire codes, building codes or UFC 3-600-01. The installation Occupational Safety office, FES Flight and BE will evaluate facilities, equipment, processes, etc., and provide recommendations to ensure safety, fire and health hazards are properly mitigated and/or controlled. **(T-1)**

24.14.2.1. Fixed electrical equipment approved for Class I, Division 1 locations may be used in Class I, Division 2 locations of the same class and compatibility group. Equipment not meeting these guidelines shall be de-energized or disabled and locked out until special operations are complete and hazardous conditions permanently eliminated. **(T-1)** Refer to paragraph **24.3.3.1** for additional guidance.

24.14.2.2. Keep portable electrical equipment out of hangars during special hazardous procedures unless it meets requirements in paragraph **24.14.2.1** and is marked accordingly.

24.14.3. All openings from occupied areas into hangars shall be protected by ramps, curbs or drains to prevent entry of liquids. **(T-1)** All areas normally occupied by personnel shall have an exit route to the outside of the hangar that does not require entering locations occupied by aircraft. **(T-1)** Refer to National Fire Protection Association 409 for additional information. Each means of egress from mezzanines shall lead directly to a properly enclosed stairwell, directly to the exterior, or to outside stairs. **(T-1)**

24.14.4. Hangar, Nose Dock and Shelter Door Design and Operation Guidance. Eliminate hazards through engineering design or redesign. Install barriers such as chains and fencing to restrict personnel from hazardous areas. Ensure mechanical safeguards are in place such as installing limit switches and doorstops where necessary to limit unnecessary door travel. **(T-1)** Doors not in compliance shall be assigned an risk assessment code by the installation Occupational Safety office. **(T-1)** A JHA shall be performed and appropriate controls put in place until doors are compliant. **(T-1)**

24.14.4.1. Identification. Establish a clear zone, i.e., five (5) feet if space allows, around all hazardous areas. **(T-1)** Hazardous areas include crush and pinch points between structural beams and hangar doors. Highlight hazardous areas such as crush and pinch points that cannot be eliminated by engineering controls or mechanical safeguards with colored paint and signs. Mark these clear zones with solid yellow or yellow and black stripes IAW **Chapter 7,** *Walking Surfaces, Guarding Floor and Wall Openings, Fixed Industrial Stairs, and Portable and Fixed Ladders.*

24.14.4.2. All sides visible when approaching a hazard area shall have a 14 by 20 inch or larger "DANGER" sign painted on the floor just outside the clear zone IAW **Table 29.3** **(T-1)** Place the sign so it can be read when approaching the hazard area. **(T-1)** The word

"DANGER" shall be printed on top with white letters with a message below stating: "HAZARDOUS AREA – STAND CLEAR DURING DOOR OPERATIONS." **(T-1)**

24.14.4.3. Place a "DANGER" sign next to all hangar door controls. **(T-1)** Sign size (at least 7 by 10 inches)**. (T-1)** The word "DANGER" shall be printed on top in white letters with a message below stating: "ONLY QUALIFIED PERSONNEL AUTHORIZED BY THE SQUADRON COMMANDER MAY OPERATE HANGAR DOORS." **(T-1)** The bottom of the sign shall reference paragraph **24.14.8.3** **(T-1)**

24.14.4.4. Safety signs shall be printed in English and the predominant language of non-English reading employees. **(T-1)** Established symbols should also be considered. Employees unable to read posted signs shall be informed of hazardous areas and instructions printed on the signs. **(T-1)**

24.14.5. Training. Employees who routinely work in hangars or require access through hangar doors shall receive Hangar Door Awareness Training, both an initial training program and annual refresher course. **(T-1)** Courses shall include, at a minimum, door hazards, emergency procedures (including manual door operation) and safe operation. **(T-1)** Training shall be documented on employee's AF Form 55, *Employee Safety and Health Record* (or equivalent product), AF Form 623, *Individual Training Record Folder*, or MAJCOM authorized substitute (paper or electronic format acceptable). **(T-1)**

24.14.6. Operating Condition. Hangar doors shall be maintained in safe working condition. **(T-1)** Door paths shall be free of obstructions with door tracks and track-ways in good condition and free of debris. **(T-1)** A visual inspection shall be made prior to operation and discrepancies corrected before operation. **(T-1)** Hangar doors shall be on a preventative maintenance schedule and only qualified employees shall perform hangar door maintenance. **(T-1)**

24.14.7. Door Pockets. Hangar door pockets and recessed areas shall not be used for storage and shall be adequately illuminated so the door operator can see any obstructions or personnel in the door path.

24.14.8. Powered Hangar Doors:

24.14.8.1. Alarm/Warning Lights. To prevent confusion, powered hangar doors shall have an alarm device with a sound distinguishable from the facility fire alarm and audible above normal noise levels. **(T-1)** The warning device shall automatically signal at least 5 seconds before any door section movement, continuously while the door is operated and shall reset immediately after movement stops. **(T-1)** Additionally, warning lights are required in high noise areas if the audible alarm is difficult to hear, but use caution to avoid stroboscopic effects. **(T-1)**

24.14.8.2. Door Controls. Controls shall not place the operator in harm's way. Controls shall be installed where they prevent the operator entering hazardous areas and shall provide the operator a clear view of door travel. **(T-1)** The door shall stop movement if the operator removes pressure on the door switch. **(T-1)** For all center door switch operations, the word "OPEN" shall be placed at the top position and the switches shall be wired so the doors open when "OPEN" is selected. **(T-1)** A hinged cover or other device shall be installed over the "CLOSE" switch or button to prevent inadvertent activation. **(T-1)** Fold-up, counterbalanced and similar doors shall have control switches located with a clear view

of the door opening. **(T-1)** Where feasible, place limit switches in appropriate locations to keep the operator away from hazardous areas. Also see Air Force design criteria or equivalent Air Force-approved engineering guidance.

24.14.8.2.1. All markings on or near controls and doors shall be easily understood and excessive markings avoided to eliminate confusion. **(T-1)**

24.14.8.2.2. Directional arrows shall be present and understandable. **(T-1)** Luminescent or reflective directional arrows shall be placed adjacent to each switch and on horizontal sliding doors to indicate direction of door travel for each corresponding switch. **(T-1)**

24.14.8.3. Only qualified personnel, approved by the squadron commander or designated representative, shall be authorized to operate hangar doors. **(T-1)** Operators shall be thoroughly familiar with operating instructions and precautions necessary for safe operation. **(T-1)** Written operating procedures outlining all safety precautions to operate the doors shall be posted next to all operating controls. **(T-1)** Qualified personnel will be documented in writing by the squadron commander or designated representative. **(T-1)**

24.14.8.4. Overhead hangar doors shall be fully opened before moving aircraft through the door entrance. **(T-1)** Horizontal sliding doors shall be opened to permit a minimum 10-foot clearance at each wingtip. If hangar construction does not permit such clearance, the doors shall be opened to the maximum limit. **(T-1)** Wing walkers shall be used when an aircraft is placed in a hangar. (Also see paragraph **24.7.2.5**) **(T-1)** Under normal conditions, powered hangar or shelter doors shall be opened at least 10 feet. **(T-1)** For special operations, such as during extreme weather conditions, the door may be opened less than 10 feet only if the door control switch is locked off or out until the door can be opened to 10 feet or more, or be closed. Refer to **Chapter 21** for hazardous energy control requirements.

24.14.8.5. Personnel Access Doors. Personnel shall not enter through a personnel door while the hangar door is moving. Hangar doors with personnel access doors shall have either safety switches installed or a manual lock on the personnel access door with appropriate guidance to ensure the manual lock is locked prior to the hangar door being moved to prevent inadvertent entry while the door is moving. **(T-1)**

24.14.8.6. Signs. Where hazards cannot be eliminated, place danger/caution/warning signs describing the hazardous condition in conspicuous locations IAW **Chapter 29**.

24.14.8.7. Operational Checkout of Doors and Safety Features. Facility managers shall conduct monthly inspections of hangar door operational and safety features. **(T-1)** CE and Airfield Management shall be notified immediately of any discrepancies. **(T-1)**

24.14.9. Roll-up Hangar Doors. See paragraph **2.7** for roll up door requirements.

24.14.10. Clear Space Requirements Around Hangars. Maintain a clear zone of at least 50 feet around all sides of a hangar, shelter or nose dock. Do not store or park aircraft, position concentrations of combustible materials or erect buildings of any kind within the clear zone. Refer to National Fire Protection Association 409 for additional information.

24.14.11. Vehicle Operations. Vehicles pose a traffic hazard and an ignition source for fuel vapors from aircraft fuel vents or a fuel spill. The Maintenance Group Commander or

equivalent shall ensure local procedures are established to control these hazards. **(T-1)** While Air Force general or special purpose vehicles do not require spark arresters, vehicle ignition and power systems are not designed for operation in hazardous atmospheres and shall not be driven within 25 feet of fuel spills. Also, vehicles or equipment with metal wheels or studded tires may be prohibited from operations in hangars. Vehicles shall not be parked unattended in front of hangar doors while aircraft are parked inside. When mission requirements or weather conditions create a need to park vehicles inside hangars, a plan for an isolated parking area shall be developed and approved by the Maintenance Group Commander or equivalent in coordination with the installation Occupational Safety office, FES Flight and BE. **(T-1)** This special parking area shall be outside of any potential hazard area and ventilated as required by the BE occupational and environmental health risk assessment. **(T-1)** Traffic patterns shall be separated from parked aircraft. **(T-1)** (**Note:** Vehicles shall not be parked unattended in front of hangar doors if aircraft are in that hangar bay.) Vehicles may be parked in front of any hangar door that is not used for the egress or ingress of aircraft operations.

24.14.12. Heaters. Combustion heaters installed in aircraft shall not be operated in a hangar. Portable engine and cabin heaters shall be removed and stored immediately after each use or when no longer required. **(T-1)** Engine and shelter heaters shall be placed as far from the aircraft as ducting permits. **(T-1)** No portable heater shall be left operating unattended. **(T-1)** Only heaters approved for operation inside hangars and that do not give off unacceptable levels of carbon monoxide (CO) shall be used. **(T-1)** Heaters and the processes for which they are used shall be evaluated by BE to ensure adequate ventilation is provided and that health threats (e.g., CO) are effectively controlled (e.g., CO alarms are installed) to prevent harmful exposures. **(T-1)**

24.14.13. Electric Wiring, Power Cords and Maintenance. Temporary or makeshift wiring in hangars is prohibited. Only properly installed and maintained service extensions shall be used. **(T-0)** Overloading electric circuits shall be avoided. **(T-0)** All hangar electrical systems and subsystems shall be protected by circuit breakers or switches with lockout capabilities and shall be de-energized and locked out prior to beginning maintenance. **(T-0)** Refer to **Chapter 21** for additional information. Portable lamps shall have three wire grounded cords long enough for the task. **(T-0)** All electric cords shall be inspected before each use and repaired or replaced as necessary. **(T-0)** Wall receptacles of different voltages and frequencies shall be configured as required by National Fire Protection Association 70, *National Electric Code*. **(T-0)** Metal ladders or stands shall not be used when servicing electrical equipment and systems. All cables/cords shall be de-energized (turned off), disconnected and stored when not in use. **(T-0)** Refer to **Chapter 8,** *Electrical Safety,* and UFC 3-560-01, *Operation and Maintenance: Electrical Safety,* for additional information.

24.14.14. Ground Power Generators. Generators shall not be positioned within 10 feet of aircraft fuel system vents. Generator design shall ensure all electrical equipment, sparking contacts, hot surfaces and other possible ignition sources are at least 18 inches above floor level. **(T-0)** Generators shall not be refueled inside hangars. **(T-1)** Place engine powered equipment so the exhaust does not pose a hazard to employees.

24.14.15. Aircraft Emergency Removal. The aircraft maintenance officer, designated by the Maintenance Group Commander or equivalent, shall establish emergency procedures to remove aircraft from hangars in case of fire, severe weather or other hazards. **(T-1)** Employees shall be trained on emergency procedures to eliminate confusion and ensure timely evacuation

of aircraft. **(T-1)** If normal towing method (nose gear) is not available, snatch blocks and/or harnesses laid out on hangar floors shall be attached to the aircraft when in-progress work permits. **(T-1)**

24.14.16. Conduct aircraft refueling and defueling operations in facilities designated and approved for aircraft fuel system maintenance (fuel cell repair) operations. Refer to TO 1-1-3 for aircraft fuel system maintenance facility requirements. For operations other than aircraft fuel systems maintenance, aircraft shall only be fueled or defueled in facilities approved through a System Safety Engineering Analysis conducted IAW instructions in TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding*. **(T-1)** System Safety Engineering Analysis-approved facilities include Tactical Air Base Hardened Aircraft shelters, modified Tactical Air Base Hardened Aircraft, 2nd and 3rd generation aircraft shelters, flow-through revetments and B-2 maintenance facilities at Whiteman AFB, MO.

24.15. Aircraft Shop and Flightline Maintenance Operations.

24.15.1. General Requirements. Plan layout of aircraft shops and the flightline operations and facilities in relation to lighting, ventilation, aisle way and work space for safe and efficient production. Provide mechanical safeguards to prevent injury from equipment failure or unsafe use. Locate hazardous operations in isolated areas less likely to endanger employees. Shop supervisors shall brief aircraft shop and the flightline employees on hazards of poor housekeeping, personal safety, occupational health, shop machinery, loose clothes and finger rings. **(T-1)**

24.15.1.1. Machine Safeguarding and Shop Layout. Machinery shall be procured with built-in safeguards for operator protection without interfering with normal equipment operation. **(T-0)** Suitable enclosures or barricades shall be installed on unguarded machinery or power-transmission equipment. **(T-0)** Firmly secure machines and equipment to floors, bases or stands located so the operator need not stand in an aisle. **(T-0)** Provide the operator sufficient space to handle materials and conduct routine job and maintenance tasks, including cleaning and housekeeping, without interfering with other operations. **(T-0)** Refer to **Chapter 11,** *Hands Tools, Portable Tools & Machinery*, and **Chapter 7** for additional information.

24.15.1.2. Tool Safety. Unsafe use of hand and power tools can injure employees or damage equipment. Supervisors shall enforce strict tool control procedures. **(T-1)** Use of personally owned hand and power tools shall be prohibited. **(T-1)** Tools shall be kept in suitable containers when not in use. **(T-1)** Appropriate PPE, such as goggles, face shields, hard hats, gloves, respirators and safety-toe shoes, shall be provided to employees and use enforced. **(T-0)** Refer to TO 32-1-101, *Use and Care of Hand Tools and Measuring Tools*, and TO 32-1-2, *Use of Hand Tools (International Business Machines)*, and paragraph **24.15.8** for battery-powered tool use.

24.15.1.3. Face shield and safety goggles are required when using compressed air for cleaning. **(T-0)** All shop and aircraft maintenance personnel authorized to use air compressors shall be trained in operation and maintenance of air compressors. **(T-1)** Compressed air for general cleaning purposes shall be limited to less than 30 psi. **(T-0)** Effective chip guarding shall be provided and have a finger- actuated press (on)/release (off) control. **(T-0)** Compressed air shall not be used for cleaning benches, floors, work areas, aircraft interior, clothing or exposed body surfaces. Aircraft pitot-static systems shall

not be cleaned with compressed air to prevent instrument diaphragm damage. Refer to paragraph **24.2.5** for additional information on cleaning with compressed air.

24.15.1.4. Compressed Gases. Compressed gas cylinders, full or empty, shall be handled with care at all times. **(T-1)** When not in use, caps shall be placed over the valves and the cylinder secured. **(T-1)** All compressed gas cylinders shall be stored in their compatibility groups and not co-mingled. Flammable gases, such as acetylene, shall be stored separately and in an upright position. **(T-1)** Storage areas shall be clean and dry to prevent corrosion and away from heat sources and oxygen. Only approved regulators with anti-flashback devices shall be used with flammable compressed gases. **(T-1)** Refer to TO 42B-5-1-2, *Gas Cylinders (Storage Type)–Use, Handling, and Maintenance*, for additional information.

24.15.1.5. Housekeeping. Floors shall be cleaned at all times to provide safe walking and working surfaces. **(T-0)** Spills shall be cleaned as they occur. **(T-0)** Electrical cords and air hoses shall be stored when not in use. **(T-0)** All flammables and combustibles shall be properly stored or removed from the shop and disposed of. **(T-0)**

24.15.1.6. Personal Safety. Loose fitting clothing or other apparel that may be caught in moving machinery shall not be worn. Refer to paragraph **2.3** for additional guidance.

24.15.1.7. Occupational Health. Aircraft maintenance operations on the flightline, in shops, aircraft shelters, hangars and maintenance facilities pose many chemical and physical hazards. These hazards shall be evaluated, the level of risk established and controls incorporated where necessary. **(T-1)** AFI 48-145, *Occupational and Environmental Health Program*, provides guidance for these evaluations. Physical hazards, such as high noise levels, shall be evaluated for design or administrative changes to abate the hazard, e.g., engineering controls and administrative controls. **(T-1)** Where administrative and engineering controls are not feasible to implement or adequate to control the exposure, the unit will provide BE-approved PPE to the employees and ensure they comply with the care and the use of such PPE. **(T-0)** Work with chemicals may require additional ventilation, the use of PPE or a change in process to protect exposed employees. A reevaluation shall be performed if a process is changed, altered or new chemicals are introduced after the initial evaluation and abatement actions. **(T-0)** BE performs these evaluations upon request. However, the functional manager or supervisor shall contact BE to arrange an evaluation if a potential health hazard is identified or if a process changes. **(T-1)**

24.15.2. Aircraft Electrical System Maintenance. Potential hazards involving aircraft electrical maintenance tasks include overloading, poor electrical contacts and wiring shorts.

24.15.2.1. Electrical systems shall be de-energized whenever possible. **(T-0)** If the approved procedure requires work on an energized circuit, approved technical data or manufacturer's instructions and 29 CFR 1910.333. shall be followed and other maintenance personnel informed of the actions. **(T-0)** If work is done on energized circuits of 50 volts or more, arc flash protection must be worn. **(T-0)** Refer to paragraph **14.4.10.2** for additional guidance. If de- energized, approved procedures shall be strictly followed. For on-equipment aircraft maintenance, the AFTO Form 492, *Warning Tag*, shall be used to flag a condition that could cause damage or injury if ignored. **(T-1)** Warning tags shall be used during maintenance actions as required by applicable technical data and/or local procedures. **(T-1)** Refer to AFI 21-101, *Aerospace Equipment Maintenance Management*,

for additional guidance. Do not use the AF Form 979, *Danger Tag*, for on-equipment aircraft maintenance. The AF Form 979 shall only be used when an immediate hazard exists and specific precautions are required to protect personnel or property or as required by TOs, instructions or other directed requirements. **(T-1)** Tags shall be placed on damaged equipment to be taken out of service and sent to the repair shop. To reduce the probability of internal electrical shorts, aircraft wiring, including wire bundles, shall be secured to prevent scraping and chafing. **(T-1)** Electrical components shall be bench-tested in a properly designed shop. **(T-1)** Testing of electrical systems or equipment while installed on the aircraft shall be held to a minimum. **(T-1)**

24.15.2.2. If a circuit breaker opens (pops) during maintenance on the aircraft, the popped circuit breaker shall not be reset without following specific guidance in the applicable aircraft system TO and the cause is determined. An unexpected popped circuit breaker may result from an overload or ground fault. A popped fuel system circuit breaker shall not be reset without following specific guidance in aircraft system TOs.

24.15.2.3. Electrical components and systems shall be de-energized and isolated from other energized circuits or power sources during cleaning operations. **(T-1)**

24.15.3. Aircraft Painting and Paint Removal Operations. There are many safety and health hazards associated with painting and paint removal operations. Spray painting an entire aircraft is permitted only in hangars designed for the purpose. Refer to **Chapter 28,** *Interior Spray Finishing,* National Fire Protection Association 410 and National Fire Protection Association 33, *Spray Application Using Flammable or Combustible Materials*, for additional information.

24.15.3.1. General Safety.

24.15.3.1.1. Fire. Painting and paint mixing operations, and paint and thinner storage, shall be conducted in areas or facilities free from ignition sources. **(T-1)** Quantities of combustible materials stored in hangars and shops shall be minimized. **(T-1)** Only approved cabinets (paragraph **22.7.3**) with self-closing doors shall be used when incidental storage of small amounts of paints and thinners is required in a facility. **(T-0)** Dispose of masking materials, paper and soiled rags in self-closing containers which shall be emptied or removed to an approved location outside the shop for pickup and disposal at the end of each day or shift. **(T-1)** Contact the installation Environmental Management office for waste disposal guidance. Spills shall be cleaned as they occur.

24.15.3.1.2. Toxicity. Whenever possible, painting shall be done in well-ventilated rooms or booths that have been evaluated and approved for use by BE. **(T-1)** Employees painting outside their areas shall obtain clearance from BE and the Occupational Safety office. **(T-1)** Personnel engaged in painting and paint removal will wear protective clothing, respiratory devices (if required), and appropriate face, eye and hand protection. **(T-1)** Painting tasks using polyurethane or other chemical resistant coatings shall only be done after a thorough evaluation of the facility, equipment and procedures by BE, Occupational Safety office and FES Flight. **(T-1)** All painting operations shall be completed IAW 29 CFR 1910.107, *Spray Finishing Using Flammable and Combustible Materials,* and **Chapter 28**. **(T-0)** Refer to **Chapter 14** for additional guidance on PPE requirements.

24.15.3.1.3. Mechanical. Spray-painting equipment shall be kept clean and well maintained. **(T-1)** Pressure hoses shall be inspected for excessive wear and replaced as necessary. **(T-1)** To prevent tripping hazards, hoses shall be properly stored when not in use. **(T-1)** Workstands and/or scaffolds shall be sized to permit reasonable ease and comfort while painting. Spray painting air pressure hoses must have fittings that are incompatible with breathing air hoses as required by AFI 48-137. **(T-1)** Refer to **Chapter 16,** *Mobile Elevating Work Platforms*, for additional information on scaffolding. **Warning:** Never point high-pressure paint nozzles at any body part or another person.

24.15.3.1.4. Sanding, Blasting and Paint Stripping Operations. These operations produce inhalation hazards and shall be evaluated by BE to ensure employees are protected and proper controls are identified and provided. **(T-1)**

24.15.3.2. Operational Requirements. Use the minimum amount of flammable or toxic paints or solvents needed. **(T-1)** All materials shall be properly identified and SDSs shall be immediately accessible (via electronic or hard copy format) IAW AFI 90-821. **(T-0)**

24.15.3.2.1. Cleaning, preparing and painting major aircraft assemblies and subassemblies, which are not removable, may be performed in any hangar meeting requirements of National Fire Protection Association 70, *National Electric Code*, National Fire Protection Association 409 and National Fire Protection Association 410. These procedures shall be approved by the Maintenance Group Commander or equivalent in coordination with the installation Occupational Safety office, FES Flight and BE. **(T-1)** No concurrent hazardous operations shall be conducted within 50 feet of major cleaning, painting or paint removal operations. **(T-1)** The work area shall be inspected prior to start of paint touchup operations to eliminate sources of ignition. **(T-1)** Hazard-free work conditions shall be maintained during the entire work period. **(T-0)** No food shall be brought into painting, cleaning or paint removal work areas. **(T-0)** Employees performing painting tasks shall wash hands thoroughly before eating. **(T-0)** Refer to **Chapter 28** and National Fire Protection Association 33 for additional information.

24.15.3.2.2. A hangar's general ventilation may be supplemented by opening hangar doors (not less than 10 feet) to provide additional air movement. This may help prevent flammable vapor concentrations exceeding 20 percent lower explosive limit (LEL), especially at floor level, in pits and drains. **Note:** If hangar doors are opened less than 10 feet due to severe weather conditions, such as extreme cold, the door's main electrical power switch shall be locked out (OFF) and remain locked out until the door is either opened more than 10 feet or closed. **(T-1)** Forced air ventilation shall be used if these actions do not achieve the desired results. **(T-1)** This would be considered an administrative device lockout condition IAW paragraph **29.8** information on locking out door controls and administrative lockout and tagout.

24.15.3.2.3. Fixed electrical equipment shall conform to the *National Electrical Code*, Article 513, *Aircraft Hangars*. **(T-0)** General illumination lighting and other equipment shall not be in range of any flammable sprays or liquids or overspray areas. Unless approved for Class I, Group D hazardous locations, electrical equipment shall be removed from the area. **(T-1)**

24.15.3.2.4. Use of heat lamps to accelerate drying of painted surfaces shall be prohibited unless part of an approved drying booth or enclosure IAW National Fire Protection Association 33. **(T-1)** Nozzles used to spray cleaning or paint removal agents under pressure shall automatically self- close when released by the operator. **(T-1)**

24.15.3.2.5. Aircraft electrical systems shall be de-energized during cleaning, painting and paint removal operations. **(T-1) Exception:** When aircraft power is required for concurrent operations, all electrical equipment exposed to flammable or combustible liquids or vapors shall be de-energized to avoid ignition from arcs, faults or hot surfaces. **(T-1)**

24.15.3.2.6. Ramp or flightline areas used for maintenance procedures shall be designated as servicing areas not open to public access. **(T-1)** Sufficient clearance shall be maintained to avoid hazards to adjacent aircraft or structures and to ensure access by firefighting equipment. **(T-1)** Aircraft being worked on shall be isolated from aircraft taxi and tow routes. **(T-1)**

24.15.3.2.7. Painting, paint removal and associated clean-up operations may generate hazardous wastes. These operations shall be evaluated by BE and Environmental Management office IAW AFI 32-7042, *Waste Management*, to ensure wastes are characterized, controlled, handled and properly disposed of. **(T-1)**

24.15.3.3. Control of Flammable and Combustible Materials. Storage of more than one day's use of paints, flammable thinners and solvents shall be located in a separate building or segregated from aircraft maintenance and servicing hangars by a fire partition with openings protected by approved fire doors. See National Fire Protection Association 30, *Flammable and Combustible Liquids Code*, for additional guidance. **(T-0)**

24.15.3.3.1. Only a one day supply of paints and flammable solvents shall be maintained in a hangar. **(T-1)** These items shall be in approved, marked containers isolated from other operations. **(T-0)** Dispensing drums, when essential, shall be equipped with positive acting pumps and pressure relief fittings, drip pans and static bonding clamps and cables. **(T-0)** Drums shall not be pressurized to dispense these products. Flammable solvents shall not be dispensed from open containers. **Note:** A day's supply, generally 1 to 10 gallons depending on amount used during the shift or work day, is considered a small amount. If operations involve more than one shift, each shift can replenish its paints and solvents as needed, but the quantity on hand shall not exceed a day's supply.

24.15.3.3.2. Petroleum distillate used as a dry cleaning solvent and other solvent cleaners, such as mineral spirits, aliphatic naptha, aromatic naptha, trichloroethylene, xylene, methyl ethyl ketone and other ketone-based thinners, are not compatible with oxygen and shall not be used near aircraft oxygen systems. These restrictions also apply to storage areas.

24.15.3.4. Fire Extinguishers. Fire extinguishers shall be available IAW TO 00-25-172 and other applicable technical data. **(T-1)** For operations not addressed, fire extinguishers shall comply with National Fire Protection Association 10, *Standard for Portable Fire Extinguishers* (current edition). **(T-0)** Portable dry chemical or equivalent fire

extinguishers shall be placed within 25 feet of the aircraft during cleaning, painting or paint removal operations. **(T-1)** The FES Flight will assist the using organization in selection of size and type of extinguishers to be used. **(T-1)**

24.15.4. Aerospace Ground Equipment (AGE). Operators shall be familiar with operating instructions for equipment they use, including emergency shutdown, other precautionary measures and use of fire extinguishers. **(T-1)** Operators shall review maintenance records and inspect equipment for leaks, damage or malfunction before operation. **(T-1)** Refer to paragraph **24.13** for guidance on vehicle operations on the flightline, in hangars and AGE support activities. AGE equipment shall not be left unattended while running, unless specifically designed for unattended operation. Contact the installation AGE Maintenance Shop for further guidance. **Warning:** Danger Area. Personnel shall not climb inside combustion powered AGE (e.g., light carts) as the enclosure may contain fatal levels of carbon monoxide.

24.15.4.1. Towing AGE. Refer to paragraph **24.13.4** for additional guidance. Do not tow compressors, ground power units, oxygen carts and similar equipment using general purpose vehicles unless equipped with a pintle hook attachment with proper rated load capacity (which shall be marked on the pintle hook and stated in the AF Form 1800) to tow AGE. **(T-1)** Pintle hooks shall be closed and a cotter-pin or other locking device used during towing operations. **(T-1)** Safety chains are not required to tow AGE. A maximum of eight (8) small AGE units may be towed, provided:

24.15.4.1.1. Combined load does not exceed rated load capacity of tow vehicle.

24.15.4.1.2. Tandem loads do not exceed load capacities of the equipment.

24.15.4.1.3. Loads, regardless of the number of units being towed, shall be kept symmetrical. **(T-1)** If towing one unit, it shall be towed on the center pintle hook. **(T-1)** When towing two units, the preferred method is to use both outside pintle hooks. When towing more than two units simultaneously, they shall be distributed as evenly as possible on each of the two outer pintle hooks. **(T-1)** Refer to the appropriate vehicle technical data to determine load ratings.

24.15.4.2. Ground Power Units. When refueling/defueling aircraft, ground power generator sets and converter and rectifier units shall be positioned IAW TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding*. **(T-1)** These units shall not be placed less than 10 feet from any aircraft fuel vent or under wing surfaces. Do not stretch cables, which strains the cables and connectors, when positioning power units. Refer to National Fire Protection Association 407, *Standard for Aircraft Fuel Servicing*, for additional information. All cables shall be de-energized (turned off), disconnected from aircraft and ensure water does not enter the connection end of the cable. **(T-1) Warning:** Enclosures of combustion powered AGE may contain carbon monoxide or an oxygen deficient atmosphere and are not suitable for human occupancy.

24.15.4.2.1. Engine-driven generators shall not be refueled inside maintenance shops.

24.15.4.2.2. Output contacts shall be energized (turned on) only after the connector is installed in the aircraft receptacle and de-energized (turned off) before disconnecting the connector from the aircraft. **(T-1)**

24.15.4.3. Compressed Gases. Nitrogen and freon displace oxygen in air and shall be handled carefully in poorly ventilated or confined spaces to minimize the potential for asphyxiation. **(T-1)** Freon is a fluorocarbon and requires stringent environmental controls IAW local procedures. Refer to paragraph **24.15.1.4** and TO 42B-5-1-2 for general safety guidance and requirements for compressed gases.

24.15.4.4. Test Equipment. Multimeters are used in most AGE shops. Users shall ensure the meter is set on the proper scale before connecting equipment to a power source. **(T-1)** The calibration date shall be checked before each use and recalibrated if out of date. **(T-1)** Personnel shall be trained prior to using this equipment and shall not hold meters in their hand when testing energized circuits. **(T-1)** Use non-conductive, insulated gloves or other effective PPE when necessary to handhold meters or test cables. Users shall also comply with UFC 3-560-01. **(T-0)**

24.15.4.4.1. Generator load banks are used to test generator sets. Use caution when testing due to the high amperage associated with the procedure. Load banks shall be maintained in strict compliance with applicable TOs and manufacturer's manuals. **(T-1)**

24.15.4.4.2. Hearing protection may be required due to high noise levels when the generator is operating at heavy loads. Contact BE for hearing protection guidance.

24.15.4.5. Jacking Operations. Prior to jacking equipment, the parking brake shall be set or chocks used or both. **(T-1)** Jack stands of the proper capacity shall be used. **(T-1)** Equipment shall be jacked to the minimum height required for the task and jacks shall be removed when the task is completed. **(T-1)** Employees shall remain under a jacked unit only as needed to accomplish the task. **(T-1)** Jacks and jack stands shall be marked with load capacity, and inspected and maintained IAW the manufacturer's instructions, **Chapter 32,** *Motor Vehicle – Operations and Maintenance*, 29 CFR 1910.244, *Other Portable Tools and Equipment*, or applicable TO. **(T-0)**

24.15.4.6. Tire Maintenance. Tires shall not be removed from AGE unless the unit is on jack stands or similarly blocked to prevent falling after tire removal. Tires shall be deflated prior to wheel disassembly. **(T-1)** Tires shall be inflated IAW applicable TO guidance. **(T-0)** High pressure air shall not be used to inflate tires. Multi-piece rim wheels require special attention during mounting, demounting and inflation. **(T-1)** Refer to paragraph **24.12.6** for more information on multi-piece rim wheels. Tires on multi-piece wheels shall be inflated in a cage or other approved restraining device. **(T-1)** Refer to paragraph **32.14** for additional tire servicing information.

24.15.4.7. Oxygen Carts. Oxygen carts shall be kept clean and free of moisture, oil and grease. **(T-1)** Oxygen carts shall not be parked in grassy, sodded or asphalt-covered areas nor exposed to extreme weather conditions, or allowed to accumulate ice or snow. Gaseous oxygen (GOX) carts shall not be parked in direct sunlight. Liquid oxygen (LOX) carts containing LOX shall not be parked in hangars, nose docks or shelters unless designed or modified for this purpose. LOX carts shall be transported with vent valve closed and parked with vent valve open. **(T-1)** Refer to TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding*, TO 42B5-1-2, **Chapter 26** and applicable aircraft TOs for more information on gaseous oxygen and LOX handling, servicing and storage.

24.15.4.7.1. Gaseous oxygen and LOX carts shall be parked and stored at least (IAW TO 00-25-172):

24.15.4.7.1.1. Twenty-five feet from structures with fire-resistant or non-combustible exterior walls or automatic fire extinguishing systems. **(T-1)**

24.15.4.7.1.2. Fifty feet from combustible structures or sources of ignition, such as heavy vehicle traffic areas, areas where equipment is operating or designated smoking areas. **(T-1)**

24.15.4.7.1.3. Seventy-five feet from aircraft parking, fueling or defueling areas. **(T-1)**

24.15.5. Communication and Navigation Equipment Repair. Repair communication and electronic equipment on an approved shop bench IAW TO or manufacturer‘s instructions. Do not operate, test or check radar or high frequency radio transmitting equipment with power-on during aircraft fueling/defueling, fuel cell/integral tank repair activities or when hazardous vapors may be present. No radar emissions are allowed in hangars due to personnel hazards or inadvertent activation of facility warning and fire protection systems. See AFI 48-109 *Electromagnetic Field Radiation (EMFR) Occupational and environmental health Program*, for additional information.

24.15.6. Flight Control Systems. Unexpected movement of flight controls may cause severe injuries. Maintenance personnel shall be trained and aware of dangers with flight control system operation. **(T-1)** Flight control operation shall be directed orally by interphone or after visual assurance from a person outside the aircraft that flight control surfaces and movement areas are clear. **(T-1)** All maintenance activities shall be coordinated and a warning tag applied to the flight controls to prevent movement when employees are exposed to potential injury. **(T-1)** Local procedures shall be developed to address work shift changes when tags must remain in place or be reapplied. **(T-1)**

24.15.7. Aircraft Hydraulic Systems. Employees shall ensure pressures are relieved prior to disassembling any hydraulic lines or system components. **(T-1)** Control(s) that could injure personnel or damage equipment shall be tagged out IAW TO procedures and/or local procedures while maintenance activities are in progress. **(T-1)** Proper PPE, such as goggles, shall be worn. **(T-0)** Hydraulic spills shall be cleaned up immediately to prevent slips and falls. **(T-1)**

24.15.8. Battery-Powered Screwdrivers and Drills. Cordless drills and screwdrivers are authorized for use outdoors and indoors during all periods of aircraft maintenance on JP-8 or other high flashpoint fueled aircraft, with the following restrictions: **Note:** Battery-powered screwdrivers and drills that are intrinsically safe or listed for use in Class 1, Division 1 or 2 areas (may be used in listed areas) need only comply with paragraph **24.15.8.6**

24.15.8.1. Tools shall not be used within fuel servicing safety zones described in TO 00-25-172.

24.15.8.2. Tools shall not be used within 5 feet of a fuel vent or open fuel tank.

24.15.8.3. Use on JP-4 fueled aircraft is not permitted. When JP-4 and JP-8 fueled aircraft occupy the same maintenance hangar, requirements for JP-4 fueled aircraft shall apply. **(T-1)**

24.15.8.4. Tools are not used to install/remove fasteners from fuel tanks, fuel cell cavities or engine enclosures.

24.15.8.5. Tools shall not be used when there is a suspected or known fuel leak.

24.15.8.6. Tool battery exchanges and recharging shall not be conducted in Class I, Division 1 or 2 hazard areas.

24.15.9. Parachute Shops. Many fabrics, paints and cleaning components used in parachute shops are highly flammable or toxic. Good housekeeping in parachute shops is essential to a safe and efficient operation. Ventilation, temperature and humidity shall be carefully controlled to prevent deterioration of materials and minimize mishap potential. **(T-1)** Covered metal safety waste containers shall be provided for the disposal of waste and rags saturated with flammable substances. **(T-1)** These containers shall be emptied or removed at the end of each day or shift to an approved location outside the shop for pickup and disposal. **(T-1)** Contact the installation Environmental Management office for waste disposal guidance. **(T-1)** Cleaning fluids shall be used only in well-ventilated rooms equipped with exhaust systems as required by the BE occupational and environmental health risk assessment. **(T-1)** Cleaning booths approved by the installation FES Flight and BE shall be provided, when necessary, for spot cleaning parachutes or components. **(T-1)** The handling of carbon dioxide (CO2) cylinders in parachute shops shall be under the direction of supervisors or trained technicians. **(T-1)**

24.15.9.1. Parachutes and Harness Fabrics. These fabrics are subject to spontaneous combustion when treated with paints containing waterproof compounds. Fabrics treated with these paints shall be thoroughly dried in open air and not packed, stored, left in shops or shipped before dry. **(T-1)**

24.15.9.2. Wire, Cords and Receptacles. Damaged or frayed electric wires, cords and plugs shall be immediately replaced or repaired by qualified electricians. **(T-0)**

24.15.9.3. Smoking. Smoking shall be prohibited in all parachute facilities. **(T-1)**

24.15.9.4. Kapok Storage. Kapok and other padding materials shall be stored in reasonable amounts in covered and vented metal safety containers. **(T-1)**

24.15.9.5. Hoisting and Hold Down Devices. Supervisors shall ensure all devices used to hang parachutes in drying towers are periodically inspected by qualified personnel. **(T-1)** Recessed hold downs shall be installed in drying room floors to eliminate tripping hazards. **(T-1)** Hard hats shall be worn by employees in drying towers. **(T-1)**

24.15.9.6. Explosives. Storing, handling and using explosives shall be IAW specific TOs and AFMAN 91-201. **(T-1)**

24.16. Fall Protection Requirements. Maintenance group commanders or designated representative must ensure safe Air Force maintenance operations. **(T-0)** Flightline and hangar operations must include an appropriate level of fall protection commensurate with Air Force mission requirements. **(T-0)** To ensure consistency across Air Force operations, AFMC and the lead MAJCOM for the Mission Design Series (MDS) will work together to ensure development of standardized fall protection requirements and procedures are published in the applicable weapon system TOs. Maintenance group commanders may declare a non-routine operation military-unique on a case- by-case basis, in coordination with the organizational/appropriate chief of safety. These terms are defined as follows:

24.16.1. Military-Unique. Refer to paragraph **1.5**

24.16.2. Nonmilitary-Unique. Refer to paragraph **1.5**

24.16.3. Given the diversity and complexity of Air Force operations, it is impossible to address every situation in this guidance. However, the intent is reasonably clear and commanders have the authority to make final determinations regarding military uniqueness. Decisions that are based upon sound risk management principles, and the DoD guidance provided, are very likely to be defendable and correct. Supervisors working with the local safety staff are in the best position to recommend decisions that optimally balance safety and mission accomplishment.

24.16.4. While the Air Force must comply with OSHA requirements to the maximum extent practical, there may be operations where, due to facility or equipment design, or operational requirements, active or passive means of fall protection are not feasible. **(T-1)** In such cases, the best level of fall protection available, within existing operational limitations, shall be provided. **(T-0)**Where adequate lead time is available or for repetitive operations, a JHA shall be conducted and documented IAW AFI 91-202. **(T-1)** Organizations should discuss JHAs with the applicable TO writer or Aircraft Item Manager for their airframe, then involve organizational/appropriate safety office. **Note:** For Air Logistics Center Depots, a standardized Process Order integrated into the task may be used in lieu of a JHA.

24.16.5. Types of Fall Protection. Fall hazards from aircraft walking and working surfaces are controlled through application of Risk Management, at command and local levels, to determine which fall protection method offers optimal employee safety for the tasks performed. The maximum use of maintenance stands and work platforms, whenever possible, will reduce the exposure and risk. Whenever it becomes necessary to perform required tasks where an employee can fall four (4) feet or more, fall protection will be used. **(T-0)**

24.16.5.1. Passive. Passive fall protection is the most preferred means of protecting employees from falls. Passive Systems need not be directly connected to the employee to prevent an employee from falling. These systems include guardrails, work stands and platforms (including aircraft maintenance stands, e.g., B-1, B-4, B-5, etc.), nets and other devices. If passive fall protection is not feasible, active fall protection will be the next option considered. **(T-0)**

24.16.5.2. Active. Active fall protection, such as positioning devices, fall restraint systems, ladder climbing devices and personal fall arrest systems, require the employee to wear a full body harness and components and attach himself/herself to an anchorage or lifeline. Positioning devices and fall restraint systems prevent an employee from falling off unprotected sides and edges by restricting the employee's range of movement while a personal fall arrest system allows an employee to fall off unprotected sides and edges, but the personal fall arrest system and components absorb the energy forces during a fall, reducing the potential for injury.

24.16.5.2.1. Personal fall arrest systems require an anchorage connection point, connecting hardware components, body and fixed or shock absorbing lanyard, depending on system design. Anchorage connecting point(s) for each employee will have minimal support strength of 5,000 pounds (22.2 kilo-newton [kN]). **(T-0)** Vertical and horizontal lifelines shall have a minimal breading strength of 5,000 pounds (22.2 kN). **(T-0)** Horizontal lifelines shall be designed, installed and used under the

supervision of a qualified person, as part of a complete personal fall arrest system, which maintains a safety factor of at least two. **(T-0)** Lanyards, D-rings, locking snap-hooks and all components of a fall arrest system will also be capable of sustaining a minimum tensile load of 5,000 pounds (22.2 kN). **(T-0)** See paragraph **13.2**, and 29 CFR 1926.502, *Fall Protection Systems Criteria and Practices,* 29 CFR 1910.66, Appendix C, *Personal Fall Arrest System,* and 29 CFR 1926.104., *Safety Belts, Lifelines, and Lanyards,* for additional personal fall arrest system guidance. To prevent employee injury or death, personal fall arrest systems shall not be used without a rescue plan. IAW American National Standards Institute Z359.4, *Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components,* prompt rescue means getting to the subject within five (5) minutes after an accidental fall. **Caution:** Shock absorbing lanyards will not be used in conjunction with self-retracting lifelines, fall limiters, retractable web lanyards or decelerator packs (inertial reel type lifelines) devices. Multi-use or combinations of use can result in two falls and could hinder and/or prevent self-rescue or external rescue. **Warning:** Hanging in a harness for an extended period of time can be fatal. Supervisors shall ensure employees using a personal fall arrest system can be properly rescued or can rescue themselves should a fall occur. **(T-0)** Availability of rescue personnel, ladders or other rescue equipment shall be determined prior to using a fall arrest system. **(T-0)**

24.16.5.2.2. Positioning and restraint systems. Fall restraint systems restrict an employee's range of movement so the individual cannot get into a position that would allow a fall. Positioning systems allow an employee to be supported on an elevated vertical/inclined surface and body support is hands free. Anchorage connecting point(s), work positioning and restraint lanyards for each employee will have minimal support strength of 5,000 pounds (22.2 kN). **(T-0)** Secure the employee to an anchor using a lanyard short enough to prevent the employee's center of mass from reaching the fall hazard. When exposed to a fall hazard, a personal fall arrest system must also be used. **(T-0)** Refer to paragraph **24.16.5.2.1** for additional guidance.

24.16.6. Mobile Work Platforms. Mobile work platforms (vehicle-mounted elevating and rotating work platforms, manually propelled maintenance stands and self-propelled mobile work platforms and scaffolds) shall have protective guardrails, midrails and toe boards (or equivalent) installed on all open sides, except the side facing the aircraft when it is within 14 inches of the working surface, unless employees are protected by a personal fall arrest system. **(T-0)** See **Chapter 16** for additional information. **Note:** The side of the platform facing the stairway is not considered an open side when the stairway is equipped with the required handrails.

24.16.7. Manually Propelled Aircraft Maintenance Stands:

24.16.7.1. Maintenance stands will be designed and maintained IAW applicable American National Standards Institute standards, manufacturer's guidance and technical order requirements. **(T-0)**

24.16.7.2. Requirements for towing small aircraft maintenance stands such as the B-1, B-4 or B-5 or larger stands such as the B-3 and J-7, are found in paragraph **24.7** or in **Chapter 16.**

24.16.7.3. Maintenance work stands shall have four (in any combination) of the following: operational brakes, wheel locks, or permanently installed jacks (e.g., two operational brakes and two permanently installed jacks). **(T-1)** Wheel chocks may be used to supplement these requirements. All stand wheels will be secured as above when not in use to avoid rolling down slanted surfaces or being moved by the wind when outdoors. **(T-1)** Chocks will be constructed or locally manufactured IAW TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding.* **(T-1) Note:** Some maintenance work stands may only have two operational brakes and no permanently installed jacks. Both brakes are required to be set.

24.16.7.4. Self-propelled elevating work platforms and manually-propelled mobile work platforms shall not be moved with personnel on the working platform unless allowed by manufacturer's instructions. Locking pins or other devices, as required, shall be in place IAW manufacturer's specifications before anyone is allowed to ascend the stairs or ladder. **(T-1)** Tools and equipment left on the work platform while the unit is moved shall rest securely on the floor of the platform and be protected by a rail and toeboard IAW paragraphs **16.4.6.10** and **16.5.3.8** **(T-1)**

24.16.7.5. Where location and aircraft configuration permit, required stand railings will be in place before stand is used. **(T-1)**

24.16.7.6. Guardrails and midrails (when required) shall be installed and access gates or openings closed per TO or manufacturer's instructions (including bolts, pins or other locking devices on removable railings and attachments) where location and aircraft configuration permit when there is a possibility of falling four (4) feet or more to the next lower surface. **(T-0)**

24.16.7.7. Platforms used at a height of 10 feet or more shall include toeboards or equivalents on all sides. **(T-0)** The minimum toeboard height shall be 4 inches. **(T-0)**

24.16.7.8. The side of the platform facing the stairway is not considered an open side when the stairway is equipped with the required handrails.

24.16.7.9. Maintenance stands will be visually inspected IAW TO 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures,* by the user daily, before use, for serviceability and leaks. Items to be inspected will include brakes, jacks, wheel locks, securing cables, locking pins, hydraulic systems, anchor connections, railings and removable attachments, including bolts, pins or other locking devices and overall equipment condition. Stands with defects shall be tagged as unserviceable. **(T-0)** Inspection should be documented on AFTO Form 244, Industrial/Support Equipment Record. **Note:** A daily inspection is not required for days the stand is not used.

24.16.7.10. Personnel will not use railings, planks, toeboards, ladders or any other device in or on the work platform for achieving additional working height or reach.

24.16.7.11. Vehicle-Mounted Elevating and Rotating Work Platforms and Self-Propelled Mobile Work Platforms.

24.16.7.11.1. When using vehicle mounted and self-propelled mobile work platforms, which have manufacturer-installed structural anchor points, with the platform elevated four (4) feet or more above the surface, personal fall arrest systems shall be worn with

lanyard attached to an approved structural anchor point if guard rails are to be removed and prior to removal. **(T-0)** When these platforms have not been manufactured with an approved structural anchor point, protective guardrails, midrails (when required), and toe boards must be installed on all open sides, except the side facing the structure (e.g., aircraft, buildings) when it is within 14 inches of the working surface. **(T-1)** Personnel will not use railings, planks, ladders or any other device in or on the work platform for achieving additional working height or reach.

24.16.7.11.2. A removable protective guardrail shall only be removed from the side of the platform that has been positioned as close as practical, but 14 inches or less and parallel to an aircraft, building or other working surface. **(T-1)** Guardrails will be installed on all open sides if platform levels are four (4) feet or higher above the ground or floor. **(T-0)** Bolts, pins or other locking devices will be provided and used on all removable railings and attachments. **(T-0)** Only guardrails and toeboards meeting the criteria in paragraph **16.4.6.10.2** will be used. **(T-0)**

24.17. Safety in Flightline Contractor Operations.

24.17.1. Contractor operations may create hazardous working conditions for Air Force personnel. To ensure Air Force personnel or resources are not subjected to hazards, the installation Occupational Safety office, FES Flight, Airfield Management and BE shall review requirement documents prior to submission to Contracting office to ensure contracts and activities of contractors performing a task or service for the Air Force. **(T-1)** Appropriate safety, fire and health requirements shall be included in contract specifications. **(T-1)** This is normally accomplished by including appropriate Federal Acquisition Regulation (FAR) provisions or clauses in the contract. Installation Occupational Safety office, FES Flight, Airfield Management and BE shall help the contracting officer and using organization establish appropriate requirements. **(T-1)** Also, appropriate US Air Force and installation traffic provisions shall be identified to help control contractor vehicles on base. **(T-1)** If a contractor procedure or condition requires correction, action shall be initiated through the Contracting Officer. **(T-1)**

24.17.2. Construction Contracts. The contracting officer shall call a pre-construction conference before the contractor begins construction on an Air Force installation. **(T-1)** Installation Occupational Safety office, Flight Safety Office, FES Flight, Airfield Management, BE, the using organization, CE, contractor representatives and other affected agencies, as appropriate, shall be present. **(T-1)** The Contracting Officer shall ensure the contractor knows all necessary Air Force safety requirements associated with the contract. **(T-1)**

Note: This guidance does not apply to US Army Corps of Engineers contracts.

24.17.3. Non-Construction Contracts. Most non-construction contracts on Air Force installations involve persons or companies providing goods and services to installation personnel and activities. During requirement development, requiring activity coordination with the installation Occupational Safety office, FES Flight, Airfield Management, BE, contract representatives, using organization and other affected organizations, as appropriate, is necessary to assure appropriate safety, fire prevention and health requirements are included in the contract. Prior to contract renewal, Occupational Safety office, FES Flight, Airfield

Management, BE, contract representatives and the using organization will review the contract to ensure its continued adequacy. **(T-1)**

Chapter 25

CIVIL ENGINEERING

25.1. Scope. Civil engineering (CE) units are typically involved in numerous planning, maintenance and fire prevention activities that have a high risk for mishaps. Safe management of the work force, inclusion of safety features (most economical during the identification, planning or design phases) and the correction of facility and grounds hazards are instrumental in preventing mishaps. Training, safe work practices, correct PPE, proper tools, human factors and risk management should all be addressed/accomplished prior to starting tasks.

25.1.1. Confined Spaces. Refer to **Chapter 23,** *Confined Spaces*, for information and guidance on confined spaces.

25.1.2. Cleaning. Soaps and solvents can cause surfaces to become slippery and increase the potential for slips and falls. Certain cleaning solvents may ignite if applied to hot surfaces or when heated, causing fires and injuries to employees.

25.1.2.1. Pressure cleaners and steam cleaners operate at pressures in excess of 100 psi and temperatures near 200° F which can scald or burn employees on contact.

25.1.2.2. Soaps and solvents can cause dermatitis, eye irritation and other medical problems if the solvents become inhaled.

25.1.3. Interruption of services, injury to employees and equipment damages can occur when electrical, gas and steam lines are broken during digging operations. Ensure digging permits are obtained prior to digging. **(T-1)**

25.1.4. Flammables and Combustibles. Improper use of flammable and combustible liquids can result in explosions, burns from fire and chemicals, asphyxiation, inhalation of vapors, absorption through the skin, skin irritation and eye damage from direct contact or exposure. The volatility of flammable or combustible liquids is increased by heating and, when heated higher than their flash points, they present additional hazards.

25.1.5. Power Tools. Portable power tools receive power from electricity, air pressure, explosive charges or a rotating flexible cable. While the portable tool increases mobility and convenience, it is frequently more hazardous to use than its stationary counterpart because portable tools are small, making safety guarding more difficult. Typical injuries from portable power tools include electrical shock, burns, cuts, eye injuries from flying particles and muscle strains. The most common injuries from portable circular saws result from contact with the blade, electric shock or burns, tripping over cords or saws, losing balance while using the saw, dropping the saw on one's self or another person and kickbacks from pinching blades in the cut. Severe eye injuries may result from flying particles or sawdust.

25.1.6. Shock or electrocution may occur from contact with energized systems. Electrical equipment can also be an ignition source for fire or explosion caused by short circuits, over-heated equipment or failure of current limiters, thermal sensors and other devices. Explosions may occur when flammable liquids, gases or dusts are exposed to ignition sources generated by electrical equipment.

25.1.7. Electrical Cords and Power Cables. Abuse or improper care of electrical cords and power cables may cause insulation to become frayed or damaged, which may lead to electrical shock of employees using the damaged cords or cables.

25.1.7.1. Excessive scraping, kinking, stretching and exposure to grease and oils will damage electrical cords and power cables and cause premature failure and possible shock or burns.

25.1.7.2. Electric cords of power hand tools may be damaged or cut if the operator allows the cord to fall in the path of material being worked or sawed.

25.1.8. Manual Handling Practices. Hernias, back strains, crushed hands and feet, broken bones and severe lacerations can result from poor manual handling practices. Injuries may occur from improper lifting procedures or failure to use mechanical lifting devices for handling heavy loads.

25.1.9. Many hazards are associated with physical limitations, e.g., fatigue and adverse working conditions. Refer to **Chapter 2,** *General Work Procedures,* for additional information.

25.1.9.1. Fatigue may cause employee inattention and inability to concentrate on job tasks that could result in trips, falls, inability to carry heavy articles properly and exposure to vehicles and other moving objects the employee may fail to observe.

25.1.9.2. Extreme or adverse weather conditions, e.g., heat, cold, extreme humidity, affect each individual employee differently and may increase the probability of a mishap.

25.1.10. Use of the wrong tool and failure to inspect tools prior to use may cause cuts, eye injury and broken bones.

25.1.11. Unsafe work practices when performing hot-work operations, such as welding, brazing, soldering, heat treating, grinding, powder-actuated tools, hot riveting and all other similar applications producing a spark, flame or heat-producing operation, may result in serious burns.

25.1.12. Working with or around hazardous substances places employees in hazardous situations, such as working with or around battery acids, paints, chemicals, sewage or other cleaning operations. For example: substances such as mercury and phosphor contained in fluorescent lamps are dangerous in open cuts, mouth or eyes. Skin problems or dermatitis may result from handling epoxy cements, caustics, oils and solvents without protection. Proper PPE shall be used. **(T-0)**

25.1.13. Simple yet dangerous work, such as excavation, earth and rock removal, may result in cave-ins, causing serious injuries or death by suffocation or crushing. Additional hazards from buried pipes or lines may also be encountered when excavating around utilities.

25.1.14. Work in areas where flying or falling objects may be present could result in a “struck-by” incident. For example: tools left on a ledge could fall on employees below.

25.1.15. Exposure to hazardous noise either in the shops or in other work areas, such as equipment rooms, generator rooms, heavy equipment operations and the flightline, without proper hearing protection can result in temporary or permanent loss of hearing.

25.1.16. Attics, crawl spaces, tanks, vaults and similar areas frequently lack illumination resulting in falls, burns, cuts or electrical shock.

25.1.17. Injuries from working on or near moving machinery range from minor cuts and bruises to a severed limb. This hazard exists where machinery is operated, including job sites where vehicles, equipment or machinery are in use. Ensure all guarding is in place and employees briefed on hazards. **(T-0)**

25.1.18. Mechanical lifting devices include cranes, hoists, slings, jacks and forklifts. Their use is subject to certain hazards that cannot be controlled by mechanical means, but only through proper supervision and training. Hazards include overloading, dropping or slipping of the load, obstructing the free passage of the load, moving a vehicle with an unsecured load, not using outriggers and other misuse of lifting devices.

25.1.19. Motor vehicle operation mishaps may occur from improper backing of vehicles. Injuries are also sustained when a person gets on or off the vehicle while it is moving or when left in neutral without the parking brake set, when operators fail to adjust for weather conditions, speed or are inattentive to the driving task. Training and licensing and/or certification is required for each type of vehicle utilized. **(T-1)**

25.1.20. The use of propane or gasoline-powered equipment, e.g., forklifts and materials handling carts, produces carbon monoxide. Employee exposure to carbon monoxide may be excessive if such operations are conducted in low ceiling, enclosed or non-ventilated areas. Ensure proper ventilation is available at all times. **(T-0)**

25.2. Supervisory Responsibilities. Supervisors must recognize workplace hazards and apply RM when existing guidance, e.g., manufacturer's instructions, does not sufficiently address operational concerns or requirements. **(T-0)** Supervisors shall not require personnel to work in environments or conditions that are hazardous to their safety or health without first providing adequate engineering and administrative controls or PPE. **(T-0)** The supervisor shall frequently inspect job sites, work methods and materials, and equipment used. **(T-0)** Any unsafe equipment or material shall be tagged and rendered inoperative or physically removed from the workplace. **(T-0)** The supervisor shall permit only qualified personnel to operate equipment and machinery according to safe work practices. **(T-0)** Refer to AFI 90-802, *Risk Management,* for additional risk management information.

25.2.1. Supervisors will:

25.2.1.1. Ensure safe working conditions. **(T-0)**

25.2.1.2. Ensure all electrical, power production and Heating, Air Conditioning and Ventilation (HVAC) personnel are trained in cardiopulmonary resuscitation (CPR) procedures. **(T-1)**

25.2.1.3. Provide necessary protective equipment in consultation with BE and the Occupational Safety office. **(T-1)** **Figure 25.1** contains additional guidance concerning PPE.

25.2.1.4. Ensure required guards and protective equipment are provided, used and properly maintained. **(T-0)**

25.2.1.5. Ensure tools and equipment are properly maintained and used. **(T-0)**

25.2.1.6. Plan the workload and only assign employees to tasks they are qualified to perform. Personnel shall not work alone in remote or isolated work areas. **(T-1)**

25.2.1.7. Ensure employees understand the work to be done, the hazards that may be present and procedures for performing the work safely. **(T-0)**

25.2.1.8. Take immediate action to correct any violation of safety rules observed or reported to them. **(T-0)**

25.2.1.9. Ensure employees exposed or potentially exposed to hazardous chemicals or materials are trained to identify, minimize or eliminate the hazards of those chemicals and materials per AFI 90-821, *Hazard Communication (HAZCOM) Program*. **(T-0)** Follow information from the SDS for specific chemicals or materials. This information shall be used by supervisors in conjunction with employee training. **(T-0)**

25.2.1.10. Conduct a JHA of job tasks whenever required to determine the safest, most efficient means to accomplish a given task. **Note:** A JHA shall be accomplished when new equipment is installed, equipment is relocated or new procedures are implemented in critical or hazardous operations and existing guidance is not available. **(T-0)** Refer to AFI 91-202 for additional guidance.

25.2.1.11. Ensure all personnel are trained on required equipment and their work environments. **(T-0)**

25.2.1.12. Ensure industrial shops and sites have a basic first aid kit, NSN 6545-00-922-1200, or suitable substitute, approved by the installation medical services, available to care for employees injuries until professional help arrives or they can obtain full medical care. **(T-1)** Refer to **Chapter 8,** *Electrical Safety*, for additional guidance.

25.2.2. The following guides will aid supervisors in administering task briefings, e.g., tailgate meetings, to employees:

25.2.2.1. Remind employees to check work areas for hazards.

25.2.2.2. Review the work request or sketch with employees.

25.2.2.3. Explain why the job is being done.

25.2.2.4. Point out existing and potential hazards and steps required to control them.

25.2.2.5. Explain work methods to be used.

25.2.2.6. Ask for questions and suggestions. Let employees know they may come to you or the safety representative with safety, fire prevention, or occupational health problems.

25.2.2.7. Ensure all employees fully understand their work assignments and safety responsibilities.

25.2.2.8. Recurring safety/weekly tailgate meetings are an excellent way for the supervisor to stress the importance of employee safety, both on- and off-the-job. Additionally, supervisors have the flexibility to include pertinent safety information relevant to their local area and work environment. These meetings allow for employee feedback and discussion and shall include one or more of the following topics as applicable to the job:

25.2.2.8.1. Occupational Health and Safety Reports.

25.2.2.8.2. Lifting and handling techniques.

25.2.2.8.3. Hazards associated with various jobs in progress.

25.2.2.8.4. Unsafe practices.

25.2.2.8.5. Recent mishaps.

25.2.2.8.6. Protective equipment.

25.2.2.8.7. Portable electric tools.

25.2.2.8.8. Hand tools.

25.2.2.8.9. Chemicals and health hazards.

25.2.2.8.10. Location and use of SDSs.

25.2.2.8.11. Safe housekeeping practices.

25.2.2.8.12. Working on or near machinery.

25.2.2.8.13. Use of ladders.

25.2.2.8.14. Working on elevated platforms or positions.

25.2.2.8.15. Falls from elevated positions.

25.2.2.8.16. Lifting and hoisting equipment.

25.2.2.8.17. Fire hazards and fire prevention.

25.2.2.8.18. First aid and CPR training.

25.2.2.8.19. Falls.

25.2.2.8.20. Pertinent safe practices. Any employee identification of safety, fire prevention or occupational health hazards that cannot be corrected by the supervisor shall be handled by existing documentation systems, such as hazard reports, self-inspection reports or internal employee complaint channels. **(T-0)** The organization chain of command shall be used to identify and correct hazards; however, if action is not taken, the installation Ground Safety office should be contacted.

25.2.3. Safety, Fire Protection and Health On-The-Job Training (OJT). Employees shall be thoroughly trained in the use of protective equipment, guards and safeguards for chemicals and the safe operation of equipment, machines and tools they use or operate. **(T-0)** Only employees who have been trained and those undergoing supervised OJT shall be allowed to operate shop equipment, machines and tools. **(T-0)** Certification and licensing are required for some tools and equipment, e.g., powder-actuated tools and electrical generators. Supervisors will ensure these special qualifications are complete and documented in employees' training records (military or civilian, as appropriate) before allowing or requiring the employee to use the tools. **(T-1)**

25.2.4. Supervisors shall watch for signs of fatigue and prevent employees from overexerting themselves. **(T-1)** Physical limitations shall be considered when assigning job tasks. Other factors to consider when assigning job tasks include mental preoccupation resulting from personal problems that may have an impact upon employees' and co-employees' safety.

25.2.5. Shop supervisors shall be aware of each employee's limitations, as reasonably possible, under different weather conditions and on-site job conditions and select personnel for job assignments accordingly.

25.2.6. Supervisors and employees shall perform pre-job planning. **(T-1)** Supervisors shall ensure operators are competent, careful, physically and mentally fit and thoroughly trained for assigned tasks. **(T-1)**

25.3. Occupational Health. Health hazards that affect CE employees also affect building occupants where work is performed and personnel passing by work in progress. Adequate controls shall be used whenever an operation poses a potential health hazard to any personnel. **(T-0)**

25.3.1. AFI 48-127, *Occupational Noise and Hearing Conservation Program*, addresses program responsibilities, designation of hazardous noise-producing equipment and hazardous noise areas, required PPE and required medical examinations for personnel exposed to hazardous noise. BE shall be contacted to evaluate and determine noise levels. **(T-1)**

25.3.2. Breathing Hazards. If process has not already been evaluated, contact BE for an occupational and environmental health risk assessment.

25.3.3. Internal combustion engines shall not be operated inside buildings unless an exhaust system or other ventilation approved by BE is installed and used. **(T-1)** When equipment is operated adjacent to buildings, the exhaust shall be directed away from the buildings. **(T-1)** Substitution of internal combustion engine forklifts with electric forklifts, modification of existing equipment, or appropriate ventilation may be necessary to keep concentrations of carbon monoxide within permissible levels. Where high concentrations of carbon monoxide accumulate (e.g., in warehousing areas with a large number of forklifts in use), BE shall be contacted to survey and identify requirements to make the work area safe. **(T-1)** Refer to AFMAN 24-306, *Operation of Air Force Government Motor Vehicles*, for requirements and information on safe vehicle operation.

25.3.4. Skin Irritants. Dermatitis, one of the leading occupational diseases in today's workplace, is also easy to prevent. Gloves can easily provide adequate protection. Caution is advised in the selection process as not all gloves are adequate for all cleaning solvents and applications. If process has not already been evaluated, contact BE for occupational and environmental health risk assessment.

25.3.5. Hazards from Flying or Falling Objects. **Chapter 14,** *Personal Protective Equipment (PPE),* and other specific job safety standards outline requirements for protective equipment, barriers and procedures to prevent injuries from flying or falling objects, e.g., face shield, hard hats or construction barriers. Proper eye protection equipment shall be provided when needed, and its use shall be strictly enforced. **(T-0)** This requirement includes employees not actually involved but who are within the area and may be affected by flying or falling objects.

25.3.6. Asbestos fibers can cause lung diseases such as asbestosis and cancer of the lung. If asbestos is used or already in place, safe handling procedures shall be IAW 29 CFR 1910.1001, *Asbestos*. **(T-0)** Employees shall not be exposed to unsafe levels of airborne asbestos. **(T-0)** Consult BE prior to all planned asbestos projects. Immediately notify BE if asbestos is suspected or confirmed during a project. Employees shall not resume work until receiving proper guidance from BE. **(T-1)** Refer to AFMAN 48-155, *Occupational and Environmental*

Health Exposure Controls, and AFI 32- 1052, *Facility Asbestos Management*, for additional guidance.

25.3.7. Confined Spaces. Confined spaces can pose serious health hazards to employees involved in entry. Supervisors and employees must be aware of potential hazards and precautions needed to avert a serious consequence. **(T-0)** **Chapter 23** addresses specific responsibilities, requirements and procedures for entry into confined spaces.

25.4. Shop Layout, Equipment, General Walking and Working Surfaces.

25.4.1. Layout. Proper layout, spacing and arrangement of equipment, machinery, passageways and aisles are essential to orderly operations. Good layout is best achieved in the design stage, with recommendations from the installation Occupational Safety office, FES Flight, BE and CE. Whether a facility is in the design stage, being remodeled or repositioning of equipment and machinery is required, basic layout considerations are important factors in planning a facility for safe operations. All interior walking and working surfaces that are part of the means of egress shall comply with UFC 3-600-01, *Fire Protection Engineering for Facilities*, and National Fire Protection Association 101, *Life Safety Code.* **(T-0)** Refer to **Chapter 7,** *Walking – Working Surfaces*, and **Chapter 11,** *Hand Tools, Portable Tools & Machinery*, for additional guidance on proper layout, spacing and arrangement. **(T-0)**

25.4.2. Electrical Installations and Equipment.

25.4.2.1. Supervisors will ensure work areas are inspected for possible electrical hazards. **(T-0)** Sufficient workspace shall be provided and maintained around electric equipment to permit safe operation and maintenance of such equipment. **(T-0)** Only qualified operators designated in writing by the supervisor shall be allowed to operate the equipment. **(T-1)** This listing of personnel qualified to operate equipment shall be maintained in the work area. **(T-1)**

25.4.2.2. Frames of all electrical equipment, regardless of voltage, shall be grounded. **(T-1)**

25.4.2.3. Exposed non-current-carrying metal parts of electrical equipment that may become energized under abnormal conditions shall be grounded IAW National Fire Protection Association 70, *National Electrical Code*. **(T-0)**

25.4.2.4. Exposed non-current-carrying metal parts of the following plug-connected equipment that may become energized shall be grounded or double insulated and distinctly marked: portable, hand-held, motor-operated tools, appliances or any equipment operated in excess of 150 volts to ground. **(T-0)**

25.4.2.5. Wires shall be covered wherever they are joined (e.g., outlets, switches and junction boxes). **(T-0)**

25.4.2.6. Parts of electrical equipment which in ordinary operation produce arcs, sparks, etc., shall not be operated or used in explosive atmospheres or in close proximity to combustible materials. **(T-0)**

25.4.2.7. Spring-loaded switches for equipment shall not be secured, e.g., taped or wired, in the ON position at any time. **(T-0)**

25.4.2.8. Flexible extension cords and power strips shall not be:

25.4.2.8.1. Used as a substitute for fixed wiring. **(T-0)**

25.4.2.8.2. Run through holes in doors, windows, walls, ceilings or floors.

25.4.2.8.3. Attached to building surfaces, e.g., stapled/nailed to surfaces. **(T-0)**

25.4.2.8.4. Spliced, stapled, tacked or placed where they create a hazard or are subject to damage. **(T-0)**

25.4.2.9. Flexible extension cords may be used for temporary taskings if:

25.4.2.9.1. Cords are of continuous lengths without splices or taps.

25.4.2.9.2. Cords are fastened so there is no pressure on joints or screws of the plug or sockets.

25.4.2.9.3. Cords are replaced when insulation has frayed or deteriorated.

25.4.2.9.4. Cords of proper size and temperature rating to withstand the electrical load and approved by a recognized testing agency are used.

25.4.2.9.5. Cord is a three-prong, dead-front plug type.

25.4.2.10. Equipment connected by flexible extension cords shall be grounded either by a three-wire cord or by a separate ground wire (except double-insulated equipment). **(T-0)** Refer to paragraphs **25.4.2.9** through **25.4.2.9.5**

25.4.2.11. Ground fault circuit interrupters shall be used on all 120-volt, single- phase, 15- and 20-ampere receptacle outlets at job sites when the receptacles are not a part of the permanent wiring of the building or structure. **(T-0)** Receptacles on a two-wire, single-phase portable or vehicle-mounted generator rated not more than 5 kilowatts (kW), where the circuit conductors of the generator are insulated from the generator frame and all other grounded surfaces, need not be protected with ground fault circuit interrupters.

25.4.3. Illumination. Adequate illumination shall be provided to ensure safe working conditions. **(T-0)** Illumination for night work shall also be supplied for warning as well as work visibility. **(T-0)** Essential regulatory information is listed below. Refer to 29 CFR 1926.26, *Illumination-General Safety and Health Provisions*, and 29 CFR 1926.56, *Illumination-Occupational Health and Environmental Controls*.

25.4.3.1. Portable lamps will have Underwriters Laboratories listed plugs, handles, sockets, guards and cords for normal working conditions. **(T-0)** Lamps used in wet or damp locations shall be equipped with a waterproof housing. **(T-0)** In flammable atmospheres, approved explosion-proof lights shall be used. **(T-0)**

25.4.3.2. For work in boilers, condensers, tanks, turbines or other grounded locations that are wet or may cause excessive perspiration, a low-voltage lighting system shall be used, either from a battery system or low-voltage lighting unit. **(T-1)** Many organizations only permit a six or twelve volt system for tools and lights used inside boilers. These are usually connected to a transformer located outside of the boiler. Battery powered lights are an even safer alternative to installed systems. In situations where these lighting systems are not available, a vapor-proof 110-volt lighting system shall be used. **(T-1)**

25.4.3.3. Flashlights for use near energized electrical equipment and circuitry will have insulated cases. **(T-0)**

25.4.3.4. At least 50 foot-candles of illumination shall be provided at all work stations. **(T-1)** However, fine work may require 100 foot-candles or more. This can be obtained with a combination of general lighting plus supplemental lighting. If fluorescent lighting is installed, it shall be installed in a manner to eliminate any stroboscopic effect with moving machinery. **(T-1)** Standard fluorescent fixtures not designed with self-locking tubes shall be fitted with tube-retainer devices, screens or guards to prevent tubes from falling out. **(T-1)** Consult installation CE whenever specific guidance on lighting is required and submit an AF Form 332, *Base Civil Engineer Work Request*, when a lighting survey is required. **(T-1)**

25.4.4. Ventilation.

25.4.4.1. Minimum safety, fire prevention and occupational health requirements pertaining to ventilation are addressed in this chapter. Ventilation and exhaust systems details, including information on flow-rate requirements, and the design of ventilation and exhaust systems are in the most current edition of the American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance.* BE will determine what, if any, periodic testing of ventilation systems is required IAW the above reference. **(T-1)**

25.4.4.2. Machines that generate dust, vapors, mists, etc., shall be connected to an effective industrial-exhaust ventilation system. **(T-0)** In shops where small numbers of installed machines are not continuously in operation, portable collection systems may be used. Hoods and exhaust systems shall be constructed and installed IAW the manufacturer's instructions. **(T-0)** Also, refer to **Chapter 11.**

25.4.4.3. In areas where welding, soldering, brazing and burning hot-work operations are performed, fumes from operations contain the metals being welded together (e.g., cadmium, zinc, lead, iron or copper). The filler material, flux and the coating on the welding rods used may generate other gases (e.g., carbon monoxide, arsine, or ozone) at concentrations hazardous to employees. When extensive hot-work operations are conducted, particularly in enclosed areas, excessive exposure to these materials could occur. Ventilation or respiratory protection may be required for these operations based on measured or calculated concentrations. Supervisors shall contact BE whenever workplace operations change, when new chemicals are introduced, processes or procedures change, or engineering controls are modified or added. **(T-1)** When welding, soldering, brazing and other hot-work operations are performed in a space screened in on all sides, e.g., welding booths, screens or non-rigid heat/spark barriers, the screens shall be arranged to ensure adequate ventilation. **(T-0)**

25.4.4.4. Boiler and furnace rooms shall have ventilation to permit clean, safe combustion and to minimize soot formation. **(T-0)** An unobstructed air opening shall be provided, sized on the basis of 1 square inch (645 square millimeter [sq mm]) free area per 2,000 British Thermal Units maximum fuel input of the combined burners located in a boiler room. **(T-1)** Air supply openings will be kept clear at all times and regularly inspected. **(T-0)** American National Standards Institute Boiler Codes may be consulted for more detailed information on boiler ventilation and combustion air requirements.

25.4.4.5. Walking-Working Surfaces. CE employees are frequently victims of falls at work sites inside and outside the shop. Walking and working surfaces often include a floor

opening or platform through which persons may fall, such as a hatchway, stair or ladder opening, pit or large manhole. Elevated working spaces above the surrounding floor or ground, such as a balcony or platform for the operation of machinery and equipment, may also be encountered by civil engineering personnel. Supervisors will ensure fall protection procedures or systems are available and used by employees where the potential of a fall from a height of four (4) feet or more exists. **(T-0)** Refer to **Chapter 7**, **Chapter 13**, *Fall Protection*, and 29 CFR 1910.28, *Duty to Have Fall Protection and Falling Object Protection*, for additional guidance.

25.4.4.6. Construction. Personal fall arrest or fall protection systems are often necessary to safely accomplish tasks performed from elevated surfaces during construction activities. Employees exposed to a walking or working surface (horizontal and vertical surface) with an unprotected side or edge, which is six (6) feet or more above a lower level, shall be protected from falling by the use of guardrail systems, safety net systems or personal fall arrest systems. **(T-0)** Refer to **Chapter 13**29 CFR 1926.501, *Duty to Have Fall Protection*, and paragraph **25.13.5** for information on roofing operations.

25.4.4.7. Fixed ladders and requirements for guarding and training employees are addressed in **Chapter 7** and 29 CFR 1910.23, *Ladders*.

25.4.4.8. When working over or near water:

25.4.4.8.1. Where the danger of drowning exists, employees shall be provided with US Coast Guard-approved life jackets or buoyant work vests. **(T-0)** This includes, but is not limited to, water-treatment ponds, storage tanks and Air Force operated Morale, Welfare and Recreation (MWR) recreational lakes or large ponds. Life jackets or buoyant work vests shall be worn at all times when employees are working alone over or near water. **(T-0)**

25.4.4.8.2. Prior to and after each use, buoyant work vests or life preservers shall be inspected for defects that would alter their strength or buoyancy. **(T-0)** Defective units shall not be used. **(T-0)**

25.4.4.8.3. Where feasible, ring buoys with at least 90 feet of line shall be provided and be readily available for emergency rescue operations. - Distance between ring buoys shall not exceed 200 feet. **(T-1)**

25.4.4.8.4. At least one lifesaving skiff shall be immediately available. **(T-0)**

25.4.4.9. Exits and Exit Markings. Essential regulatory information is included below. For additional guidance, see 29 CFR 1910.37, *Means of Egress, General*.

25.4.4.9.1. Every exit will have “EXIT” in plain legible letters not less than six (6) inches high with the strokes of the letters not less than 3/4 inch wide. **(T-0)**

25.4.4.9.2. Doors, passageways or stairways that are neither exits nor ways to an exit (but may be mistaken for an exit) shall be clearly marked “NOT AN EXIT” (or similar designation) or by a sign indicating their actual use; for example: “STORAGE ROOM” or “BASEMENT.” **(T-0)**

25.4.4.9.3. When the direction to the nearest exit may not be apparent to an occupant, an exit sign with an arrow indicating direction shall be used. **(T-0)**

25.4.4.9.4. Exit access shall be arranged so it is unnecessary to travel toward any area of high hazard potential in order to reach the nearest exit (unless the path of travel is effectively shielded by suitable partitions or other physical barriers). **(T-0)**

25.4.4.9.5. Exit signs shall be clearly visible from all directions of egress and shall not be obstructed at any time. **(T-0)** If occupancy is permitted at night, or if normal lighting levels are reduced at times during working hours, exit signs shall be suitably illuminated by a reliable light source. **(T-0)** New exit signs shall be the internally illuminated, light emitting diode type. **(T-1)** Existing signs may be internally or externally illuminated. Use of radio luminescent signs is prohibited without the written approval of the USAF Radioisotope Committee. Replace and dispose of existing radio luminescent signs IAW AFI 40-201, *Managing Radioactive Materials in the US Air Force.* As the installation Radiation Safety Office, BE will direct the proper disposal methods and guidelines. **(T-1)**

25.4.4.9.6. A door from a room to an exit or to a way-of-exit access shall be the side-hinged swinging type. **(T-0)** It will swing out in the direction of travel if 50 or more persons occupy the room or the exit is from an area of high hazard potential. **(T-0)**

25.4.4.9.7. Areas around exit doors and passageways shall be free of obstructions. **(T-0)** The exit route shall lead to a public way. **(T-0)** The exit access must not go through a room that can be locked, nor may it lead into a dead-end corridor. **(T-0)**

25.4.4.9.8. Where occupants may be endangered by the blocking of any single exit due to fire or smoke, there shall be at least two means of exit remote from each other. **(T-0)**

25.4.4.9.9. Exits, exterior steps and ramps shall be adequately lighted to prevent mishaps. **(T-0)** Separate lighting shall not be required if street or other permanent lighting gives at least one foot-candle of illumination on the exit, steps and ramp. **(T-0)**

25.4.4.9.10. Monthly testing of exit lights shall be accomplished IAW National Fire Protection Association 101, *Life Safety Code.* **(T-0)**

25.4.4.10. Machinery, Shop Equipment, Machine Guarding and Power Transmission Apparatus. Refer to **Chapter 11.**

25.4.4.11. Roll-up Doors. See paragraph **2.7** for roll up door requirements.

25.5. Fire Prevention. All CE personnel shall receive fire prevention training as part of their general non-supervisory (AFOSH) training. **(T-1)** Training shall be documented IAW AFI 91-202. **(T-1)** Regulatory OSHA fire extinguisher requirements are IAW AFI 32-2001, *Fire Emergency Services Programs*. Also see **Chapter 6,** *Fire Protection and Prevention*, and National Fire Protection Association 10, *Standard for Portable Fire Extinguishers*, for additional information.

25.5.1. Supervisors in charge of operations where fuels, solvents or other flammable liquids are used shall be constantly alert for hazards and unsafe acts. **(T-1)** Refer to paragraph **22.2.4** for additional guidance.

25.5.1.1. Solvents shall not be used as cigarette lighter fluid. **(T-0)**

25.5.1.2. The use of low flash point petroleum solvents shall be avoided whenever possible.

25.5.1.3. Open flames, open element heaters, equipment not properly grounded and non-explosion-proof electrical equipment used in the presence of flammable or combustible liquids shall be avoided. **(T-0)**

25.5.2. Fire extinguishers with a rating of at least 2A:20BC shall be installed in shop areas located so an extinguisher is available within 50 feet. **(T-1)** The number of extinguishers depends upon the size and layout of the facility. The installation FES Flight shall be consulted for more detailed information on the type, selection, installation, inspection, maintenance and hydrostatic testing of portable fire extinguishers. **(T-1)** Fire extinguishers will:

25.5.2.1. Be kept fully charged and in their designated area. **(T-1)**

25.5.2.2. Be located along normal paths of travel. **(T-1)**

25.5.2.3. Not be obstructed or obscured from view. **(T-1)**

25.5.2.4. Be visually inspected by management or a designated employee at least monthly to ensure they:

25.5.2.4.1. Are serviceable. **(T-1)**

25.5.2.4.2. Are in their designated places. **(T-1)**

25.5.2.4.3. Have not been tampered with or actuated. **(T-1)**

25.5.2.4.4. Do not have corrosion or other impairments. **(T-1)**

25.5.2.4.5. Are accessible and not obstructed. **(T-1)**

25.5.2.5. Be examined, and, if necessary, after inspection, recharged or repaired to ensure operability and safety. Attach a tag or keep a central record to indicate the maintenance or recharge date and signature or initials of the person performing the service/inspection.

25.5.2.6. Be hydrostatically tested. Fire extinguishers shall be hydrostatically tested every five years IAW National Fire Protection Association 10. **(T-0)**

25.5.2.7. Be placed so the maximum travel distance does not exceed 75 feet for Class A or 50 feet for Class B locations, unless there are extremely hazardous conditions. **(T-0)**

25.5.3. Smoking at job sites shall only be permitted in approved designated smoking areas and never while performing work. **(T-1)**

25.5.4. Supervisors will ensure employees remove construction debris and rubbish from the job site upon completion of the job, or daily if extended beyond one day. **(T-1)** Hazardous materials shall not be left at job sites unless properly stored. **(T-1)** Work being performed on job sites shall not endanger building occupants (e.g., exits blocked, fire alarm devices disconnected, etc.). **(T-1)**

25.6. Compressed Air.

25.6.1. All employees shall be aware of the inherent dangers of using compressed air. **(T-0)** Alternate methods of cleaning surfaces should be sought. Compressed air may be used if no alternative method of cleaning surfaces is acceptable. Compressed air shall never be used to blow debris from a person. **(T-0)** The downstream pressure of compressed air will remain

below 30 psi whenever the nozzle is dead-ended and then only when effective chip guarding and PPE are used. Face shield, safety goggles and hearing protection are required when cleaning with compressed air. **(T-0)**

25.6.2. All personnel assigned to shops with air compressors shall be familiar with compressor operating and maintenance instructions. **(T-0)**

25.6.3. The following are requirements for air compressors:

25.6.3.1. Air compressors shall be maintained strictly IAW manufacturer's instructions or an applicable TO. **(T-1)**

25.6.3.2. The drain tank to prevent moisture build up. **(T-1)**

25.6.3.3. Air tanks shall be protected by adequate safety relief valves. **(T-0)** These valves shall be tested at regular intervals (as required by manufacturers' specifications) to ensure they are in good operating condition. **(T-0)**

25.6.3.4. The pressure controller and gauge shall be maintained in good operating condition. **(T-0)**

25.6.3.5. The maximum working pressure of compressed air lines shall be identified in psi. **(T-1)** Pipeline outlets shall be tagged or marked showing maximum working pressure immediately adjacent to the outlet. **(T-0)**

25.6.4. Air supply lines shall be protected from damage by vehicles, tools and equipment. **(T-0)** They shall be inspected regularly and maintained in good condition. **(T-1)** Air supply lines shall be marked or tagged to identify the maximum psi on the lines. **(T-0)**

25.6.5. Compressed Air Systems. Plumbing employees shall be trained and authorized to inspect, maintain or install compressed air systems. **(T-1)**

25.7. Jacks and Portable Hoists. Equipment maintenance personnel shall not use hydraulic floor jacks, post jacks, portable hoists or mechanical jacks to support equipment while repair is being accomplished. **(T-1)** The equipment shall be blocked or placed on approved axle or frame stands before repair operations are begun. **(T-1)** Jacks used primarily in one location shall be inspected every six (6) months, or before and after the jack is sent out of the shop for special work. **(T-1)** Shop personnel shall not use a jack or hoist that is leaking or is faulty in its operation. **(T-1)** Faulty jacks and hoists shall be taken out of service, tagged and not used until repaired. **(T-1)** Load ratings shall be stenciled or otherwise plainly marked on all jacks and hoists. **(T-1)** Inspection dates shall be properly documented by shop supervisors. **(T-1)** Refer to paragraph **12.5.2.3** for guidance on inspecting hoists.

25.8. Shoring and Trenching.

25.8.1. The walls and faces of excavations and trenches over five (5) feet in depth, where employees may be exposed to danger of a cave-in, shall be guarded by a shoring system, sloping and benching system or some other equivalent means consistent with 29 CFR 1926, Subpart P – Excavations. **(T-0)** Trenches less than five (5) feet deep with hazardous soil conditions, shall also be effectively protected. **(T-0)** Refer to 29 CFR 1926, *Subpart P - Excavations:* 1926.650, *Scope, Application and Definitions Applicable to Subpart P*, 1926.651, *Specific Excavation Requirements*, 1926.652, *Requirements for Protective Systems*, for additional guidance. **Note:** A competent person will examine the excavation soil to determine

the need for a shoring system, sloping and benching system or some other equivalent means. **(T-0)** A registered professional engineer shall be consulted in areas required by 29 CFR 1926, Subpart P – Excavations. **(T-0)**

25.8.2. Employees will take extra care when hand excavating in close proximity to utilities to preclude interruption of services, equipment damage or injury to employees, which can result from breaking electrical, gas or steam lines. **(T-1)** AF Form 103, *Base Civil Engineering Work Clearance Request,* shall be coordinated and approved before any digging commences. **(T-1)**

25.8.3. If a hazardous atmosphere exists or there is a potential for one to exist in the excavation (e.g., welding in/or near the excavations, other hazardous work activities, excavations in landfill areas or excavations in areas where hazardous substances are stored nearby), the atmospheres in the excavation shall be tested before employees enter excavations greater than four (4) feet in depth. **(T-0)** The competent person shall consult with BE for proper atmospheric evaluation of the excavation. **(T-1)**

25.9. Barricades and Traffic Signs. Whenever a common area is disturbed by CE maintenance, repair or construction operations and presents a hazard to personnel in the area (residents, other employees or passers-by), care shall be taken to warn these personnel and other engineering employees of the potential hazard. **(T-0)**

25.9.1. Appropriate barriers shall be erected around excavations, open manholes, open electrical panels, etc., whenever they will be left unattended. **(T-0)**

25.9.2. Appropriate warning signs and steady or flashing warning lights for periods of reduced visibility (e.g., nighttime operations, inclement weather, fog) shall be posted a sufficient distance from the hazard to give ample advance warning to approaching pedestrian or vehicular traffic. **(T-0)** For vehicular traffic, comply with Department of Transportation's (DOT) *Manual on Uniform Traffic Control Devices.*

25.9.3. Airfield hazard warnings will comply with AFI 32-1042, *Standards for Marking Airfields.* **(T-1)**

25.9.4. Traffic control signs or devices will conform to the DOT's *Manual on Uniform Traffic Control Devices.* **(T-0)**

25.9.5. Employees exposed to vehicle traffic shall be provided with and required to wear warning vests marked with or made of reflector-type or high visibility material. **(T-0)** **Chapter 14** provides additional guidance for these requirements. In some situations, the use of flagmen to control the flow of traffic may be necessary. Employees in equipment operations, pavement maintenance, plumbing, heating maintenance and exterior electrical career fields shall be trained in traffic control procedures. **(T-1)**

25.10. Sanitation.

25.10.1. Shop supervisors shall ensure shop personnel use the protective clothing and equipment that will protect them from hazards of the work they perform. **(T-0)** It is the responsibility of employees to keep their PPE in a clean, sanitary state of repair and use the proper equipment when required.

25.10.2. Employees shall keep their hands and face clean, change clothes when they are contaminated with solvents, lubricants or fuels and keep their hands and soiled objects out of their mouth. **(T-0)** No food or drink shall be brought into or consumed in areas exposed to

toxic materials, chemicals or industrial shop contaminants. **(T-0)** After exposure to any contaminant, shop personnel shall wash their hands before eating or smoking. **(T-0)** Safe drinking water shall be provided in or reasonably near all shops. **(T-0)** Waste food from the lunch area shall be kept in a receptacle that is tightly covered and kept clean. **(T-1)** Restrooms must be provided with hot and cold running water and shall be kept clean and in a sanitary condition. **(T-0)**

25.10.3. Shop personnel required to wear protective clothing shall be provided with change rooms equipped with clothing lockers having separate storage facilities for clean and soiled clothing. **(T-0)** Shower facilities shall be provided when necessary to remove contamination from skin. **(T-0)**

25.10.4. Clothing used daily and issued by the shop shall be cleaned and stored in shop lockers or fenced areas within the building. **(T-0)** Employees shall inspect clothing and protective equipment daily for serviceability and satisfactory condition. **(T-0)** In addition, supervisors or a designated employee will spot check equipment and clothing. **(T-0)** Refer to 29 CFR 1910.141, *Sanitation,* for additional guidance.

25.11. Restrictions. Long full beards, unrestrained long hair, frayed trouser and shirt cuffs, loose clothing (such as loose shirt tails, improperly worn coveralls), loose shoe laces and torn clothing can become caught in tools or machinery and cause serious injury to employees. Personal grooming and appearance standards shall be enforced to prevent serious injuries should clothing, hair or jewelry be caught in operating tools and machinery. **(T-1)** Clothing worn shall be suitable to weather conditions and work being done. **(T-1)** Highly combustible garments or coveralls made of a synthetic material such as nylon shall not be worn in or around high-temperature equipment or operations such as boiler operations, hot-tar roofing, welding or any other work with open-flame devices. **(T-0)** Refer to AFI 32-1064, *Electrical Safe Practices,* for additional guidance.

25.12. Equipment Operations and Pavements. CE construction equipment varies considerably in size, age, capabilities and operating characteristics. Training outlines for operator qualifications shall be tailored to the particular equipment and shall be updated as new equipment is received. **(T-0)** Equipment manufacturers normally have copies of their training guides and operator manuals available for use in developing training outlines. American National Standards Institute's standards on lifting devices have additional information about some types of equipment. Appropriate PPE, e.g., hard hats, as required, shall be used. **(T-0)** 29 CFRs 1926.600, *Equipment*, 1926.601, *Motor Vehicles*, 1926.602, *Material Handling Equipment*, 1926.603, *Pile Driving Equipment*, 1926.604, *Site Clearing*, 1926.605, *Marine Operations and Equipment*, and 1926.606, *Definitions Applicable to Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations*, contain general requirements applicable to construction equipment. Additional information on PPE is listed in **Figure 25.1**

25.12.1. Backhoes. The front bucket, if so equipped, and outriggers shall be fully down before attempting to dig. **(T-0)** To prevent being struck, employees shall not enter the area through which the digging arm can swing. To avoid being struck by spillage or falling materials, employees shall not be permitted under loads and they will stand away from any vehicle being loaded or unloaded. **(T-0)** The operator will check overhead and lateral clearance for fixed obstructions such as trees, poles, wires, etc. **(T-0)** Operation under energized electrical lines shall be permitted only where absolutely necessary. **(T-0)** These operations shall be approved by the commander, and a spotter shall be used to constantly check clearance. **(T-0)** Refer to

AFI 32-1064, *Electrical Safe Practices*, for additional guidance. When traveling to and from job sites, the backhoe shall be completely folded, secured and centered and the front bucket raised only high enough to provide adequate ground clearance. **(T-0)**

25.12.2. Mobile Cranes. Operators must successfully complete an AFCEC-approved Initial 80-Hour Crane Course. **(T-1)** After completion, then the operator will receive an AF Form 483, *Certificate of Competency*, allowing them to operate for two months prior to receiving refresher training through an AFCEC-approved course. **(T-1)**

25.12.3. Dump Trucks. Dump truck operators shall be trained IAW Air Force Qualification Training Package 3E2X1-15 prior to operating any dump truck in the performance of his or her duties. **(T-1)** Dump trucks shall not be operated with loads exceeding the manufacturer's rated capacity. **(T-1)** Different materials have different specific weights (e.g., wet sand versus bark mulch) and, although the truck may have the volumetric capacity for the load, it may not have the weight capacity. Loads that pose a flying debris hazard shall be covered with a tarp or similar covering. **(T-1)** Before dumping the vehicle's load, operators will always check overhead clearance both directly over the vehicle and ahead of it in the direction to be traveled while the body is still raised. **(T-1)** Distances traveled with the bed raised shall be kept to a minimum. **(T-1)** Employees shall not be permitted in the bed while it is being raised. **(T-1)** The cab floor shall be kept clear of debris that could interfere with controls. **(T-1)** The number of people carried in the cab will never exceed the number of seat belts installed. **(T-1)**

25.12.4. Motor Graders. Operators shall follow manufacturer‘s instructions of the particular equipment in use. **(T-1)** Although similar in design, the variations in capabilities and operating characteristics are numerous. Clearances around machines can vary as much as several feet depending on the position of the mold board and circle, tilt of wheels, etc., and the operator must know these limits. **(T-1)** Graders are noisy and often operated in dusty conditions. Proper hearing, respiratory and eye protection shall be provided and used, when required by BE or Occupational Safety. **(T-1)** Consult with installation Occupational Safety office and BE on questions pertaining to PPE. Refer to **Chapter 14** for additional guidance on PPE requirements.

25.12.5. Wheeled Loaders. As with motor graders, the variety of wheeled loaders available to Air Force personnel is extremely varied. Operators shall be familiar with the operating characteristics of each vehicle and its limits. **(T-1)** Such things as control positioning, turning radius and capacity vary widely. Solid frame equipment and articulated units are extremely different in handling characteristics, especially when being transported over the road. When traveling empty at excessive speed, a loader will bounce, weave or road walk. Loaders are noisy, and are frequently operated in dusty conditions. Proper hearing, respiratory and eye protection shall be provided and used, when required by BE or Occupational Safety. **(T-1)** Consult with installation Occupational Safety office and BE on questions pertaining to PPE. Refer to **Chapter 14** for additional guidance on PPE requirements.

25.12.6. Bulldozers and Tracked Loaders. This equipment is available in a range of sizes from very small to large with a wide variety of attachments, e.g., swing blades, ripper teeth, and combination buckets. Bulldozers and tracked loaders are relatively slow moving; few are suitable for driving on streets and all are noisy. Each operator shall be thoroughly familiar with the equipment before being allowed to operate it without supervision. **(T-1)** Proper hearing, respiratory and eye protection shall be provided and used, when required by BE or

Occupational Safety. **(T-1)** Consult with installation Occupational Safety office and BE on questions pertaining to PPE. Refer to **Chapter 14** for additional guidance on PPE requirements.

25.12.7. Sweepers. As with other construction equipment there is a great variety of street, airfield and combination sweepers in the Air Force inventory. All, however, share some common traits in that they are noisy, can create great quantities of dust and have extremely poor rearward visibility. In vehicles equipped with air conditioning, dust is less of a factor. In vehicles without air conditioning, respiratory protection may be required. If not already evaluated, contact BE for an occupational and environmental health risk assessment. Sweepers operating on the airfield shall be radio-equipped and will have the headset-type radio due to the high volume of noise from the rear engine and blower. **(T-1)** When operating on active airfields, these vehicles shall be in direct contact with the control tower or escorted by a vehicle that is in contact with the control tower. **(T-1)** Extreme caution shall be exercised when backing this equipment; the use of a spotter is mandatory. **(T-1)** Hearing protection shall be worn when required. **(T-0)**

25.12.8. Rollers. Self-propelled rollers are heavy equipment and are difficult to stop once put into motion. The operator shall be intimately familiar with the equipment, especially the turning arc and stopping distances. **(T-1)** When it is necessary to transport a roller over the road under its own power, its slow speed can present a hazard to other vehicle operators. Supervisors will attempt to make all such movements during non-peak traffic periods. **(T-1)** Since few rollers are equipped with lights, movement during periods of reduced visibility shall be avoided unless escort vehicles are provided front and rear. **(T-1)**

25.12.9. Concrete Saw. Personnel will stay clear of the front and blade operating side of the saw during operation. **(T-1)** Cutter blades will be in good condition and not excessively worn, warped or broken. **(T-1)** A good water supply shall be maintained to cool the cutting blade. Safety-toe shoes, goggles and hearing protection shall be worn during operation. **(T-1)** Contact BE for an occupational and environmental health risk assessment.

25.12.10. Pavement Breaker (Jackhammer). The tool shall always be worked away from the body. **(T-1)** Proper lifting techniques shall be used and personnel cautioned not to twist the upper body while moving the tool. **(T-1)** Sound footing shall be used and a firm grasp shall be kept on the tool at all times. **(T-1)** The operator and personnel in the hazard zone of the operating site will wear appropriate safety-toe shoes, goggles and hearing protection; the operator will wear gloves. **(T-1)** A respirator may be required when operations create dust. If process has not already been evaluated, contact BE for an occupational and environmental health risk assessment.

25.12.11. Router. Employees will keep their hands and feet clear of the cutting tool and maintain a firm grasp on the handle during operation. **(T-1)** Safety shoes, goggles, hearing protection and gloves shall be worn during operation. **(T-1)** All personnel exposed to hazards of the equipment will wear appropriate PPE. **(T-0)** Consult with installation Occupational Safety office and BE on questions pertaining to PPE. Refer to **Chapter 14** for additional guidance on PPE requirements.

25.12.12. Concrete Mixer. Employees will keep their hands and arms clear of moving parts of the mixer. **(T-1)** The mixer shall be supported in a stable position before operation. **(T-1)** The hopper shall not be overloaded since this could cause equipment damage as well as injury to

employees. **(T-1)** Safety-toe shoes, goggles and hearing protection shall be worn when operating or working near the equipment, when required, and BE-approved respiratory protection if heavy concentrations of airborne cement dust are created during operation. **(T-1)** Consult with the installation Occupational Safety office and BE on questions pertaining to PPE. Refer to **Chapter 14** for additional guidance on PPE requirements.

25.12.13. Concrete Spall Repairs Using Polymer. Polymers are used extensively on airfields because of their quick setting properties. Most are composed of two (2) separate components and are hazardous to mix and place. Manufacturer's recommendations shall be followed for safe handling. **(T-1)**

25.12.14. Joint Seal Kettle-Melter.

25.12.14.1. Kettles shall not be operated without installation FES Flight approval. **(T-1)** A permit shall be obtained at least two (2) working days prior to the placement of the tar kettle. **(T-1)**

25.12.14.2. Serious burns can result from improper operation. Clothing that is loose fitting shall be worn. **(T-1)** Pants will completely cover the legs to below the tops of shoes. **(T-1)** Shirts shall be long sleeved. **(T-1)** Loose-fitting gloves shall be worn. **(T-1)**

25.12.14.3. Safety-toe shoes and a face shield shall be worn. **(T-0)** The operator and personnel handling the heated kettle product will wear face shields and gloves. **(T-0)** All tripping hazards shall be removed from the vicinity of the worksite. **(T-1)**

25.12.14.4. Containers shall not be overfilled and shall be allowed sufficient room for the bitumen (tar) to slosh without spilling when the container is moved. **(T-1)**

25.12.14.5. Appropriate number and type of fire extinguishers shall be kept near the kettle. **(T-1)**

25.12.14.6. When adding bituminous or joint sealant materials to the kettle, the product shall be eased into the kettle to prevent splashing of heated materials on the operator. **(T-1)** The kettle shall be watched closely and the products not heated above the safe heating temperature specified by the product manufacturer. **(T-1)**

25.12.14.7. Employees will never use direct heating of the materials. **(T-1)** No open flame or source of ignition shall be permitted near an asphalt material that is heated to a temperature near its flash point. **(T-1)** Wherever heating kettles are in use, the temperature of the product shall be controlled by thermostatic devices or checked at frequent intervals with an accurate thermometer to prevent overheating. **(T-1)** **Warning:** Gasoline or other highly volatile solvents shall never be used for cleaning. **(T-1)**

25.12.15. Pavement Grinders (Line Eradicator or Paint Scraper). Employees will keep their hands and feet clear of the cutting wheels. **(T-1)** The operator and personnel within the immediate work area will wear safety-toe shoes, goggles and hearing protection. **(T-0)**

25.12.16. Tampers. Employees will keep their hands and feet clear of the tamping tool. **(T-1)** A firm footing shall be maintained while using this equipment. **(T-1)** Safety-toe shoes and hearing protection are required when operating tampers. **(T-0)**

25.12.17. Pneumatic Drill. Safety-toe shoes, goggles and hearing protection shall be worn during operation. **(T-0)** A firm grasp will be maintained on the tool. **(T-1)** It shall be kept aligned with the hole to prevent binding. **(T-1)** The tool shall not be forced. **(T-1)**

25.13. Carpentry and Structural Maintenance.

25.13.1. Potential physical and health hazards can be effectively controlled by following proper work procedures and controls, and by using required PPE. **Figure 25.1** contains additional PPE guidance and information.) Prior to commencement of work, ensure personnel are not exposed to asbestos or lead-based paint. **(T-1)** Contact installation Environmental Management office and BE for asbestos and lead verification. **(T-1)** If lead or asbestos is found, contact BE for an occupational and environmental health risk assessment. **(T-1)**

25.13.2. General Carpentry.

25.13.2.1. Employees shall not leave a woodworking machine running unattended nor attempt to clear, clean, or repair the machine while it is operating. **(T-0)** When maintenance is necessary, the machine shall be completely shut down and its control switches locked and tagged in the "OFF" position according to instructions in **Chapter 21,** *Hazardous Energy Control.* **(T-0)** Supervisors shall ensure periodic inspections are accomplished on all shop equipment. **(T-1)** Chips or dust shall never be removed from machinery by hand. **(T-1)** Machine guards shall not be removed nor made inoperative except for authorized maintenance. **(T-0)** When guards are removed during machine repair, power control switches shall be locked in the "OFF" position and properly tagged. **(T-0)** The machine will remain locked until the guards are replaced. **(T-0)**

25.13.2.2. PPE worn while operating machinery, equipment and saws normally consists of eye protection, safety-toe boots and hearing protection. Other safety-related PPE include respirators and kneepads to protect the knees where employees must kneel while working. Refer to **Chapter 14** for additional guidance. Hard hats are required in lumber storage areas and on job sites where the potential exists for being struck by falling objects, e,g., roofing and construction materials. **(T-0)**

25.13.2.3. See general guidance that applies to both carpentry and structural maintenance work methods or tools. The following specific guidance applies to table saws:

25.13.2.3.1. Keep hands out of the line of cut when feeding table saws. Use a push stick when close to the blade. **(T-1)**

25.13.2.3.2. Adjust saw to expose the least amount of saw blade above table and material being cut. **(T-1)**

25.13.2.3.3. Always stand out of line of stock being ripped. **(T-1)**

25.13.2.3.4. Hold stock being cut against a gauge when cutting with a circular table saw. **(T-1)**

25.13.2.3.5. Always use the appropriate saw for the cut. For instance, it would be unsafe to rip with a crosscut saw or to crosscut with a rip saw. **(T-1)**

25.13.2.3.6. Avoid crosscutting long boards on a table saw. Normally, long stock may be crosscut on a radial arm saw. **(T-1)**

25.13.2.3.7. Never adjust the saw or fence gauge while the saw is operating. Designate the line of cut on the table top with a permanent mark when setting the gauge of a table saw without removing the guards. **(T-1)**

25.13.2.3.8. Always use a brush or stick to clean or scrape sawdust from a saw. **(T-1)**

25.13.3. Ventilation Systems.

25.13.3.1. Ventilation. Only essential safety, fire prevention and occupational health requirements are addressed in this standard. Contact BE for specific guidance, including information on flow rate requirements. Ventilation and exhaust systems shall be installed and maintained IAW the manufacturer's instructions. **(T-1)**

25.13.3.2. Application. Machines that develop fine dust or other airborne contaminants shall be equipped with effective industrial exhaust ventilation. **(T-1)** In shops where small numbers of installed machines are not continuously in operation, portable collection systems may be used. Hoods and exhaust systems shall be constructed and installed to meet requirements in American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance*. **(T-0)** Refer to **Chapter 11** for additional guidance.

25.13.3.3. Exhaust Ducts and Pipes. These shall be constructed and sized to minimize clogging and shall discharge into an enclosed container. **(T-1)**

25.13.3.4. Refuse. Refuse shall be removed daily in all operations not required to have an exhaust system or where the refuse cannot be handled by an exhaust system. **(T-1)**

25.13.4. Storage and Handling of Lumber.

25.13.4.1. Storage areas for lumber and other building materials can be hazardous. For example, when lumber is stored upright, precautions shall be taken to prevent it from falling into aisles or passageways. **(T-1)** Lumber stored in tiers shall be stacked, blocked and interlocked. **(T-1)** The stacks shall be limited in height so they are stable and secure against sliding or collapse. **(T-1)** Storage areas shall be kept free of accumulations of materials that constitute tripping, fire or explosion hazards. **(T-1)** Smoking shall not be permitted in outside or inside storage areas, and signs to this effect shall be posted. **(T-1)** Refer to AFJMAN 23-210, *Joint Service Manual (JSM) for Storage and Material Handling*, for specific storage requirements.

25.13.4.2. When heavy stock cannot be safely handled by employees, suitable mechanical lifting devices shall be used. **(T-1)**

25.13.4.3. Gloves shall be worn to reduce injury potential to the hands from splinters or from being pinched between stacks. **(T-1)** Accidental movement of stacked material can cause serious injuries. **(T-1)** Caution shall be taken not to disturb other tiers when removing partial stacks. **(T-1)**

25.13.4.4. Manual handling is relatively safe if proper lifting and carrying positions are used. Balanced handling is the key to safe handling. However, disregard of accepted safe practices can result in injuries such as hernias, back strains, crushed hands and feet, broken bones and severe lacerations.

25.13.5. Roofing Operations.

25.13.5.1. Roof work, because of its nature and the environment, has a high mishap potential. Pre-planning, refresher employee training, pre-job briefings and following required safeguards can prevent mishaps. Prior to commencement of work, ensure personnel are not exposed to asbestos. **(T-1)** Contact the installation Environmental Management office and BE for asbestos verification. If asbestos is found, contact BE for an occupational and environmental risk assessment.

25.13.5.2. Roofing materials shall be segregated by type and size in stable stacks that are safe from falling. **(T-1)**

25.13.5.3. Ladder requirements are included in **Chapter 7.** Chicken ladders or crawling boards shall have cleats spaced at equal intervals not to exceed 24 inches. **(T-1)**

25.13.5.4. Employees engaged in roofing activities on low-slope roofs (a roof having a slope less than or equal to 4 in 12 [vertical to horizontal]), with unprotected sides and edges 4 feet or more above lower levels shall be protected from falling by guardrail systems, safety net systems, personal fall arrest systems or a combination of warning line system and guardrail system, warning line system and safety net system, warning line system and personal fall arrest system, or warning line system and safety monitoring system. **(T-0)** Scaffolding and fall protection systems shall be inspected daily and/or prior to use by the supervisor. **(T-0)** Inspections shall be documented, signed by the supervisor and maintained on the job site at all times. **(T-0)** On roofs 50 feet or less in width, the use of a safety monitoring system alone (i.e., without the warning line system) is permitted. Employees on a steep roof with unprotected sides and edges four feet or more above lower levels shall be protected from falling by guardrail systems with toe boards, safety net systems or personal fall arrest systems. **(T-0)** Proper PPE is identified in **Chapter 14** and **Figure 25.1** Additional guidance on fall protection may be found in **Chapter 13** and 29 CFR 1926.501.

25.13.5.5. Additional guidance on scaffolding is included in **Chapter 17,** *Scaffolding*. Refer to 29 CFR 1926.451, *Scaffolds, General Requirements*, and 29 CFR 1926.500, *Fall Protection Scope, Application and Definition Applicable*, for additional guidance.

25.13.5.6. To avoid splashing, asphalt and drip-dried material pieces shall be slipped rather than pitched into kettles containing melted bitumen. **(T-1)**

25.13.5.7. Employees shall not stand or work below any hoisted materials or hot substances. **(T-1)**

25.13.5.8. All housekeeping standards shall be followed to prevent injuries to employees and others who may pass near the roofing work site. **(T-1)** Unsupervised open-flame devices, improper storage, and improper disposal of waste materials may cause a fire. Contact the installation Environmental Management office for proper disposal guidelines.

25.13.5.9. PPE will consist of eye and face protection, foot and leg protection, proper clothing and gloves, and hard hats for working with hot or cold application roofing maintenance or where overhead work is being performed. **(T-1)** If process not already evaluated, contact BE for an occupational and environmental health risk assessment. Refer to **Chapter 14** and **Figure 25.1** for additional PPE information.

25.13.5.10. Tar kettles and pots, when used, shall be located so they shall not be a fire threat to surrounding buildings or other structures. **(T-1)** When in operation, tar kettles and pots shall not be left unattended for extended periods of time, due to the possibility of fire. **(T-1)** After use of the kettle, heavy tar buildup shall be cleaned from plumbing pipes. **(T-1)** Refer to paragraph **25.12.14.1** for permit requirements. Additional information can be found in National Fire Protection Association 241, *Standard for Safeguarding Construction, Alteration and Demolition Operations*.

25.13.6. Masonry.

25.13.6.1. Mixing Concrete and Mortar. Mixing concrete and mortar, whether performed manually or by motorized mixers, is a very strenuous and often hazardous operation. During the operation, masonry shop employees will come in contact with Portland Cement. Employees will use every means possible to prevent inhalation, ingestion, or body contact with cement dust. **(T-1)** Portland Cement will cause chemical burns and rashes when it comes in contact with parts of the body. Portland Cement can seep inside employee's shoes. Generally, once detected, feet and toes have already suffered permanent damage, and the employee may require hospitalization. Protective clothing and boots shall be worn when mixing concrete and mortar. **(T-1)** If process not already evaluated, contact BE for an occupational and environmental health risk assessment. Shop supervisors shall train new employees in the proper techniques for mixing and handling concrete and mortar. **(T-1)**

25.13.6.2. Brick and Concrete Block Work. Brick and concrete block operations include carrying brick, concrete or cinder block and mortar on the job site as well as putting them in place. Shop supervisors will ensure proper lifting and carrying techniques are used. **(T-1)** They will also ensure employees raise or lower needed tools and materials by handlines after reaching the work position. **(T-1)** No tools or materials will be carried at no time while ascending or descending ladders. **(T-1)** Tools and materials may be transported by scaffold as long as load capacity is not violated.

25.13.6.3. Cleaning and Etching Old and New Brick and Concrete Work. As a part of brick and concrete work, masonry employees may be required to clean or etch old and new work. Some agents used in this operation contain tri-sodium phosphate, muriatic acid and potassium or sodium hydroxide. Tri-sodium phosphate shall not come into contact with aluminum as hydrogen gas may form and cause an explosive hazard. **(T-1)** Shop personnel shall be aware of the hazards associated with this work. **(T-1)** Employees, when diluting muriatic acid, will never add water to the acid; they will always add the acid to water. **(T-1)** Proper PPE shall be worn. Refer to **Figure 25.1** for additional guidance.

25.13.6.4. Fiberglass Work. When repairing fiberglass components such as tanks, bathtubs, shower stalls and lavatories, employees may be exposed to fiberglass filler, epoxies, resins, accelerating agents and ketones or acetone. Employees shall be aware of fire hazards associated with mixing epoxies and resins with accelerating agents and ketones. **(T-1)** Employees shall be aware that ketone mixers are highly toxic and narcotic and could result in dizziness and nausea if inhaled. **(T-1)** The supervisor will consult with BE to ensure employee exposure is monitored and appropriate respiratory protection requirements are established. **(T-1)** Refer to **Chapter 33,** *Composite Materials,* for additional guidance.

25.13.6.5. Storage and Handling of Sand, Grout, and Cement. Sand and aggregate materials are often delivered in bulk form for shop use. Sand shall be covered to prevent it becoming wet during inclement weather. **(T-1)** Also, grout and cement shall be kept in a dry place to prevent hardening. **(T-1)** Employees shall wear the proper respiratory protection (as required), eye protection, clothing, and shoes when handling cement and grout compounds. **(T-1)**

25.13.6.6. Care and Use of Power Mixers and Trowels. Cement mixers are operated with electric or gasoline motors or engines and are chain or belt driven. Gears, pulleys, chains or belts on power mixers shall be guarded to prevent employees being caught in them. **(T-1)** The power source for electrically operated mixers shall be grounded. **(T-1)** Power cords shall not be allowed to fray or break, exposing bare wires. **(T-1)** The area surrounding electrically operated mixers shall be kept as dry as possible to prevent electrocution of the operator if an electrical malfunction occurs. **(T-1)** Employees will not smoke during refueling operations on those mixers operated by gasoline engines. **(T-1)** Hot engines shall not be refueled until they cool. **(T-1)** All mixers shall be thoroughly cleaned after each use. **(T-1)** Powered trowels or screens used to compact and smooth concrete shall be cleaned after each use and inspected for damage and serviceability prior to each use. **(T-1)**

25.13.6.7. Preparation of Footings. Precautions that shall be taken by employees prior to pouring footings include:

25.13.6.7.1. Identifying the location of underground utilities such as gas, electric or water. **(T-1)**

25.13.6.7.2. Study pre-excavation conditions such as soil conditions and hydrostatic pressure to evaluate changes that might occur or situations that might develop. **(T-1)** Generally, masonry shop employees will not arrive at the job-site to pour footings until all preparations have been made. **(T-1)** They shall be made aware of existing hazards prior to pouring footings. **(T-1)**

25.14. Protective Coating Maintenance.

25.14.1. General Requirements. Interior spray, airless and electrostatic painting facilities and requirements are addressed in **Chapter 28,** *Interior Spray Finishing*. Refer to **Figure 25.1** and **Chapter 14** for additional PPE information. Ventilated lockers for clothing and shower facilities located separately from the shop shall be provided. **(T-1)**

25.14.2. Occupational Health and Toxic Materials.

25.14.2.1. Pigments, Extenders and Fillers. The dry constituents of paints such as pigments, extenders, and fillers shall be handled carefully in receiving and storage areas as well as in product formulations to prevent overexposure of employees to airborne dusts. **(T-1)** Spills shall be promptly cleaned up before the material is spread throughout the area. **(T-1)** If during the addition of the pigments or extenders employees could be overexposed to toxic dusts, controls shall be instituted. **(T-1)** If process not already evaluated, contact BE for an occupational and environmental health risk assessment. All inorganic pigment should be considered as potentially toxic. These hazards may exist in application of new paint, and in removal of old paint.

25.14.2.1.1. Special care shall be given to avoid overexposure of employees when pigments containing lead and metallic chromates (corrosion inhibitors), cadmium, copper or cobalt are used. **(T-1)** Contact installation Environmental Management office for environmental concerns. If process not already evaluated, contact BE for an occupational and environmental health risk assessment.

25.14.2.1.2. Arsenic and mercury compounds used in anti-fouling marine paints shall be handled carefully. **(T-1)** Employees may inhale these materials, and if good personal hygiene is not observed, employees may ingest significant amounts through contact of dirty hands with food or cigarettes.

25.14.2.1.3. Extenders or fillers such as silica, asbestos, talc or mica, when breathed in excessive amounts, will cause fibrosis in the lungs. Symptoms from overexposure to silica may not appear for 10 or more years depending on exposure levels and duration.

25.14.2.1.4. Asbestos extenders or fillers shall not be used. **(T-1)**

25.14.2.1.5. Fillers containing talc or mica, although not as hazardous as free silica or asbestos, can also lead to lung damage. Employee exposure shall be controlled. **(T-1)**

25.14.2.1.6. A pigment such as titanium dioxide or a filler such as gypsum is considered a “nuisance” dust. Dust levels must be controlled to ensure good visibility, prevent eye irritation and prevent lung deposits. **(T-1)**

25.14.2.2. Organic Solvents. Organic solvents are widely used in painting. Solvents are used to suspend pigments, dissolve film-forming oil materials and as thinners to dilute paints and reduce paint viscosity. All organic solvents have some effect on the central nervous system and the skin. The principal modes of exposure are inhalation of vapors and skin contact. Some solvents can be absorbed through the intact skin and migrate to the bloodstream. Excessive solvent vapor inhalation may cause impairments that have no discernible permanent effects on health, such as lack of coordination and drowsiness, but which may increase the risk of accidents. In other cases, exposure may result in serious damage to the blood, lungs, liver, kidneys and gastrointestinal tract. Supervisors will acquaint themselves and their employees with the properties and hazards of the solvents they use. (T-0) Skin contact with solvents may cause dermatitis, ranging in severity from a simple irritation to actual damage to the skin. Even the most inert solvents can dissolve the skin’s natural protective barriers of fats and oils, leaving the skin unprotected. When these natural lubricants are removed, the skin becomes subject to disabling and possibly disfiguring dermatitis and infection.

25.14.2.3. Measures to control exposures to solvents include substitution of a less toxic solvent, mechanical exhaust ventilation and use of protective clothing. Substitution of a less toxic or less volatile solvent is effective in controlling solvent exposure and reducing the hazard potential. However, this control method is more easily instituted when the actual function of the solvent is less specific than it is in paint formulating, such as in metal cleaning or degreasing operations. Substitution of a material or product should be accomplished when the replacement material or product would significantly reduce or eliminate risk to employee health and safety. The use of closed systems and local exhaust ventilation is an effective way of preventing solvent vapors from entering the employees’ breathing zone. Containers of flammable solvents shall be covered when not in use. **(T-1)**

Local exhaust ventilation can remove vapors at their point of origin and thus prevent toxic concentrations in the workplace. If good personal hygiene is not observed, employees may ingest significant amounts of toxins through contact of dirty hands with food or cigarettes. The skin should always be protected from contact with solvents. Gloves, face shields, goggles and other protective clothing may be used. Do not wash skin with any raw organic solvent. Although some solvents are less toxic than others, good safety practices dictate that care be exercised when using any organic solvents.

25.15. Plumbing Maintenance.

25.15.1. Plumbing maintenance normally includes the installation, preventive maintenance and repair of water supply systems, sewage and water disposal systems, natural, liquefied petroleum gas or other gas supply systems (to include gas appliances) and oxygen supply systems. Hazards encountered during plumbing maintenance include, but are not limited to, entry into an oxygen-deficient atmosphere (enclosed area or confined space), fire or explosion by introducing an ignition or flame source into a hazardous environment, falls, cave-in of excavated area, burns from heat-producing equipment, strains and sprains of the back or other muscle group, cuts and bruises. Working in confined spaces, handling heavy and awkward materials, being subjected to numerous obstructions in limited working space and health related hazards are conducive to mishaps. Plumbing maintenance employees shall be knowledgeable of these hazards and conditions and take reasonable actions to prevent mishaps before they occur. **(T-0)** Refer to **Chapter 23** for confined space entry procedures and requirements.

25.15.2. Personal Protective Equipment. Ventilated clothing lockers shall be provided and shower facilities will be separated from the shop. **(T-0)** Refer to **Figure 25.1** and **Chapter 14** for additional PPE guidance.

25.15.3. Hot Operations.

25.15.3.1. Torches and Furnaces. Work and storage areas for this equipment shall be well ventilated. **(T-0)** Refer to **Chapter 27,** *Welding, Cutting, and Brazing,* **Chapter 18,** *Hydrocarbon Fuels,* National Fire Protection Association 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes,* and **Chapter 22,** *Flammables and Combustibles,* for additional information.

25.15.3.1.1. No one shall be permitted to use a torch or furnace until trained on its use and familiar with the operating instructions. **(T-1)**

25.15.3.1.2. Where flammable or explosive vapors or dust may be present, torches and furnaces shall not be used until the atmosphere has been tested and the sources of such vapors or dust removed. **(T-1)**

25.15.3.1.3. Gasoline blowtorches and furnaces shall not be used in small, unventilated spaces since they could cause explosions or create an oxygen deficient atmosphere. **(T-1)** Acetylene gas shall never be brought in contact with metal powders such as copper or silver as the combination may react with explosive atmospheres. **(T-1)**

25.15.3.1.4. Heating pots shall be placed on non-combustible surfaces and heated slowly to prevent overflow or ignition of material in them. **(T-1)** Material shall be broken into small pieces before being placed into heat pots. **(T-1)**

25.15.3.1.5. Combustible materials in locations where torches or furnaces are used shall be protected or kept far enough away to prevent being subjected to sparks or dangerous temperatures. **(T-1)** Appropriate type fire extinguishers shall be available. **(T-1)** Refer to **Chapter 27** for additional requirements and necessary permit(s).

25.15.3.2. Soldering and Brazing. Soldering and brazing is the joining of metal parts by melting a fusible alloy. When solders used have a melting point above 800° F, the procedure is called brazing.

25.15.3.2.1. The concentration of toxic fumes and irritants at the breathing level of the operation shall be checked. **(T-1)** Where required because of toxic fumes, a respirator or adequate ventilation shall be provided. **(T-1)** Lead-tin, zinc, silver, cadmium and antimony- tin solders can pose moderate to serious health hazards. If welding, soldering and brazing operations have not been evaluated, contact BE for an occupational and environmental health risk assessment.

25.15.3.2.2. Electric soldering irons shall be grounded unless of double-insulation construction. **(T-1)** All soldering irons shall be placed in suitable non-combustible receptacles when not in use. **(T-1)**

25.15.3.2.3. When required, an AF Form 592, *USAF Hot Work Permit*, shall be obtained for these operations. **(T-1)** Refer to **Chapter 27** and **Table 27.2** for additional information.

25.15.3.2.4. Appropriate safety eyewear shall be worn during all soldering and brazing operations. **(T-0)**

25.15.4. Gas Systems. Maintenance of gas systems includes natural gas, liquefied petroleum gas, oxygen, nitrogen or nitrous oxide. Shop personnel shall be familiar with the properties of gases in the systems they maintain. **(T-1)** Until proven otherwise, all escaping gases shall be considered flammable. Prior to entering an area where a gas leak is suspected, the area shall be properly vented and purged of existing gas. Personnel entering the area shall be suited with proper protective equipment and respiratory protective devices. **(T-1)** Consult with installation Occupational Safety office and BE with questions pertaining to PPE. Refer to **Chapter 14** for additional guidance. For oxygen-deficient atmospheres, supplied air systems with a special emergency escape air supply are required and shall be used. **(T-0)** Tools used to repair leaks in or perform maintenance on gas lines shall be spark-free and protective clothing shall be static-free. **(T-0)** When working on oxygen dispensing lines, employees will not use tools and equipment coated with flammable or combustible lubricating substances or grease.

25.15.5. Tunnels, Pits and Sumps.

25.15.5.1. Where shop personnel are required to work in utility tunnels, pits and sumps, the atmospheric conditions shall be checked for explosive atmosphere or oxygen deficiency before allowing employees to enter. **(T-0)** Personnel shall be suited with proper protective equipment and respiratory protective devices, when required, while performing maintenance to underground utilities. **(T-0)** Consult with the installation Occupational Safety office and BE on questions pertaining to PPE. Refer to **Chapter 14** for additional guidance on PPE. All tunnels, pits or sumps known to be contaminated shall be tagged or otherwise identified for work crews. **(T-1)** Employees shall be assigned in pairs for work on underground utilities. **(T-1)** All known contaminated tunnels, pits and sumps shall be

ventilated while work is in progress. **(T-0)** Smoking or open flames shall never be permitted in or around known or suspected contaminated tunnels, pits or sumps. **(T-0)** Spaces determined to be permit required confined spaces shall be entered under all provisions addressed IAW **Chapter 23**. **(T-0)**

25.15.5.2. When manhole covers are removed, barriers shall be installed to prevent injury to personnel not associated with the work in progress. **(T-0)**

25.16. Refrigeration and Air Conditioning Maintenance.

25.16.1. Potential hazards include hazardous noise, electrical hazards, exposure to refrigerants (possible asphyxiation if in enclosed areas or confined spaces), frostbite, lifting hazards, and compressed gases and cylinders. **Figure 25.1** contains additional guidance regarding PPE.

25.16.2. General Requirements.

25.16.2.1. Equipment rooms (e.g., where air conditioning equipment is installed) shall be kept free and clear of all trash and clutter. **(T-1)** Provide guards or shields for refrigerant hot or cold gas piping or moving parts.

25.16.2.2. All belts, pulleys and rotating shafts shall be guarded to prevent accidental contact. **(T-1)** Large valve handle stems shall be marked (color coded) for easy recognition. **(T-1)**

25.16.2.3. Electrical parts of the equipment and controls will have all covers and plates in place. **(T-1)** Wiring shall be properly secured to the equipment or structure. **(T-1)** Exposed metal surfaces shall be grounded IAW *National Electrical Code,* Article 250. **(T-0)**

25.16.3. Storage and Handling.

25.16.3.1. The rules above apply to all refrigeration and air conditioning maintenance work centers that use and store compressed gases.

25.16.3.2. Cylinders shall be legibly marked with the type of gas contained and stored with minimum intermingling of types of refrigerant and shall be stored separately from flammable gases and oxygen. **(T-0)**

25.16.3.3. Where caps are provided for valve protection, they shall be kept in place at all times until the cylinder is actually in use. **(T-0)** Valves shall be closed and valve caps will be secured except when in use. **(T-0)**

25.16.3.4. Cylinders are used only to contain gas.

25.16.3.5. Non-refillable containers shall not be refilled with any material after use of the original contents. **(T-1)** Containers shall be disposed of according to the manufacturer's or filler's instructions, or by the directions provided from the installation Environmental Management office. **(T-1)**

25.16.3.6. Cylinders shall never be lifted by the valve. **(T-1)** Cylinders shall not be suspended by chains, ropes or slings unless the manufacturer has provided appropriate attachment points. **(T-1)**

25.16.3.7. Storage areas shall be legibly marked with the names of gases being stored. **(T-1)** Full cylinders and empty cylinders shall be segregated and full ones arranged so the oldest stock can be removed first with a minimum of handling. **(T-1)** The storage area shall

be kept as dry as possible and away from exposure to salt or other corrosive chemicals or materials. **(T-1)** Cylinders shall be secured by a metal securing device or rack specifically designed to prevent damage. **(T-1)**

25.16.3.8. The rules below apply to all refrigeration and air conditioning maintenance work centers that use and store compressed gases.

25.16.4. Fluorocarbons. Fluorocarbons are relatively inert, in general nonflammable (in all concentrations in air under ordinary conditions) and low in toxicity. Hot work shall never be performed on charged systems. **(T-1)** Fluorocarbon vapors are all much heavier than air and tend to collect in low areas, thus possibly displacing available air. The vapors undergo decomposition when drawn through a flame or on contact with very hot surfaces. Decomposition products include hydrogen fluoride and hydrogen chloride and, perhaps, small quantities of carbonyl compounds such as phosgene. The halogen acids are both toxic and intensely irritating to the nose and throat with the irritating action readily noticeable before hazardous levels are reached. If such a situation develops, the affected areas should be vacated, the heat source and leak eliminated, and the area well ventilated before resuming work.

25.17. Heating Systems and Central Heating Plant Maintenance.

25.17.1. Steam Piping and Valve Maintenance.

25.17.1.1. All four (4) inch and larger steam valves or main steam valves to any building shall be operated only by qualified heat systems personnel. **(T-1)**

25.17.1.2. High-pressure steam valves located in enclosed areas or confined spaces shall not be turned closed until the area is completely protected against the release of steam into the area or space by such means as a double block and bleed system. **(T-1)** Double block and bleed requires the closure of a line, duct or pipe by closing two inline valves and by opening a drain or vent valve in the line between the two closed valves.

25.17.1.3. When a valve in a confined space or enclosed area is to be opened, the operator will close the main valve at the steam plant before opening the steam valve in the enclosed area or confined space. **(T-1)** The operator will ensure all pressure has been bled off prior to opening the steam valve. **(T-1)** The operator shall ensure the potential for hazardous release of steam is rendered safe before opening the steam valve. **(T-1)**

25.17.1.4. Routine operations, maintenance and repair in steam pits and other enclosed areas or confined spaces may be accomplished on electric circuits, controls, motors, pumps, receivers, condensate lines and vent fans while steam pressure is in the steam line, providing conditions and temperatures are acceptable. However, no operational changes, repair or maintenance shall be accomplished on steam lines while there is steam pressure on the lines. **(T-1)**

25.17.1.5. Operating personnel will open drain valves and remove water from the steam line prior to opening a high-pressure steam valve. **(T-1**) They will familiarize themselves with the location of these drain valves to ensure water accumulations are drained from the distribution lines. **(T-1)**

25.17.1.6. When bypass lines and valves are installed around a high-pressure steam valve, the bypass valve shall be opened first. **(T-1)** When the steam line becomes heated or the

steam pressure equalized on both sides of main steam valve, the main steam valve may then be opened.

25.17.1.7. All high-pressure steam valves shall be opened very slowly, and personnel will remain at a safe distance while valve positions are being changed. **(T-1)**

25.17.1.8. When dismantling a valve (removing bonnet, etc.) for maintenance, the employee will ensure pressure has been relieved through all possible means. **(T-1)** The valve body shall be checked for a removable plug to relieve pressure. **(T-1)** Bolts shall be carefully removed. **(T-1)** Personnel will never position their body over the valve or in line with the direction of travel, in case the bonnet blows. **(T-1)** Many locations (boilers, steam pipes, etc.) associated with heating systems and central heating plants may have material containing asbestos present. BE shall be consulted on all planned asbestos projects and shall be immediately notified upon discovery of suspected or confirmed asbestos during a project or suspension of work due to asbestos. **(T-1)** For further guidance, consult AFI 32-1068, *Heating Systems and Unfired Pressure Vessels*, and AFI 32-1067, *Water Systems.*

25.17.2. Vaults, Manholes and Tanks.

25.17.2.1. All confined spaces and enclosed areas shall be considered hazardous and shall not be entered until tested for oxygen amount, and flammable or toxic atmosphere by BE or other qualified individual. **(T-0)** Refer to **Chapter 23** for confined space entry requirements.

25.17.2.2. Atmospheres containing 19.5 percent or less oxygen by volume shall not be entered without the use of an air-supplied respirator approved by BE. **(T-0)**

25.17.2.3. Only manhole cover hooks or other methods approved for this purpose shall be used when removing or replacing manhole covers. **(T-1)** When replaced, the covers shall be properly seated. **(T-1)** The bearing surfaces shall be free from dirt or ice that might prevent proper seating of the cover. **(T-1)**

25.17.2.4. Personnel will enter and leave manholes or vaults only by means of a ladder or built-in rungs; they shall not step on cables, cable hangers or pipes. **(T-1)**

25.17.2.5. When a manhole or vault is open, at least one member of the crew shall be stationed at the surface to act as a safety observer and take appropriate actions in case of emergency. **(T-0)** When manhole covers are removed, install barriers to prevent injury to personnel not associated with the hazard. **(T-0)**

25.17.2.6. Cool vests or other heat-reducing equipment shall be made available to employees who enter vaults or manholes under high heat conditions, e.g., steam leak repair. **(T-1)**

25.18. Water and Wastewater Treatment.

25.18.1. Employees involved in operation and maintenance of water and wastewater treatment systems are exposed to many potential, but controllable hazards. Most mishaps can be prevented through a complete and ongoing training program, specific operating procedures, emergency operating procedures and being knowledgeable of unsafe chemical reactions. Mishaps can result from falls, improper lifting, electrical shock, not using protective equipment while handling chemicals, hazardous chemical reactions and asphyxiation from oxygen-deficient atmospheres (19.5 percent or less oxygen by volume). Other mishaps can be caused

by ignition of flammable or explosive gases; hazards around open excavations; falls into water pits or lagoons; getting caught in moving mechanical parts; striking obstructions; improper use of hand or portable tools, equipment or vehicles; and exposure to toxic or harmful organisms. Refer to **Chapter 23** for confined space entry requirements.

25.18.1.1. Explosive Gases. The most common sewer gases are methane, carbon monoxide and hydrogen sulfide. These gases, when mixed with air and a spark, can explode with great force. Such explosions are most common and dangerous in confined spaces such as tanks, underground lift stations or manholes. Hydrogen sulfide is generally encountered more frequently in wastewater systems than any other hazardous gas. In light concentrations, it has a foul odor similar to rotten eggs. After continued exposure, hydrogen sulfide will over-stimulate the olfactory sensors and will no longer register as an odor. It is heavier than air and usually collects in low areas. Methane is lighter than air and will escape with proper ventilation. Closed tanks and tight rooms are the greatest danger areas. They shall be tested for oxygen and methane or hydrogen sulfide with approved meters. **(T-0)**

25.18.1.2. Oxygen Deficiency. Oxygen deficiency (19.5 percent or less oxygen by volume) is a major hazard in wastewater collection systems and treatment plants. Some gases, both explosive and non-explosive, are heavier than air and settle into low spots and physically displace oxygen. Ambient air shall be tested for oxygen deficiency with approved equipment. **(T-0)** Required procedures and methods shall be used when entering system components suspected to be oxygen deficient. **(T-0)**

25.18.1.3. Toxic and Hazardous Chemicals. Many different chemicals are used in water and wastewater treatment. Due to the large number of chemicals and the diverse processes in which they are used, it is not possible to list all chemical hazards in this standard. Additionally, with the nature and number of chemicals, and their by-products that may be encountered, supervisors should conduct a JHA or other hazard or risk assessment, and, when necessary, develop operating instructions or written guidance for operations involving their use. Exposure to such substances can result in burns, rashes, nausea, loss of eyesight, damage to vital organs, fatal poisoning and various other conditions. Extreme care shall always be taken when working with chemicals to prevent accidental injury to employees. **(T-1)**

25.18.1.4. Chemical Treatment Processes. Chemical treatment processes can pose hazardous situations for employees exposed to the various chemicals during handling, operations and maintenance. Due to the potential adverse health effects caused by inhalation of toxic hazardous materials, use of approved respiratory protection is often required in addition to atmospheric monitoring to ensure safe work conditions are maintained.

25.18.1.5. Federal and some state agencies set exposure limits to protect employees against exposure to hazardous substances. The Air Force incorporates the most appropriate limits as the occupational and environmental exposure limits. Occupational and Environmental Exposure Limits are the Air Force limits on the amount or concentration of a substance in air. Occupational and Environmental Exposure Limits may also contain a skin designation. Contact BE for questions related to Occupational and Environmental Exposure Limits.

25.18.1.6. Occupational and Environmental Exposure Limits are usually based on an 8-hour time weighted average exposure. BE determines compliance with Occupational and Environmental Exposure Limits through quantitative measurements and/or professional judgment. Supervisors that need assistance complying with Occupational and Environmental Exposure Limits should contact BE.

25.18.1.7. Areas where chemicals are present may become immediately dangerous to life and health (IDLH) because of deficient facility design, location, or equipment malfunction. Each IDLH area will have a means of emergency contact available to personnel working in the area. **(T-1)** Either a telephone shall be located immediately outside the IDLH area or radio contact capabilities shall be available while personnel are working in the IDLH area. **(T-1)** IDLH levels vary depending on the chemicals involved. If process not already evaluated, contact BE for an occupational and environmental health risk assessment. Some locations may require, as a minimum, the installation of a mechanical exhaust system that is turned on prior to entering the room (e.g., automated door interlocks). In addition, local regulations may require modern gas detection alarms in locations where some gases are used, i.e., where chlorine gas is used an alarm that activates when the gas reaches the Occupational and Environmental Exposure Limits may be required. Electronic gas detectors may also be used to sense hazards or exposures associated with ammonia, hydrogen sulfide, carbon monoxide, etc. Additional points to consider include:

25.18.1.7.1. Type of ventilation system, exhaust duct location (should be near floor), size of fan, air changes per hour, automatic fan operation and availability of make-up air.

25.18.1.7.2. Level of chemical use, quantity stored, location of gas cylinders or chemical containers, condition of equipment and accessibility of equipment.

25.18.1.7.3. Room location (e.g., above ground or below ground), room size, room layout and cross-ventilation.

25.18.1.7.4. Mishap history, safety factors, equipment handling problems and unique conditions.

25.18.1.8. Each chemical treatment room shall be evaluated by BE. Contact BE for an occupational and environmental health risk assessment. Follow the subsequent guidance related to IDLH:

25.18.1.8.1. If IDLH conditions exist:

25.18.1.8.1.1. Before entry into a potentially IDLH gaseous chemical treatment room, the person entering will ensure they have all required protective equipment, to include self-contained breathing apparatus. **(T-1)** IAW **Chapter 23,** an additional person shall be present with the proper rescue equipment, including self-contained breathing apparatus, to assist the other person in case of emergency. **(T-1)**

25.18.1.8.1.2. Any self-contained breathing apparatus shall be approved by BE as required by AFI 48-137, *Respiratory Protection Program.* **(T-0)**

25.18.1.8.1.3. The chemical treatment supervisor will develop written OIs covering emergency procedures. **(T-1)** Individuals shall be thoroughly trained in

use of the equipment. **(T-1)** Annual training shall be conducted and documented by the supervisor. **(T-1)**

25.18.1.8.1.4. Self-contained breathing apparatus shall be inspected at least monthly or more frequently IAW manufacturer guidelines. **(T-1)** A record shall be kept of inspection dates. **(T-1)**

25.18.1.8.1.5. The functional manager should program and install engineering controls when feasible.

25.18.1.8.2. If IDLH conditions do not exist:

25.18.1.8.2.1. An additional person standing by with a self-contained breathing apparatus is not necessary when entering a chemical treatment room not determined IDLH by BE.

25.18.1.8.2.2. Employees should take precautions to ensure exhaust ventilation is operating when the chemical treatment room door is opened. If any hazardous condition is suspected or detected, the employee will not enter the room or area. The situation shall be evaluated and managed the same as an IDLH condition. **(T-1)** Entry into the contaminated area shall only be conducted by properly trained and protected personnel. **(T-1)**

25.18.1.8.2.3. For additional guidance, refer to 29 CFR 1910.134, *Respiratory Protection*, AFI 32-1067, *Water Systems*, and AFI 48-137.25.18.2. Personal Sanitation and Protective Equipment.

25.18.2.1. Wastewater and sewage systems often contain disease causing organisms. Every employee will practice good personal hygiene. **(T-1)** Risk to occupational health and from physical mishaps are best reduced when a plant is kept clean. All personnel will comply with required periodic physicals and recommended vaccinations as determined by the local health authority. **(T-1)**

25.18.2.2. Gloves, boots and coveralls keep wastewater from contacting the skin. Rubber gloves are essential when there are scratches or open wounds on the hands. If employees come in direct contact with wastewater, they will scrub thoroughly with strong soap and hot water as soon as possible. **(T-1)** Running hot and cold water, strong soap, hand disinfectant and an adequate supply of disposable towels shall be maintained. **(T-1)** All employees will scrub well and disinfect hands before eating or smoking. **(T-1)** Emergency eyewashes or showers shall be provided IAW **Chapter 9. (T-1)**

25.18.2.3. PPE is required when loading, mixing or adding chemicals. Supervisors shall review the SDS for each chemical used and select PPE based on performance characteristics of the chemical protective equipment or clothing relative to the tasks performed, conditions present, duration of use and potential hazards identified. **(T-0)** Verify proper selection of PPE with BE prior to purchase. Refer to **Figure 25.1** for additional PPE guidance.

25.18.2.4. Food or drink preparation, eating, drinking or smoking shall be permitted only in authorized areas. **(T-0)**

25.18.2.5. Because of the possibility of contamination, change rooms equipped with storage facilities for street clothes and separate storage facilities for protective clothing shall be provided. **(T-1)**

25.18.3. Treatment Plant. The following items shall be accomplished to prevent or lessen effects of mixing incompatible hazardous chemicals. **(T-1)** Plans or OIs shall be developed for operations under emergency conditions to include, but not limited to, safe venting of toxic gases, neutralization, air sampling, evacuation of non-essential personnel and a respiratory protection program. **(T-1)** There must be prompt mishap notification of appropriate officials such as the FES Flight, BE, commanders, Occupational Safety office and others with technical knowledge or skill to help resolve emergencies. **(T-1)** The nature of the emergency and chemicals involved shall be documented and distributed as written notifications. **(T-1)** Supervisors shall ensure the following precautionary measures are adhered to for the plant components listed: **(T-1)**

25.18.3.1. Bar Screens and Racks.

25.18.3.1.1. All railings are firmly anchored. **(T-1)**

25.18.3.1.2. All screening in tight, easily-removed cans. **(T-1)**

25.18.3.1.3. Wash-down hoses are used to keep all screen deck areas clean. **(T-1)**

25.18.3.2. Shredding (Pulverizing) and Grinding.

25.18.3.2.1. All walkways are clean and free of grease. **(T-1)**

25.18.3.2.2. All power is turned off and locked out before servicing. **(T-1)**

25.18.3.2.3. All guards and screens are firmly in place. **(T-1)**

25.18.3.3. Pumping and Lift Station Maintenance Repair.

25.18.3.3.1. All power is switched off and locked out before servicing. **(T-1)**

25.18.3.3.2. Test for gas and oxygen if below ground level. **(T-1)**

25.18.3.3.3. Equipment removal hatches are not opened except during actual use, and then are fenced off. **(T-1)**

25.18.3.3.4. Positive displacement pumps are never started against a closed discharge valve. **(T-1)**

25.18.3.4. Wet Pits and Sumps.

25.18.3.4.1. All manhole safety steps are followed. **(T-10**

25.18.3.4.2. Test for gases and oxygen before entering. **(T-0)**

25.18.3.4.3. All chlorination equipment is turned off upstream and enough time allowed for ventilation. **(T-1)**

25.18.3.5. Grit Chamber.

25.18.3.5.1. All walking and working surfaces are clean and free of grease or oil. **(T-1)**

25.18.3.5.2. Tools are not hand-carried up or down a ladder; always use a bucket and rope, tool belt or pouch. **(T-1)**

25.18.3.6. Sedimentation Basin (Clarifier).

25.18.3.6.1. Non-slip surfaces are maintained on all ladders, stairs and catwalks. **(T-1)**

25.18.3.6.2. Firm rails are provided on inside of all walks. **(T-1)**

25.18.3.6.3. Employees never walk on sludge, but hose a path ahead. **(T-1)**

25.18.3.6.4. Employees wear protective overalls and non-skid rubber boots. **(T-1)**

25.18.3.6.5. Approved life vests with attached lifelines are provided at appropriate points around the clarifier. **(T-1)**

25.18.3.6.6. Employees cleaning an effluent weir wear safety harness, gloves, goggles and have a helper standing by. **(T-1)**

25.18.3.6.7. Guards are in place around all moving parts. **(T-1)**

25.18.3.7. Digester Equipment. Digester equipment locations are probably the most dangerous areas in any plant. Supervisors shall ensure:

25.18.3.7.1. Testing for explosive gas and oxygen. **(T-1)**

25.18.3.7.2. Sufficient ventilation is maintained. **(T-1)**

25.18.3.7.3. A backup helper is standing by. **(T-1)**

25.18.3.7.4. All valves on both sides of sludge pumps are completely closed before servicing. **(T-1)**

25.18.3.7.5. Below-ground pump room blowers are wired so ventilation is provided any time the pump is running. **(T-1)**

25.18.3.7.6. Spillage is avoided and, if it occurs, is cleaned up at once. **(T-1)**

25.18.3.7.7. Employees do not attempt to service radioactive element automatic sludge moisture meters. **(T-1)** Meters containing radioactive material may require an Air Force radioactive material permit IAW AFI 40-201. Contact the BE to determine if a permit is required.

25.18.3.8. Digester Tanks.

25.18.3.8.1. On start-up, completely fill the tank to overflow thereby preventing any air-gas mix in partly filled tank that would be explosive. **(T-1)**

25.18.3.8.2. Draw digested sludge at the same rate you add raw sludge to fixed roof digesters, thus preventing any vacuum or extinguishing of gas boilers. **(T-1)**

25.18.3.8.3. Maintain forced ventilation in all rooms and galleries. **(T-1)**

25.18.3.8.4. Test for gas and oxygen before entering any closed area. **(T-1)**

25.18.3.8.5. Always follow manufacturer's instructions in servicing boilers or heat exchangers. **(T-1)**

25.18.3.8.6. Ensure chamber is cleared before lighting the pilot. **(T-1)**

25.18.3.8.7. Ensure all electrical fixtures are explosion-proof. **(T-1)**

25.18.3.8.8. Always allow heat exchanger to cool before opening. **(T-1)**

25.18.3.8.9. Do not allow smoking anywhere around any digestion area equipment. **(T-1)**

25.18.3.9. Empty or Partially-Filled Digester Tanks. Empty or partially-filled digester tanks are especially dangerous and shall be treated with extreme caution. **(T-1)**

25.18.3.9.1. Always test for explosive atmosphere and oxygen deficiency before entering. **(T-0)**

25.18.3.9.2. Open all manholes and force heavy ventilation during the time anyone is working inside. **(T-0)**

25.18.3.9.3. Always have at least two (2) backup helpers standing by. **(T-1)**

25.18.3.10. Digested Sludge Storage Tanks.

25.18.3.10.1. Ensure all electrical equipment is explosion-proof. **(T-1)**

25.18.3.10.2. Ensure forced air ventilation is provided before entry and during the period of occupancy by employees. **(T-1)**

25.18.3.10.3. Ensure air relief valves are working during draw-off. **(T-1)**

25.18.3.10.4. Regularly check for flammable gases. **(T-1)**

25.18.3.10.5. Carefully control draw-off rate. Prevent surges. **(T-1)**

25.18.3.10.6. Always clean lines with water, never air. **(T-1)**

25.18.3.11. Sludge Gas Collection and Use Equipment.

25.18.3.11.1. Protect all gas lines from freezing weather. **(T-1)**

25.18.3.11.2. Use antifreeze in all water traps during freezing weather. **(T-1)**

25.18.3.11.3. Regularly check all points for gas leaks, using a meter or soapy water. **(T-1) Caution:** Never rely on odor to detect presence of sludge gas. **(T-1)**

25.18.3.11.4. Maintain positive gas pressure in all lines. **(T-1)**

25.18.3.11.5. Use enclosed dry type gas compressors, not water seals. **(T-1)**

25.18.3.11.6. Check gas boiler safety devices often, especially pilot cut off and blow back protection devices (flame arresters). **(T-1)**

25.18.3.11.7. When purging tanks of gas, open all manholes high and low and force ventilate from low ones. **(T-1)**

25.18.3.12. Trickling Filter.

25.18.3.12.1. Anchor (tie down) the rotary distributor before inspection or servicing. **(T-1)**

25.18.3.12.2. Walk carefully if necessary to get on filter media. Never allow equipment on the media. **(T-1)**

25.18.3.12.3. Regularly inspect under drains for solids buildup and collapsed drains. These conditions hinder ventilation and induce septicity, causing gas formation. **(T-1)**

25.18.3.12.4. Always provide a firm base off the media for the jack plate, if necessary, to lift distributors for servicing. **(T-1)**

25.18.3.12.5. Prohibit mercury seals on distributors because of hazards to operators and contamination of receiving waters. **(T-1)**

25.18.3.13. Aeration Tanks.

25.18.3.13.1. Provide guardrails for all work areas and walkways. **(T-1)**

25.18.3.13.1.1. Place approved life vests with attached lifelines at appropriate locations around aerator rails. **(T-1)**

25.18.3.13.2. Always center the test hoists used to service diffusers. **(T-1)**

25.18.3.13.3. Use a dry fixed ladder to enter a dry empty tank and be careful of slick sides and floor. Use a water hose and stiff bristled brush to keep the work area clean and to provide safe footing. **(T-1)**

25.18.3.14. Stabilization Ponds.

25.18.3.14.1. Maintain roads on top of levees with gravel or asphalt. **(T-1)**

25.18.3.14.2. Never work alone while mowing or clearing vegetation on berms (dikes) because of drowning hazard. **(T-1)**

25.18.3.14.3. Wear a life vest while working, inspecting or otherwise in a boat or raft on a pond. **(T-1)**

25.18.3.14.4. Always work from a sitting position in a boat, unless it is designed to be stable while working in a standing position. **(T-1)**

25.18.4. Manholes. The following safety precautions and procedures shall be observed:

25.18.4.1. Test for both oxygen deficiency and explosive gases with approved meters before entering. **(T-0)**

25.18.4.2. Remove cover with a special hook, never by hand. **(T-1)**

25.18.4.3. Place the cover flat and at least three (3) feet from the manhole lip. **(T-1)**

25.18.4.4. When a manhole or vault is open, at least one member of the crew shall be stationed at the surface to act as a safety observer and take appropriate actions in case of emergency. **(T-0)** When manhole covers are removed, install barriers to prevent injury to personnel not associated with the hazard. **(T-0)**

25.18.4.5. Carefully test the permanent ladder for rust, weakness or slippery rungs before using. **(T-0)**

25.18.4.6. Ensure the portable ladder is firmly seated and cannot slip. Always use a ladder to enter the manhole. **(T-0)**

25.18.4.7. Ventilate the lowest working levels with portable blowers for at least 30 minutes before and during the time employees are in the hole. **(T-0)**

25.18.4.8. Always wear a safety harness and lifeline and be constantly attended by a helper on the surface. **(T-0)**

25.18.4.9. Wear a helmet, gloves and rubber boots while inside a manhole. **(T-0)**

25.18.4.10. Ensure all lighting is explosion-proof. **(T-0)**

25.18.4.11. Prohibit open flames, sources of ignition or smoking in or at the opening of an open manhole. **(T-0)**

25.18.4.12. Lower tools in a bucket or pouch; never drop them into the manhole. **(T-0)**

25.18.4.13. Continue testing for oxygen deficient, explosive and toxic atmospheres during the entire time an employee is inside a manhole, wet well, etc. **(T-0)** Do not trust your nose. Some toxic and flammable gases have no odor or can quickly paralyze a person's sense of smell. **(T-0)**

25.18.5. Laboratories. Laboratories use many dangerous chemicals. Many of the testing procedures can result in mishaps if the technician is not fully alert at all times. Basic rules for laboratory safety are:

25.18.5.1. Sampling Safety.

25.18.5.1.1. Never take field samples with bare hands; always wear gloves. **(T-1)**

25.18.5.1.2. Do not climb over or go inside guardrails. Use poles, ropes, dippers or other long distance samplers. **(T-1)**

25.18.5.1.3. When collecting gas samples, do not open the tank cover completely. Install a sampling port, if needed. **(T-1)**

25.18.5.1.4. Use self-contained breathing apparatus, venting and a helper when taking gas samples in an IDLH environment. **(T-1)**

25.18.5.2. Lab Housekeeping. General cleanliness and correct storage of chemicals and equipment are important for accuracy as well as safety in the laboratory. Basic rules include:

25.18.5.2.1. Follow a daily general cleanup schedule in the lab. Dirty glassware or clothing can encourage infection. **(T-1)**

25.18.5.2.2. Have a special spot for storing each piece of equipment. **(T-1)** After each use, clean, disinfect, and return equipment to its rack (an outline painting, as on a tool board, helps keep a place for everything and everything in its place). **(T-1)**

25.18.5.2.3. Always clean up and discard any spills immediately following incident. **(T-0)** All contaminated waste spills shall be disposed of in a manner consistent with approved waste disposal procedures and applicable environmental regulations. **(T-0)** The installation Environmental Management office can provide additional guidance.

25.18.5.2.4. Keep the lab well lighted, at least 50-foot candles on every work surface. **(T-1)**

25.18.5.2.5. Ensure all work benches or tables have slate or special plastic chemical-resistant tops or are painted with chemical-resistant paint frequently. **(T-1)**

25.18.5.2.6. Ensure all work areas have non-drip edges or keep work that could be spilled in containers that would recover the spill. **(T-1)**

25.18.5.2.7. If possible, provide deep sinks of stone or non-crack porcelain lined with disposable rubber or plastic mesh. **(T-1)**

25.18.5.2.8. Do not crowd the lab; have plenty of room. **(T-1)** Do not store any other equipment in the lab. **(T-1)** Do not permit food or drink preparation, eating or smoking in the lab. **(T-0)**

25.18.5.2.9. Color code all lab service lines (gas, water, electricity, etc.). **(T-0)**

25.18.5.3. Chemical Safety. Refer to AFI 48-158, *Occupational Exposure to Hazardous Chemicals in Laboratories,* for additional guidance and information.

25.18.5.3.1. Keep working amounts of chemicals stored in the lab to a minimum, never over one gallon (four [4] liters) of any one kind. **(T-1)** Refer to **Chapter 22** for flammable chemical requirements.

25.18.5.3.2. Store all bulk chemicals in original containers in a separate fireproof storeroom. If possible, store larger bulk containers on the floor. **(T-1)**

25.18.5.3.3. Have individual bulk siphons to transfer chemicals from bulk storage to working stock bottles. **(T-0)** Never siphon by mouth. **(T-0)**

25.18.5.3.4. If possible, place all chemical storage jars on wide shelves with retaining rails to prevent their being accidentally pulled or jarred off. **(T-1)**

25.18.5.3.5. Stand jars containing highly corrosive acids or bases in lead, plastic, or ceramic individual trays that are deep enough to contain the solution in the event the jar breaks. **(T-0)**

25.18.5.3.6. Store all chemicals as low as possible, never higher than shoulder height. Ensure chemicals stored together or close to each other are compatible with each other. **(T-0)**

25.18.5.3.7. Clearly label all chemicals with common and chemical names, formula, strength, and date prepared or received. **(T-0)** Replace these labels as needed to keep them legible. **(T-0)**

25.18.5.3.8. Add red “Skull and Crossbones” labels to all containers of poisonous chemicals. **(T-0)**

25.18.5.3.9. Ensure used chemicals are carefully disposed of by employees who are familiar with their properties and disposal requirements. **(T-0)** Do not flush them down the drain unless permitted by environmental disposal requirements. **(T-0)** Contact the installation Environmental Management office for proper disposal guidelines. **(T-0)**

25.18.5.3.10. Keep highly reactive chemicals stored at safe distances. **(T-0)**

25.18.5.4. Lab Equipment Safety.

25.18.5.4.1. Only trained, experienced technicians are permitted to operate lab equipment. **(T-1)**

25.18.5.4.2. Exact, clear operating procedures for autoclaves, water stills and any other special pressure equipment shall be permanently posted near the respective equipment. **(T-1)**

25.18.5.4.3. Valves and switches on such equipment shall be clearly numbered in their order of use. **(T-1)**

25.18.5.4.4. All electrical equipment shall be grounded. **(T-0)**

25.18.5.4.5. All electrical cords shall be inspected for wear or cracks in insulation and shall be replaced as necessary. **(T-0)**

25.18.5.4.6. Manufacturer's operating and safety instructions shall be kept in a permanent file. Supervisors will ensure employees follow these rules. **(T-1)**

25.18.5.4.7. All equipment shall be set away from gas and electrical service switches or valves. **(T-0)**

25.18.5.4.8. All chemical reactions that produce vapors or gases shall be conducted in a ventilated hood with front closed and fan on. **(T-0)**

25.18.5.4.9. Chemicals with high temperature reactions shall be heated in a water, oil or salt bath, not over an open flame. **(T-0)** A wired glass shield shall be placed between the fan and any high temperature or caustic reaction in case the vial or container breaks. **(T-0)**

25.18.5.4.10. Employees will ensure centrifuges are perfectly balanced before turning them on. **(T-1)**

25.18.5.5. Glass Safety.

25.18.5.5.1. Always fire polish all ends of glass tubes that are used or stored. **(T-1)**

25.18.5.5.2. Wear gloves when working with glass. **(T-1)**

25.18.5.5.3. Hold rod or tube in contact with stopper and twist to insert. **(T-1)**

25.18.5.5.4. Keep cork borers sharp and use exact size needed. **(T-1)**

25.18.5.5.5. PYREX, KIMAX or equivalent tubing should be used whenever possible.

25.18.5.5.6. Wear full or wrap-around goggles or a face shield when working with glass. **(T-1)**

25.18.5.5.7. Always support glass units with several padded clamps that are firmly anchored. **(T-1)**

25.18.5.5.8. Properly discard all glassware that is chipped or cracked in any way. **(T-1)**

25.18.5.5.9. Pad all glass storage drawers with clean paper towels. Change the towels frequently. **(T-1)** Have individual cardboard tubes or dividers for pipette storage drawers. **(T-1)**

25.18.5.6. Lab Safety Procedures. The safest lab can be dangerous unless precautions are observed.

25.18.5.6.1. Never pipette by mouth; always use a bulk siphon. **(T-0)**

25.18.5.6.2. Always wear rubber gloves to handle wastewater samples and perform analysis. **(T-0)**

25.18.5.6.3. Always scrub thoroughly and use a hand disinfectant after finishing any waste-water lab work. **(T-0)**

25.18.5.6.4. Know proper procedures and follow a checklist. **(T-1)**

25.18.5.6.5. Wear safety glasses or goggles in the lab, when required for safe operations. **(T-1)**

25.18.5.6.6. Always wear a rubber apron when working with acids or caustics. **(T-1)**

25.18.6. Sanitary Sewer Systems. The buddy system shall be used when maintenance is performed on sewer systems in confined spaces. **(T-1)** Before going into a sanitary sewer system, the atmosphere shall be tested to determine if dangerous gases are present. **(T-0)** Sewer gases that may be encountered are methane, hydrogen sulfide and carbon monoxide. Presence of these gases could cause explosions, asphyxia or death. Refer to **Chapter 23** for additional requirements. Employees will use proper protective clothing, boots and respirator devices to perform emergency maintenance or rescue operations when these systems cannot be vented to a safe level. **(T-0)** Immunizations required, such as tetanus, typhoid, cholera, etc., shall be determined by the installation medical authority IAW Air Force Joint Instruction (AFJI) 48-110, *Immunizations and Chemoprophylaxis for the Prevention of Infectious Diseases.*

25.19. Aircraft Arresting Systems.

25.19.1. Personnel engaged in aircraft arresting systems operations and maintenance are exposed to several potential hazards, including exposure to flammable and combustible liquids and gases and absorption of toxic and hazardous chemicals through the skin and respiratory system. Aircraft arresting systems personnel are subject to some physical injuries associated with aircraft arresting systems maintenance, and are also subject to noise, lifting hazards, and in underground facilities, confined space hazards (e.g., oxygen deficiency). Particular attention shall be given to prevent exposure to hazardous noise levels since the effects of over-exposure are not always apparent immediately or in the near future. **(T-1)** Potential physical and health hazards can be effectively controlled by following guidance in this chapter, by proper work procedures and controls, and by using protective equipment and clothing. Refer to **Chapter 14,** AFI 32-1043, *Managing, Operating, and Maintaining Aircraft Arrest Systems,* TO 35E8-2-5-1, *Operation and Maintenance Aircraft Arresting System Mod BAK-12/E32A*, and AFI 48-127 for additional guidance.

25.19.2. Requirements.

25.19.2.1. Personal Protective Equipment. Engineering and administrative controls are the preferred means of protecting personnel. The use of PPE is supplemental to and not a replacement for such controls. PPE is identified in the text, **Figure 25.1** and **Chapter 14.**

25.19.2.2. Fire Prevention. **Chapter 22** provides guidance on the storage, use, and handling of flammable and combustible liquids. In addition, consult the installation FES

Flight and **Chapter 6** for guidance on selection and placement of fire extinguishers and required training.

25.19.2.3. Equipment and Component Cleaning. If solvents are used, use only approved and authorized types and ensure adequate ventilation is maintained throughout the operation. **(T-1)** If the process is not already evaluated, contact BE for an occupational and environmental health risk assessment. Refer to the most current edition of American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance,* for additional information on ventilation requirements.

25.19.2.4. Illumination. At least 50 foot candles of illumination shall be maintained at the operator's position. **(T-1)** Where necessary, additional artificial lighting shall be supplied. **(T-1)**

25.19.2.5. Occupational Health.

25.19.2.5.1. When noise level surveys identify a need for hearing protection, earplugs, earmuffs or both shall be provided to all personnel and their use strictly enforced. **(T-0)** Emphasis shall also be placed on all personnel who are within the area and may be affected by a noise hazard when noise sources are operating. **(T-1)** If process not already evaluated, contact BE for an occupational and environmental health risk assessment.

25.19.2.5.2. Training. First aid training shall be provided at installation level for aircraft arresting systems individuals in need of such training. **(T-1)** An initial group of first aid instructors shall be trained either by installation medical services or the American Red Cross. **(T-1)** These instructors shall be responsible for providing first aid training for aircraft arresting systems personnel. **(T-1)** The installation Occupational Safety office will confirm first aid training was accomplished during the unit's annual safety inspection. **(T-1)**

25.19.2.6. When working with Aircraft Arresting Systems, be aware of the following:

25.19.2.6.1. Walking and Working Surfaces. Essential information is included in this standard. Refer to **Chapter 7** for more detailed information on walking surfaces, openings and holes.

25.19.2.6.1.1. The entrance to Barrier Arresting System (BAK)-12 pits is hazardous because of the ladder and hatchway counterweight proximity and the presence of the sump pump pit. Use extreme caution in both areas. Employees shall be trained in confined spaces and entry procedures IAW **Chapter 23. (T-0)** The Confined Space Program Team will determine if the barrier pits are classified as confined spaces. **(T-0)**

25.19.2.6.1.2. Use the two-person policy when working on the BAK- 12 due to pit cover weight and underground location, etc. **(T-1)**

25.19.2.6.2. Active Runway Precautions. Communication is the key to controlling this hazard. Ensure continuous communication is maintained between the tower and operations during all phases of maintenance and operations. **(T-1)** Contact installation

Airfield Manager or designated representative for training requirements and qualifications for operating vehicles on an airfield. **(T-1)**

25.19.2.6.2.1. Maintain proper runway clearance as prescribed by local regulation. **(T-1)** When approaching an active runway, do not proceed to a point beyond the runway hold position, or an equivalent distance from the runway edge without proper clearance from the Air Traffic Control tower. **(T-1)**

25.19.2.6.2.2. Maintain adequate clearances to all types of engagements. **(T-1)** **Note:** There is a hazard of the pendant or tape breaking, causing a whiplash of the extended tape or pendant.

25.19.2.6.2.3. Rotating Machinery Precautions. Rotating machinery is a hazard with all aircraft arresting systems. Use extreme caution during rewind operations and checkouts. **(T-1)** Refer to 35E-8-series TOs and **Chapter 11** for detailed guidance.

25.19.2.6.2.4. High Voltage Precautions. High voltages are present in airfield lighting system components; use caution and two-person policy. **(T-1)**

25.19.3. Runway Barriers.

25.19.3.1. When engaging aircraft, the facilities (above or below ground) housing the arresting equipment shall be evacuated. **(T-1)** Dangers arise from inhaling vapors or brake pad dust, which may contain asbestos particles. In addition, equipment failure can cause debris to fly about. Operators shall remain clear of the tape sweep area. **(T-1)** Bailout alarms shall be included in barrier buildings to allow notification to evacuate the facilities by the tower. **(T-1)**

25.19.3.2. When engaging an aircraft, personnel shall be behind the runway holding position, and at least 25 feet from the arresting system energy absorber. **(T-1)** For MA-1A, E-5, and BAK-15 systems, personnel should retreat a distance equal to the span between the edge sheaves or 1.5 times the runway width, whichever is greater, but no closer than a distance equal to that of the runway holding position. **(T-1)**

25.19.3.3. Each operator shall be trained in the use of hand signals IAW UFC 3-260-18F, *Air Force Aircraft Arresting Systems (AAS) Installation, Operation and Maintenance (IO&M),* and any applicable TO. **(T-0)**

25.19.3.4. When returning to a facility (above or below ground) after an engagement or to clean the equipment, protective clothing and respiratory protection may be necessary. Refer to BE's occupational and environmental health risk assessment to determine if type of clothing and respiratory protection are recommended. This information shall be posted in each aircraft arresting systems facility. **(T-1)**

25.19.3.5. All arresting systems (barriers) require a minimum of three (3) operators. **(T-1)** Underground arresting systems require additional operators. **(T-1)** Refer to applicable TO 35E8- series for additional requirements.

25.19.3.6. All operators shall be aware when cable is being rewound. **(T-1)**

25.19.3.7. Sufficient ventilation shall be provided during maintenance or rewinding operations. **(T-1)**

25.19.3.8. Operators shall be made aware of tripping hazards when using barriers. **(T-0)** Hearing and respiratory protection shall also be used, as required. **(T-0)**

25.20. Personal Protective Equipment for CE Operations. Following is a quick reference guide to PPE that may be required for selected activities and equipment in CE operations. It is not all inclusive and the omission of an activity or item of equipment does not mean PPE is not required. The supervisor is ultimately responsible for providing and enforcing wear of PPE determined as recommended or required for the process by the installation Occupational Safety or BE. Specific PPE for each work area and person is determined through coordination with the supervisor, unit commander, Occupational Safety office and BE. BE is the OPR and installation authority for determination of respiratory protection IAW AFI 48-137. All questions concerning respiratory protection shall be addressed to BE. **(T-1)** The employee is responsible for the care and proper use of PPE provided. PPE shall be provided and used by employees wherever inhalation, absorption or physical contact injuries may occur. **(T-0)** Refer to **Chapter 14** for additional information on PPE. **Note:** For respiratory protection, consult BE's occupational and environmental health risk assessment.

Figure 25.1. Personal Protective Equipment For CE Operations.

Personal Protective Equipment for CE Operations	
OPERATION	**MINIMUM PPE REQUIRED**
Operating Construction Equipment:	
Dump Truck, Roller, Paver	Safety-toe boots Gloves Head protection
Loader, Grader, Sweeper, Backhoe, Bulldozer	Safety-toe boots Gloves Head protection Eye protection (if dusty) Hearing protection Respiratory protection
Crane	Safety-toe boots Gloves Hearing protection Head protection
Pavement Maintenance Equipment:	
Jackhammer, Pneumatic Drill/Tools	Respiratory protection Safety-toe boots Eye protection Face protection Hearing protection Gloves: Chemical resistant, vibration dampening (if required) Head protection

Concrete Saw, Router, Pavement Grinder	Safety-toe boots Eye protection Hearing protection Respiratory protection (if dusty) Gloves: Chemical resistant, vibration dampening (if required) Head protection
Asphalt Kettle	Safety-toe boots Eye protection Gloves Apron Respiratory protection
Concrete Mixer	Safety-toe boots Eye protection Respiratory protection Hearing protection (if noisy) Head protection
Landscape Maintenance Equipment:	
Walk-Behind Mower, Powered Edger	Safety-boots Eye protection Hearing protection Respiratory protection (if dusty) Head protection
Riding Mower	Eye protection Hearing protection Respiratory protection (if dusty)
Tractor-Towed Mower	Safety-toe boots Eye protection Hearing protection Respiratory protection (if dusty) Gloves Head protection
Chain Saw	Safety-toe boots Eye protection Hearing protection Respiratory protection (if dusty) Gloves Head protection Leggings
Powered Auger Rototiller	Safety-toe boots Eye protection Hearing protection Gloves Head protection
Stump Cutter, Chipper	Safety-toe boots Eye protection

	Hearing protection Gloves Head protection
Lawn Roller	Safety-toe boots Gloves
Fertilizer Handling and Application	Safety-toe boots Eye protection Respiratory protection Coveralls Gloves (Chemical resistant)
Stationary Woodworking Machinery	Eye protection Hearing protection Respiratory protection (if dusty)
Portable Power Tools	Eye protection Hearing protection Respiratory protection (if dusty)
Powder-Actuated Tools	Eye protection Hearing protection
General Carpentry, Painting, Plumbing, Sheet Metal, Welding and Masonry	Safety-toe boots Gloves (Chemical resistant) Eye protection Face protection Knee pad protection (if extended kneeling) Hard hat (Overhead hazards) Respiratory protection (if required by BE)
Roofing	Fall protection Eye and burn protection (if using asphalt, e.g., gloves, long sleeve shirts, aprons, etc.) Head protection
Soldering, Brazing, Welding	Safety-toe boots Eye protection Gloves Respiratory protection (if required)
Spray Painting	Eye protection Respiratory protection (if using dry tints) Gloves
Working in Sewers	Respiratory protection Gloves Rubber boots Coveralls Head protection
Metal-Working Machinery	Safety-toe boots

	Eye protection Gloves Head protection (if overhead crane system is in use) Hearing protection
Mixing Concrete or Mortar	Safety-toe boots Gloves Eye protection Respiratory protection Hearing protection
Placing Brick or Block, etc.	Safety-toe boots Gloves Eye protection
Cleaning Masonry	Eye protection Acid resistant gloves
Working Below Other Employees	Eye protection Head protection
General Refrigerator or Heating Work	Safety-toe boots Gloves (Chemical resistant)
Exterior Electric Work or Overhead Distribution (AFI 32-1064, *Electrical Safe Practices*	Head protection Fall protection (safety harness, lanyard) Electrician gloves Safety-toe boots
General Interior Electric and Power Production Work or Barrier Maintenance	Safety-toe boots Eye protection Gloves Respiratory protection
Battery Work (Liquid Electrolyte)	Safety-toe boots Gloves (Chemical resistant) Splash protection for face Life vest
Water or Waste Laboratory	Eye protection Respiratory protection Chemical resistant gloves Chemical resistant apron
General Materials Handling	Safety-toe boots Gloves Hard hat (Overhead hazard)

Chapter 26

LIQUID NITROGEN (LN2), OXYGEN (LOX) AND CRYOGENS

26.1. Specific Hazards.

26.1.1. Physical Hazards.

26.1.1.1. Liquid nitrogen (LN_2) or liquid oxygen (LOX) hazards are primarily associated with phase change and low temperature effects of cryogens. A tremendous volume increase occurs when either liquid undergoes a phase change from liquid to gas. When LN_2 vaporizes, each cubic foot of liquid expands to 695 cubic feet of nitrogen gas. For LOX, the expansion ratio is 860 to 1. Containment of cryogens may create a tremendous pressure increase if liquid to gas conversion occurs, so a sealed container can become a bomb. Expansion on ratio of LN_2 can displace oxygen in a confined space, causing an asphyxiation hazard. Expansion of LOX can cause oxygen enrichment, producing fire and explosion hazards. See paragraph **26.1.3** for additional information.

26.1.1.2. The cold temperature of LN_2 (-320° F) and LOX (-297 ^{o} F) can alter the strength, ductility, thermal expansion, thermal conductivity and heat capacity of materials. Mild carbon steels become brittle and failure-prone when exposed to cryogens. However, properly treated metals such as austenitic steels, nickel, aluminum, copper and a number of alloys are safe for low temperature work.

26.1.1.3. LN_2 can liquefy oxygen from the air it contacts. Therefore, an open container of LN_2 will slowly condense air causing a LOX concentration buildup within the LN2. The presence of LOX within LN_2 can cause unexpected chemical reactions with other materials. See paragraphs **26.1.3** and **26.1.4** for additional information on LOX reactivity with chemicals.

26.1.2. Physiological Hazards.

26.1.2.1. Evaporation of LN_2 in a poorly ventilated or unventilated enclosure may reduce the oxygen content of the air and produce asphyxiation and death. Because the brain requires the most oxygen, a reduction in available oxygen will first affect the mental processes. A slight impairment of the ability to concentrate and think clearly is an early symptom, which then progresses to a loss of consciousness. Unconsciousness can occur in seconds in atmospheres with very high concentrations of nitrogen. Recovery in fresh air is rapid and complete if exposure to high concentrations of nitrogen is short. Prolonged exposure can cause death.

26.1.2.2. The extremely cold temperature of LN_2 and LOX can freeze or seriously damage human tissue upon contact. The effect is similar to frostbite or thermal burn and is instantaneous. Uninsulated parts of equipment are cooled to extremely low temperatures by LN_2 and LOX and will freeze to the skin on contact. Flesh can be badly burned and severely torn in an attempt to free it, which must be done immediately since the results of prolonged skin contact are worse.

26.1.3. LOX Chemical Hazards. Normal air contains about 21 percent oxygen and 79 percent nitrogen. LOX contains about 4,100 times more oxygen than the same volume of air. Under these conditions, combustible materials and organic compounds react at explosive rates, and

materials not normally thought of as combustible can burn or explode. Because of this, control of combustible and potentially reactive materials in LOX work is as important as the control of ignition sources when flammable gases or liquids are handled. Because of the severe reaction of LOX with various materials, unauthorized substitutions of various LOX-service parts, fittings, hoses, seals, lubricants and so forth can be disastrous. Such reactions can arise out of hydrocarbon contamination or substitution of unsuitable materials. Hydrocarbon contamination can cause explosions and fires. Oil, dirt and other foreign debris are a special concern during aircraft servicing where serious aircraft fires have resulted from combustible foreign matter in aircraft LOX systems. LOX must be handled only in areas where it will not come in contact with hydrocarbon materials when leaked or spilled, including all areas where LOX might flow after a spill. If spilled onto asphalt, LOX will seep into cracks and form shock-sensitive compounds which can explode violently upon impact. **(T-0)** LOX spills also cause localized atmospheric oxygen enrichment, which increases the fire danger until dissipated.

26.1.4. Solvents and Chemical Hazards. Some solvents and chemicals used for LN_2 and LOX production and storage cause skin irritation or burns, and can be absorbed through the skin. It may also cause liver damage and poisonous if taken internally.

26.1.5. Spill Hazards. LN_2 and LOX spills may cause asphyxiation, fire, explosion, severe cryogenic burns or equipment damage. Whenever the cryogenic liquid is exposed to the atmosphere, moisture condenses from the air and forms a fog over the immediate area. Refer to the installation and work area spill plans and the National Institute for Occupational Safety and Health *Pocket Guide to Chemical Hazards* (**www.cdc.gov/NIOSH/npg/**) for additional information on handling cryogenic spills.

26.2. General Requirements.

26.2.1. Characteristics and Production of LN_2 and LOX.

26.2.1.1. Liquid Nitrogen. LN_2 is a colorless, odorless, nonflammable, nontoxic and chemically inactive water-like fluid with a boiling point of -320° Fahrenheit (F). LN_2, less dense than water, weighs approximately 6.7 pounds per gallon. The expansion ratio for LN_2 (from LN_2 to gaseous nitrogen) is 695 to 1 at normal temperature and pressure. The critical temperature of LN_2 is -233° F at 493 pounds per square inch absolute. At temperatures higher than this, LN_2 cannot be liquefied regardless of pressure.

26.2.1.2. Liquid Oxygen. LOX is a pale blue, nontoxic, water-like fluid with a boiling point of-297° F. It is heavier than water, weighing approximately 9.5 pounds per gallon. The expansion ratio for LOX is 860 to 1 at normal temperature and pressure. The critical temperature of oxygen is -181° F at 737 per square inch absolute. At temperatures higher than this, LOX cannot be liquefied regardless of pressure. Liquid oxygen is attracted to an electromagnet much like iron and will combine readily with other substances to actively support combustion.

26.2.2. Production of LN_2 and LOX.

26.2.2.1. Storage Tanks (Cryotainers). LN_2 and LOX storage tanks are constructed with an inner cylinder supported in an outer vacuum insulated jacket to reduce radiation and convection heat transfer. The evacuated space between the inner and outer vessels contains a highly efficient insulating material, which reduces boil off of the LN_2 or LOX. Pressure buildup in the inner tank, necessary to transfer liquid from the tank, is accomplished by

vaporizing liquid in coils located beneath the tank. All operating controls are located in a cabinet at the front end of the tank. Storage tanks are manufactured in various sizes and shall be designed and constructed IAW the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. **(T-0)** Safety relief valves shall be installed so moisture cannot collect, freeze and interfere with proper operation of the valves. **(T-0)** Frangible disks shall also be included in the design of pressurized tanks. **(T-0) Note:** Tanks operating at atmospheric pressure do not require pressure relief devices if adequately vented. Refer to 29 CFR 1910.104, *Oxygen*, for additional guidance.

26.2.3. Generating Plants. Air Force LN_2 and LOX plants can typically produce one and one-half to five tons of liquid oxygen per day (24 hours). These plants produce four products: liquid and gaseous nitrogen, and liquid and gaseous oxygen. LN_2 and LOX are generated from atmospheric air through five basic steps: compression, purification, refrigeration, expansion and distillation.

26.2.4. High Pressure. Pressures approaching 4,000 pounds per square inch (psi) may be found in production facilities. To prevent personnel injury and property damage from whipping of failed lines, all high-pressure lines shall be secured with brackets, braces or other suitable tie-down devices. **(T-0)**

26.2.5. Contamination. Atmospheric contamination during production runs may introduce impurities into the cryogens. To avoid this hazard, the following operations are not permitted during production:

26.2.5.1. Painting.

26.2.5.2. Welding, cutting and brazing.

26.2.5.3. Solvent use.

26.2.5.4. Any operation generating toxic and noxious gases or vapors.

26.3. Cryogenic Facility Siting.

26.3.1. Safe Distance Criteria. The special hazards associated with LN_2 and LOX require care be exercised in siting these facilities. Production or storage facilities of 100 gallons or more shall conform to the following minimum separation distances. **(T-0)** Refer to UFC 3-600-01, *Fire Protection Engineering for Facilities,* and TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding*. IAW AFMAN 91-201, *Explosives Safety Standards,* and DoD 6055.09-STD, *DOD Ammunition and Explosives Safety Standards,* if the cryogen is used as a propellant and/or fuel, the most stringent distance shall apply.

26.3.1.1. Stationary Cryogenic Containers, Cylinders and Tanks. Stationary containers located outdoors shall be separated from exposure hazards IAW the minimum separation distances. **(T-0)** Refer to National Fire Protection Association 55, *Compressed Gases and Cryogenic Fluids Code,* for additional guidance.

26.3.1.2. Bulk oxygen systems (100 gallons or more) located outdoors shall be separated from exposure hazards. **(T-0)**

26.3.2. Facility Requirements.

26.3.2.1. Security fencing and lighting shall be IAW AFI 23-201, *Fuels Management.* **(T-0)**

26.3.2.2. LOX production and storage facilities shall be permanently placarded to indicate "OXYGEN—NO SMOKING—NO OPEN FLAMES" or an equivalent warning. **(T-0)**

26.3.2.3. Notify the installation CE prior to installation, modification or repair of utility services (water, electricity, sewage, telephone).

26.3.2.4. Joint sealer shall be LOX-compatible in LOX handling and storage areas (where spills are most likely to occur). **(T-0)** This area will cover a 25-foot radius (minimum) from the LOX cart fill point during servicing. The area around the LN_2 and LOX plant itself (where spills are most likely to occur) shall be concrete. **(T-1)** Refer to AFI 23-201 for additional guidance.

26.3.2.5. A paved road shall be provided to and from the facility for delivery, maintenance and emergency vehicles. **(T-1)** Refer to AFI 23-201 for additional guidance.

26.3.2.6. Generator plants shall be permanently grounded. **(T-1)** Storage and servicing tanks shall have adequate grounding points. **(T-1)** Refer to AFI 23-201 for additional guidance.

26.3.2.7. Generating plants shall be sited to minimize airborne contamination of the local area. **(T-1)**

26.4. Occupational Health.

26.4.1. Solvents and Chemicals. Refer to paragraphs **26.1.3** and **26.1.4** for hazards of chemicals used in LN_2 and LOX production and storage. BE's occupational and environmental health risk assessment recommends appropriate controls.

26.4.2. Noise. Noise levels in generating plants can reach high levels, particularly during defrost, start-up and shutdown operations. AFI 48-127, *Occupational Noise and Hearing Conservation Program*, addresses program responsibilities, designation of hazardous noise-producing equipment and hazardous noise areas, required PPE and required medical examinations for workers exposed to hazardous noise. If process not already evaluated, contact BE for an occupational and environmental health risk assessment.

26.4.3. First Aid Medical Treatment For Cryogenic Burns. Remove the victim from exposure immediately and transport to the nearest emergency room as soon as possible. Identify exposure to LN_2 or LOX. Keep the victim warm and dry by wrapping exposed areas in a blanket. No attempt to re-warm frozen body parts shall be made until the victim is under proper medical care. **(T-1)** Affected parts will not be rubbed because the tissues may be damaged. **(T-1)** Clothing that may restrict circulation to the frozen area shall be loosened or removed. **(T-1)** Do not allow the victim to drink alcoholic beverages or smoke, because these actions decrease blood flow to the frozen tissue. Control of shock and pain and re-warming of frozen parts shall be done only by medical services personnel. **(T-1)**

26.5. Safety Precautions When Working With LN 2 and LOX.

26.5.1. PPE for $LN_2$2 or LOX. PPE is of two distinct types — cryogenic and chemical protection; and may not be interchangeable. Local procedures shall be developed to prevent hydrocarbon or chemical contaminated PPE from being used during cryogen transfers.

26.5.1.1. Personnel handling or transferring LN_2 or LOX shall follow PPE requirements in **Chapter 14,** *Personal Protective Equipment (PPE).* **(T-0)** Non-absorbent long sleeves

shall extend to the gloves. **(T-0)** Cuff-less trousers shall be worn outside leather boots or over high-top leather shoes to shed spilled liquid. **(T-0)** Boots and shoes shall have no mesh sides or air holes and will be tightly laced to prevent spilled cryogen seeping inside. **(T-0)** Only tightly woven materials shall be worn during $LN_2$2 or LOX operations. **(T-0)** A face shield, eye protection (safety goggles or safety glasses with side shields) and apron (leather or other BE-approved) shall be worn. **(T-0)**

26.5.1.2. LN_2 and LOX both saturate clothing. Such contact holds the LN_2/LOX against the skin and may be more hazardous than a direct splash. Contaminated clothing will be removed, hung up and air dried for one hour. **(T-1)**

26.5.2. Low Temperature Precautions:

26.5.2.1. Avoid splashing on exposed skin. Cryogenics burn on contact.

26.5.2.2. Do not touch an uninsulated cryogenic surface unless wearing the proper PPE. Bare skin will freeze to any uninsulated cryogenic surface and portions of the skin will continue to adhere to the surface after removal of the affected part. Remove the affected part immediately, as leaving the skin in contact with the surface will freeze the underlying tissue and cause additional damage.

26.5.2.3. Assume all surfaces are cold until proven otherwise. External frost may not always be present.

26.5.3. Equipment and Materials Precautions:

26.5.3.1. Most metal becomes very brittle at cryogenic temperatures and will shatter or crack under stress.

26.5.3.2. Valves may freeze if any moisture is present in the system. Droplets of moisture can freeze into balls and pit valve seats causing them to leak.

26.5.3.3. Most glass and some plastics will shatter on contact with LN_2 or LOX due to thermal stress.

26.5.4. Asphyxiation Prevention:

26.5.4.1. Small amounts of liquid generate large amounts of gas. Avoid using cryogenics in small unventilated rooms.

26.5.4.2. LN_2, when vaporized, is initially heavier than air, sinks to the floor or lowest point, and displaces oxygen. There may not be sufficient oxygen remaining to support life.

26.6. Fire Prevention and Protection.

26.6.1. Always avoid contact between LOX and petroleum-based products. Such a mixture is shock sensitive and will explode when struck. **Note:** Most cosmetics and hair care products are petroleum-based.

26.6.2. Ensure no oil or grease is present on clothing or equipment when working with or around LOX. Remove and replace soiled clothes with clean ones. Remove oil or grease on equipment with approved non-petroleum solvents.

26.6.3. Static electricity may ignite combustible materials in an oxygen-rich atmosphere. Workers shall wear only approved clothing and shall ground themselves before beginning LOX operations. **(T-0)**

26.6.4. Never use LOX for cooling people, parts, equipment or food.

26.6.5. Avoid open containers of LN_2. Although inert, LN_2 is colder than LOX. It liquefies oxygen from the surrounding air and, therefore, an open container of LN_2 will slowly condense oxygen from the air causing a LOX concentration buildup within the LN_2. When the LN_2 is pale blue in color, there is LOX present in the mixture. The LOX contamination can cause unexpected chemical reactions with other materials.

26.6.6. Consult the installation FES Flight on fire protection and compatible firefighting agents for LN_2 and LOX production and storage facilities. Nitrogen is a fire suppressant but oxygen supports combustion. In an oxygen supported fire, stop the oxygen flow if possible. Use large quantities of water, preferably in the form of a spray, to cool the burning material. If electrical equipment is involved in the fire, ensure electrical power is turned off before applying water. **(T-1)** LOX is a vigorous oxidizing agent and supports combustion of many materials not flammable in air. A LOX fire cannot be extinguished with carbon dioxide (CO_2), dry chemical or foam. Unless the LOX flow can be stopped or the combustible materials isolated from the LOX, such fires are difficult if not impossible to extinguish.

26.6.7. Always maintain a clear and unobstructed access to and from LN_2 and LOX facilities for firefighting equipment. **(T-1)**

26.6.8. Do not permit LOX to come in contact with organic material or flammable substances. Some materials react violently with oxygen under certain conditions of pressure and temperature. These include oil, grease, asphalt, kerosene, cloth, paint, tar and dirt, and anything which may contain oil or grease. If LOX is spilled on asphalt or surfaces contaminated with combustibles (for example, oil-soaked concrete or gravel), do not walk on or roll equipment over the area of the spill. Keep sources of ignition away for at least 15 minutes after all frost has disappeared.

26.7. Electrical Safety. LN_2 and LOX production plants and tank support equipment may require electrical service up to 480 volts alternating current. Use extreme care when working around any electrical connections, panels, motors or other energized components. Moving fluids, drive belts, removal of clothing and almost any form of friction can generate a static charge. Ground LN_2 and LOX plant components and storage tanks at all times.

26.8. Housekeeping.

26.8.1. LOX reacts violently when it contacts many commonly used materials. Therefore, it is important that floors and drip pans in LOX plants and storage areas are kept in spotless condition. Tanks shall be kept clean and free of all hydrocarbons. **(T-1)**

26.8.2. Because dirty tools and equipment are sources of hydrocarbon contamination, all tools and equipment used with oxygen components and systems shall be kept meticulously clean and properly stored. **(T-1)**

26.9. Receipt, Storage and Issue of LN_2 or LOX.

26.9.1. Because of the catastrophic consequences of mixing LN_2 and LOX in storage tanks and carts, workers shall exercise care in verifying the correct product is transferred to the

correct storage tank or cart. **(T-1)** Refer to TOs 42B6-1-1, *Quality Control Aviators Breathing Oxygen and Aviators Gaseous Breathing Oxygen*, and 42B7-3-1-1, *Quality Control of Nitrogen*, for detailed procedures. Only fittings designed specifically for LOX or LN_2 equipment will be used; workers will never fabricate or use ones that are compatible with both LOX or LN_2 equipment. **(T-1)**

26.9.2. At least two workers, fully knowledgeable in Air Force safety criteria and operational procedures, shall be within normal voice or eye contact when generating or transferring cryogenic fluids. **(T-1)** This also applies to maintenance actions on cryotainers or plants when cryogenic fluids are present in the system. Personnel requirements for aircraft servicing operations shall be IAW TO 00-25-172. **(T-1)**

26.9.3. All transfers of LN_2 and LOX shall be closely monitored to minimize the extent of spills or leaks. **(T-1)** The use of drip pans is required. **(T-1)** Asphyxiation or oxygen enrichment hazards will exist if a spill occurs within a building or confined space. Appropriate local emergency procedures shall be developed for this contingency. **(T-1)**

26.10. Mission-limiting Weather Conditions.

26.10.1. Each Air Force installation shall develop local procedures to ensure key personnel and agencies involved in high risk weather activities and operations are notified IAW the installation weather support document. **(T-1)** Each installation shall employ a lightning safety program with a two-tiered notification system to minimize worker exposure to lightning hazards. **(T-1)** Refer to **Chapter 3,** *Weather Safety,* for adverse weather program guidance.

26.10.2. The supporting AF weather organization shall make initial notification of adverse or mission-limiting weather conditions to predetermined support agencies. **(T-1) Note:** Adverse or mission-limiting weather conditions include strong surface winds, heavy rain, heavy snow, freezing precipitation and thunderstorms, e.g., frequent lightning, and the potential for damaging winds, heavy rain, hail and tornadoes.

26.10.3. A *Lightning Warning* is in effect whenever any lightning occurs within a five (5) nautical mile radius of predetermined locations and activities. Workers shall cease aircraft LOX servicing whenever a Lightning Warning is in effect. **(T-1)** Refer to **Chapter 3** for additional adverse weather guidance.

26.11. Common Cryogenic Liquids, Their Properties and Precautions.

26.11.1. While LOX and LN_2 are widely used cryogens, other cryogens are also used within the Air Force. As with LOX and LN_2, these cryogenic liquids have boiling points below minus 130 ^{o} F (minus 90 ^{o} C) and their use must be properly controlled to prevent any contact with the liquid, container or piping, or exposure to the gases. **(T-1)** Common cryogenic liquids include nitrogen, helium, hydrogen, argon, methane, oxygen and carbon monoxide.

26.11.2. Although liquefied carbon dioxide (CO_2) does not meet the definition for a cryogen, at -57° C it is very cold, can burn exposed skin and shall be treated as a cryogen. **(T-1)**

26.11.3. Workers shall read the SDS and safety precautions for all cryogens used. **(T-0)**

26.11.4. Use of Cryogenic Liquids.

26.11.4.1. Cryogenic liquids are extremely cold, have high liquid-to-vapor expansion ratios and may be flammable, properties that make them dangerous to handle and use.

26.11.4.2. Skin or eye contact with cryogenic liquids, cold equipment and materials used in conjunction with cryogens, or splashing liquid can cause severe burns, frostbite, tearing of flesh and eye damage. Vapors from boiling liquids can cause eye damage, freeze skin and produce oxygen deficient environments.

26.11.4.3. BE's occupational and environmental health risk assessment of the cryogenic liquid work processes identify hazards and recommend controls. Typical PPE for work with cryogenic liquids includes safety goggles, insulated gloves, lab coat or apron, a face shield and leather boots. Gloves should be loose enough to easily toss off in the event spilled cryogens enter the gloves. Supervisors shall contact BE if PPE concerns arise.

26.11.4.3.1. Wear a long sleeve shirt and cuffless pants. **(T-0)** Pants should be worn over the tops of boots. **(T-0)**

26.11.4.3.2. Wear leather boots without mesh sides or air holes. **(T-0)** Non-leather boots may be worn if specifically designed for wear while handling cryogens.

26.11.4.3.3. Do not wear jewelry or other materials that could trap spilled liquid against the skin.

26.11.4.3.4. Stay out of cryogen vapor pathway. **(T-1)**

26.11.4.3.5. Use fume hoods when working with cryogens.

26.11.4.3.6. Always use tongs when handling objects in liquid. **(T-1)**

26.11.4.3.7. Only use materials approved for use with cryogens. **(T-0)** Unapproved materials such as plastic, rubber, wrought iron and carbon steel will become brittle and shatter. (Chemical ensemble vinyl overboots shall not be worn while handling cryogens, except when threat of chemical/biological threat exists, as determined by the organization commander.)

26.11.4.3.8. Periodically inspect equipment and remove ice and frost blockages from openings to prevent over pressurization. **(T-1)**

26.11.4.3.9. Do not tamper with pressure relief valves. Report any leaky or improperly set relief valves to maintenance personnel or the manufacturer. **(T-1)**

26.11.4.3.10. Keep equipment clean without using corrosive cleaning materials that could damage the metal jacket. **(T-1)**

26.11.5. Dispensing and Transport of Cryogenic Liquids.

26.11.5.1. Special precautions shall be taken to prevent spills while dispensing or transporting cryogens and minimize exposure to liquids and vapors. **(T-1)** The high liquid to vapor expansion ratio can rapidly displace all oxygen in a room and result in asphyxiation. Personnel using cryogens shall:

26.11.5.1.1. Wear proper PPE when dispensing or transferring cryogenic liquids. **(T-0)**

26.11.5.1.2. Cool the secondary container by adding a little cryogenic liquid first, when obtaining liquid from a large dispensing dewar or cylinder. **(T-1)** Dispense slowly to mitigate thermal stress and prevent excess splashing. **(T-1)** Do not leave the filling

operation unattended to avoid overfilling the container. Do not allow the cryogenic liquid to fall too far before reaching the receiving container.

26.11.5.1.3. Ensure the secondary container is secured when manually pouring liquid into a smaller dewar. **(T-1)** Do not overfill, fill to less than 80 percent full to allow room for expansion and use a phase separator, if available, to control the vapor path while pouring.

26.11.5.1.4. Use at least two (2) personnel to transport cryogenic liquids indoors. **(T-1)** Use handcarts equipped with brakes to move large dewars and cylinders. **(T-1) Note 1:** Avoid traveling in an elevator with a dewar. For buildings with multiple floors, take necessary steps to prevent people from traveling in the elevator with the unattended cylinder/dewar. **(T-1)** Spills or elevator failures may be dangerous in this restricted space as oxygen could be displaced if the cylinder failed or leaked. Prior to transport, signage will be placed on each floor stating a dewar is not to be accompanied during transport on the elevator. **(T-1) Note 2:** One person transporting LOX and LN2 carts to the flightline is acceptable as long as carts are equipped with a pintle hook and towed behind a vehicle.

26.11.5.1.5. Always use care when handling equipment. **(T-1)** Damage to dewars could cause loss of vacuum, increased evaporation or leaks.

26.11.5.1.6. Wear PPE and hold the dewar as far away from the face as possible when carrying a dewar. **(T-0)** Containers that cannot be easily and safely carried shall be placed on a stable wheeled base designed for the dewar. **(T-0)**

26.11.6. Storage of Cryogenic Liquids. Gas from a cryogenic liquid storage unit left open to the atmosphere or a catastrophic failure of a storage unit could create an oxygen deficient atmosphere. To reduce the likelihood of this occurring, users shall ensure:

26.11.6.1. Glass dewars have an exterior coating/cover/plastic mesh to minimize projectiles if an explosion occurs. **(T-1)**

26.11.6.2. Dewars are stored in well-ventilated rooms with a minimum of six (6) air changes per hour. **(T-1)** If the ventilation rate is unknown, contact BE to evaluate the storage area as the installation of oxygen detection systems and alarms for cryogenic liquid storage areas may be required based on location, ventilation and quantity of material stored.

26.11.6.3. Do not store cryogenic liquids with corrosive or flammable chemicals.

26.11.6.4. Dewars shall be placed so vents and openings are positioned away from personnel and lab equipment. **(T-1)**

26.11.6.5. Bulk cryogenic storage and dispensing facilities shall follow the siting process in paragraph **26.3** **(T-1)**

26.11.6.6. Bulk cryogenic liquid dispensing areas within buildings must be well ventilated. **(T-0)** Consult BE for recommended continuous oxygen monitoring equipment. All new installations shall be designed with an oxygen monitoring system and alarm. **(T-0)**

26.11.6.7. Cryogenic liquid dewars are not stored in hallways, unventilated closets, environmental rooms or stairwells.

26.11.7. Special Precautions for Liquid Oxygen and Flammable Cryogenic Liquids. Flammable cryogenic liquids like methane, hydrogen and carbon monoxide are hazardous. While oxygen does not burn, it supports and accelerates combustion rates of other materials and may form explosive mixtures with other combustibles. Prior to using flammable cryogenics and oxygen:

26.11.7.1. The supervisor shall contact BE to assess cryogen engineering and work practice controls. **(T-1)**

26.11.7.2. All combustible materials are kept away from flammable liquids and oxygen.

26.11.7.3. "No Smoking" signs are posted, and no sources of ignition are present.

26.11.7.4. Oxygen dewars and equipment are kept very clean as surface contamination can ignite if oxygen leaks from the dewar.

26.11.7.5. Stationary equipment is properly grounded and mobile equipment is properly bonded when dispensing.

26.11.7.6. Valve operation is performed very slowly to prevent ignition of contaminants in the system.

26.11.7.7. Flammable gas venting is independent from other ventilation systems and a nitrogen purge is used when needed.

26.11.8. Emergency Procedures.

26.11.8.1. Periodic equipment inspections, removal of ice blockages and replacement of damaged or old storage units will reduce the probability of catastrophic failure of storage units. Ice blockages that prevent the container from venting properly can cause an explosion hazard. **Note:** Contact the installation FES Flight and BE immediately if ice blockages occur.

26.11.8.2. If a spill occurs, immediately exit the area and contact the installation FES Flight to monitor oxygen levels in the area and determine when it is safe to re-enter.

26.11.8.3. If experiencing symptoms such as lightheadedness, dizziness or confusion, immediately seek fresh air and medical attention.

26.11.8.4. An unconscious employee in a cryogenic liquid storage area shall only be retrieved by personnel using a self-contained breathing apparatus. **(T-1)** Once the person is removed to fresh air, provide rescue breathing or CPR until paramedics arrive.

26.11.8.5. If eyes or skin comes in contact with cryogenic liquid or gases, follow first aid procedures, then immediately seek medical attention. Refer to paragraph **26.4.3** for additional guidance.

26.11.8.5.1. Immediately remove any contaminated clothing. If clothes are contaminated with oxygen, hydrogen or carbon monoxide, remove clothing, evacuate personnel from the facility and keep contaminated clothing away from ignition sources.

26.11.8.5.2. Do not apply dry heat or rub damaged flesh or eyes.

26.11.8.5.3. Seek treatment at the nearest medical treatment facility.

26.11.8.5.4. Workers shall notify their supervisor of injuries.

Chapter 27

WELDING, CUTTING AND BRAZING

27.1. Hazards and Human Factors.

27.1.1. Welding, cutting and brazing operations present hazardous situations which, if the proper precautions are not taken, can lead to serious injuries and/or death. Many workers have been injured because they failed to use proper PPE, used faulty equipment or from personnel error. The use of protective equipment is the least preferred method of controlling hazards and should not be relied on alone to provide protection against hazards. Protective equipment should be used in conjunction with guards, engineering controls and sound manufacturing practices. Refer to **Chapter 3,** *Weather Safety*, for additional guidance on hazards and controls. Many Air Force welding, cutting and brazing mishaps are caused by:

27.1.1.1. Inadequately trained personnel.

27.1.1.2. Poor housekeeping practices.

27.1.1.3. Poor shop layout.

27.1.1.4. Inadequate lighting and ventilation.

27.1.1.5. Improper storage and movement of compressed gas cylinders.

27.1.1.6. Exposure of oxygen cylinders and fittings to oil or grease creating a fire or explosive hazard.

27.1.1.7. Pointing welding or cutting torches at a concrete surface causing spattering or flying fragments of concrete.

27.1.1.8. Electric shock when motors, generators and other electric welding equipment are not grounded.

27.1.1.9. Inhalation of toxic fumes or vapors from welding metals or alloys.

27.1.2. Numerous hazardous chemicals and metals are used in fluxes, paints, coatings and fillers. Toxic fumes or gases are released into the atmosphere during welding, cutting and brazing operations. SDSs provide information about the hazards associated with these products. All filler metals and fusible granular materials carry the following caution: *CAUTION - WELDING MAY PRODUCE FUMES AND GASES HAZARDOUS TO HEALTH. AVOID BREATHING THESE FUMES AND GASES. USE ADEQUATE VENTILATION*.

27.1.3. Brazing and welding filler metals containing cadmium carry the following warning: *WARNING - CONTAINS CADMIUM - POISONOUS FUMES MAY BE FORMED ON HEATING*.

27.1.4. Brazing and gas welding fluxes containing fluorine compounds carry the following precautionary wording on tags, boxes or other containers: *CAUTION CONTAINS FLUORIDES*. This flux, when heated, gives off fumes that may irritate eyes, nose and throat.

27.1.5. Cleaning and other operations involving chlorinated hydrocarbons may generate toxic vapors or mists. Refer to paragraph **27.18.6** for additional guidance.

27.1.6. Fires, explosions and injuries can occur from welding operations that are:

27.1.6.1. In the proximity of combustible solids, liquids or dusts.

27.1.6.2. In the presence of possible explosive mixtures of flammable gases and air.

27.1.6.3. In the presence of an oxygen-enriched atmosphere, where hot work is performed.

27.1.6.4. In close proximity of explosive hydrogen gas, which is formed when sulfuric acid comes in contact with mild steel.

27.2. Acquisition.

27.2.1. Only American Welding Society approved apparatus such as torches, regulators, pressure reducing valves, acetylene generators, machines, manifolds, cables and hoses, etc., shall be used. **(T-0)** In locations where the acquisition of such apparatus is not feasible, contact the installation Occupational Safety office or CE for guidance.

27.2.2. Compressed gases may be purchased in either government-owned or supplier-owned cylinders. In either case, the purchase agreement shall specifically indicate that the compressed gas cylinders meet the marking requirements of 29 CFR 1910.253, *Oxygen Fuel-Gas Welding and Cutting*. **(T-0)** In addition, they shall be inspected and shall have a safety relief device installed per the requirements in 29 CFR 1910.101, *Compressed Gases (General Requirements).* **(T-0)** Government-owned cylinders which are not in compliance with the above requirements shall not be used and shall be removed from service. **(T-0)** In locations where the adherence of OSHA requirements is not feasible, contact the installation Occupational Safety office or CE for guidance.

27.2.3. Only protective clothing and equipment approved by BE and installation Occupational Safety office shall be used. **(T-1)** Refer to **Chapter 14,** *Personal Protective Equipment (PPE),* for additional guidance.

27.2.4. Contractor activities involving welding, cutting and brazing shall meet requirements of 29 CFR 1910.252, *Welding, Cutting, and Brazing - General Requirements,* and National Fire Protection Association 51B, *Standard For Fire Prevention During Welding, Cutting and Other Hot Work*, which may also be used as a technical reference. **(T-0)** The contracting officer, in consult with the Occupational Safety office and FES Flight, shall determine the necessity for specific references to OSHA standards, Air Force fire, safety and health standards, and other guidance as necessary in the contract. **(T-1)** In locations where the adherence of OSHA requirements is not feasible, contact the installation Occupational Safety office or CE for guidance.

27.3. Operating Precautions. The information listed below provides minimum guidance on operating precautions and procedures. It shall be used in conjunction with 29 CFR 1910.252 on all matters involving US Air Force welding operations. **(T-0)** Information in 29 CFR 1910.252 may be obtained by contacting your installation Occupational Safety office or visiting the OSHA website: **http://www.osha.gov.** Additional information is also available in National Fire Protection Association 51B.

27.3.1. Acetylene is extremely flammable and, when mixed with air, is highly explosive. Use and store acetylene cylinders in an upright position. If cylinders have been lying in a horizontal position, they must stand upright for a minimum of two (2) hours prior to use. **(T-0)** Never use acetylene at a pressure in excess of 15 pounds per square inch, gauge; higher pressure may cause the cylinder or equipment to explode. **(T-0)**

27.3.2. Follow manufacturer's instructions with respect to the sequence of operations in lighting, adjusting and extinguishing torch flames. **(T-0)** Purge hoses in open spaces and away from ignition sources. **(T-0)** Light the torch with a friction lighter or stationary pilot flame, keeping a safe distance between the torch and the welder's hands. **(T-0)** Point the torch away from persons or combustible materials when lighting. **(T-0)** Do not attempt to light a torch from hot metal.

27.3.3. When not in use for extended periods, i.e., 30 minutes or more, or when unattended (no one in the vicinity for observation), shut off fuel gas and oxygen supply at the tank. **(T-0)**

27.3.4. Do not open an acetylene valve more than one and one half turns of the spindle and preferably no more than three-fourths of a turn. **(T-0)**

27.3.5. Always open the cylinder valve slowly. Do not remove the wrench or handle used to open the cylinder from the stem of the valve while the cylinder is in use. **(T-0)**

27.3.6. If cylinders are manifold or coupled, ensure at least one wrench is always available for immediate use. **(T-0)**

27.3.7. Provide ventilation in shops or rooms where work is to be performed, but avoid strong drafts directed at the welding operation. **(T-0)** Do not use oxygen to provide ventilation; this action shall accelerate combustion. **(T-0)** Contact BE on proper ventilation requirements.

27.3.8. Never attempt to preheat or weld jacketed vessels, tanks, containers or covered parts until precautions have been taken to adequately vent/inert the space. **(T-0)** Do not weld or cut a container or piping system containing hydrogen gas, flammable or combustible liquids, vapors or other flammable or combustible materials without first inerting the container or system. **(T-0)** Take similar precautions for new containers since preservatives or other combustibles may be present. When applicable, ensure that the appropriate technical orders are followed. **(T-0)** Refer to paragraph **27.11** for additional guidance.

27.3.9. Do not place work to be welded or heated on a concrete floor. **(T-0)** Concrete, when heated, may spall and produce projectiles, exposing the welder to injury from flying hot particles.

27.3.10. Provide appropriate fall protection for welders and helpers when on elevated surfaces. Keep welding areas neat, clean and free from tripping hazards. **(T-0)** Provide protection for personnel on the ground or rope off area directly below the operation. **(T-0)** Refer to **Chapter 13,** *Fall Protection,* **Chapter 16**, *Mobile Elevating Work Platforms,* **Chapter 17**, *Scaffolding,* and 29 CFR 1910.28, *Safety Requirements for Scaffolding,* for additional guidance.

27.3.11. Welding, cutting and brazing operations may produce a toxic or unhealthy atmosphere. Refer to AFI 90-821, *Hazard Communication (HAZCOM) Program*, and BE guidance for ventilation requirements associated with welding operations.

27.3.12. Do not perform cutting and welding operations:

27.3.12.1. In indoor areas not approved by installation FES Flight, Occupational Safety office and BE. **(T-1)** This shall ensure fire, safety and health protection considerations shall be included in the selection of indoor welding, cutting and brazing operations. **(T-1)**

27.3.12.2. In buildings with installed sprinkler systems when the system is inoperable, unless other means of fire detection, reporting and extinguishing have been approved by the installation FES Flight. **(T-0)**

27.3.12.3. In explosive atmospheres or where explosive atmospheres may develop.

27.3.12.4. Within 50 feet of flammable liquids, i.e., flashpoint below 100° F.

27.3.12.5. When unable to comply with the above requirements (paragraphs **27.3.12.1** thru **27.3.12.4**), interim procedures must be established through the installation Occupational Safety office, FES Flight and BE. **(T-1)**

27.3.13. An AF Form 592, *USAF Hot Work Permit*, is required whenever there is cutting, welding or brazing being accomplished outside of the designated shop area. **(T-1)** The directions for filling out and signing the AF Form 592 are contained in **Table 27.2** The hot work permit must be obtained from the installation FES Flight prior to starting welding operations. **(T-1)** The requirements for usage of the AF Form 592 are outlined in **Table 27.2** **Note:** BE assistance and coordination may be required, e.g., BE survey report, PPE listing/recommendation, etc.

27.4. Welding Equipment Precautions.

27.4.1. Protect welding torch hoses from damage caused by contact with hot metal, open flames, corrosive agents or sharp edges. Release pressure on hoses at the end of each workday, during lunch or break periods, when not in use for extended periods or when unattended (no one in the vicinity for observation). Visually inspect the entire length of welding hose once per shift and prior to use. This inspection is not required when equipment shall not be used during that shift.

27.4.2. Prior to use, repair or replace hoses exhibiting leaks, cuts, burns, worn spots or other evidence of deterioration. When using acetylene, ensure replacement hoses or fittings are approved for use with acetylene equipment. **(T-0)** When parallel lengths of oxygen and acetylene hoses are taped together for convenience and to prevent tangling, not more than 4 inches in each 12 inches shall be covered by tape. **(T-0)** Use a soap and water solution to check all recently repaired or replaced hoses for leaks; do not use an open flame. **(T-0)** Make sure hoses and hose connections are in serviceable condition. **(T-0)** Hose connections shall be of the ferrule type that shall withstand, without leakage, twice the normal service pressure (but not less than 300 psi). Use oil-free air or oil-free inert gas for the test. **(T-0)** Welding hoses are color coded: oxygen hoses are green, fuel gases are red and inert-gases or air are black. Hose connections are usually marked STD-OXY for oxygen and STD-ACET for acetylene. The acetylene union nut has a groove cut around the center to indicate left-hand threads. Make-shift repairs to oxygen/acetylene hoses or connections are not authorized. **(T-0)**

27.4.3. Provide shielding to protect personnel from heat, sparks, slag, light and ultraviolet radiation. **(T-0)**

27.4.4. To prevent personnel from inadvertently touching hot items, post warning signs around equipment or item(s) that are left unattended during welding operations. **(T-0)**

27.4.5. Wear appropriate PPE for the welding operation being performed. Welding in confined spaces, manholes or other restricted areas may require additional or special PPE. Refer to BE's

occupational and environmental health risk assessment for appropriate PPE, and paragraph **27.7** and **Chapter 23,** *Confined Spaces*.

27.4.6. In case of an emergency, ensure a means to quickly extract the welders is provided. **(T-1)** Refer to **Chapters 14** and **23** and AFI 90-821 for additional guidance.

27.5. Facilities.

27.5.1. Inside Areas. A specific area shall be designated and approved by the installation FES Flight, Occupational Safety office and BE for welding and cutting operations. **(T-1)** It shall be of fire resistant or noncombustible construction appropriate for its hazard classification, free of combustible and flammable materials, and segregated from adjacent areas. **(T-0)** This area shall be exempt from requiring an AF Form 592 on a daily basis. **(T-1)**

27.5.1.1. Where possible, welding activities shall be isolated from adjacent activities. **(T-1)** Workers and other personnel adjacent to the welding areas shall be protected from the radiant energy or spatter of welding and cutting arcs by the use of noncombustible and/or flameproof screens. **(T-0)**

27.5.1.2. Welding booth walls, screens and non-rigid heat and spark barriers used to isolate the welding activity shall be finished to limit reflectivity. **(T-1)** Booths, screens, etc., shall be arranged to ensure adequate ventilation. **(T-1)** Asbestos-containing materials shall not be used as barriers.

27.5.1.3. Where arc-welding is regularly performed adjacent to painted walls, the walls shall be painted with a finish having low reflectivity to ultraviolet radiation. **(T-1)**

27.5.1.4. Procedures shall be established to prevent personnel entering a welding area from inadvertently being exposed to welding hazards. **(T-0)** These procedures shall include, as a minimum, warning signs posted at all personnel entryways of designated welding areas. **(T-0)** These signs shall mandate the use of PPE before entering a welding environment. **(T-0)**

27.5.1.5. Combustible floors shall be kept wet and covered with damp sand or protected by fire resistant shields. **(T-0)** Where floors have been wet down and damp sand applied, rigid control shall be exercised over the grounding of equipment and personnel shall be protected from possible shock. **(T-0)** Caution shall be exercised against slips and falls on any wet surfaces. **(T-0)**

27.5.1.6. A fully charged and operable fire extinguisher, appropriate for the task, shall be kept at the work area at all times while welding operations are in progress. **(T-0)** Consult with the installation FES Flight for additional guidance.

27.5.1.7. Whenever there are cracks or other floor openings that cannot be closed or covered within 35 feet of the welding or cutting operation, precautions shall be taken to remove or otherwise protect combustible materials on the floor below that may be exposed to sparks. **(T-0)** The same precautions shall be observed with regard to cracks or openings in walls, open doorways, and open or broken windows.

27.5.1.8. Where a fire protection system exists, the system shall be fully operational while welding or cutting work is being performed and the proper fire extinguishing equipment shall be readily available. **(T-10** If welding or cutting is to be conducted within three (3) feet of automatic sprinkler heads, noncombustible sheet material or damp cloth guards shall

be used to temporarily shield the individual sprinkler heads. **(T-0)** The type of shielding shall be specified on the AF Form 592 by the issuing authority. Personnel authorized to issue permits shall: **(T-1)**

27.5.1.8.1. Inspect the area before allowing any welding, cutting or brazing activities to begin. **(T-1)**

27.5.1.8.2. Ensure a copy of the signed AF Form 592 is readily available in the immediate area of the welding, cutting and brazing operations. **(T-1)**

27.5.1.8.3. Fire watcher procedures shall be implemented whenever welding activities are within 35 feet of combustible materials, regardless of protection provided. **(T-0)** A qualified individual proficient in the operation of available fire extinguishing equipment and knowledgeable of fire reporting procedures shall observe welding or cutting activities. **(T-0)** Their duty is to detect and prevent the spread of fire produced by welding or cutting activities. An additional fire watcher may be required to observe areas that are hidden from the view of a single fire watcher (other side of partitions, walls, ceilings, etc.).

27.5.1.8.4. Provide a fire watch for a minimum of 30 minutes after completion of all welding, cutting and brazing work. **(T-0)** Utilize heat sensing meters to scan for hot spots in the work. **(T-1)** Do not leave the work area unattended during breaks in work during a work shift. **(T-1)** Walk and scan all areas of application checking for hot spots, fumes or smoldering, especially at wall and curb areas, prior to departure at the end of each work shift. **(T-1)** Ensure any and all suspect conditions are eliminated prior to leaving the site each work shift. **(T-1)**

27.5.1.8.5. When fire watchers are required, upon completion of their duties they shall sign Line 14 of the hot work permit and return it to the issuing authority. **(T-1)** If work continues for more than one day, the area shall be inspected prior to each day's operation to ensure that no conditions have changed and requirements of the original permit are in effect. **(T-0)** The permit shall be signed and dated daily in Block 12 at the completion of each day's work until completion of operations or as required by local policy. **(T-1)** Only the tasks authorized by the original permit shall be accomplished. Additional tasks shall require a new permit to be issued. **(T-1)**

27.5.1.8.6. At the completion of the fire watch, the following areas shall be inspected:

27.5.1.8.6.1. The work area and all areas within five (5) feet of the work area. **(T-1)**

27.5.1.8.6.2. If the work area is on a roof or floor above, the ceiling area and floor area on the level below the work area and void areas between the floors/roof. **(T-1)**

27.5.1.8.6.3. If the work area is in or above any vertical chase area, the chase area on the floor below, any chase areas in the void between the work area and the floor below, and the lowest level of the vertical chase. **(T-1)**

27.5.2. Outside Areas. When work cannot be moved, the area shall be made fire safe by removing combustibles or protecting combustibles from ignition sources. **(T-0)**

27.5.2.1. The welding operation shall be roped off or segregated by physical barrier whenever possible. **(T-1)** Placards reading *"WELDING OPERATIONS IN PROGRESS"*

shall be prominently displayed for warning purposes. **(T-1)** Protective screens, when possible, shall be placed around welding operations. **(T-1)** When screens are not feasible, workers and other personnel adjacent to the welding areas shall be required to wear appropriate personal protective goggles. **(T-1)**

27.5.2.2. Authorization, including an AF Form 592, to perform welding, cutting or brazing shall be obtained from the installation FES Flight prior to the start of such operations. **(T-1)** Refer to and **Table 27.2** for additional information regarding AF Form 592. Coordination with BE may be required for welding, cutting or brazing operations involving a hazardous task, e.g., BE survey report, PPE listing/recommendation, etc. **Note:** Hazardous tasks performed in an inside area shall comply with paragraph **27.5.1**. **(T-0)**

27.5.2.3. Fire watcher procedures shall be implemented per requirements in paragraphs **27.5.1.8.3** through **27.5.1.8.5** **(T-1)**

27.5.2.4. The welding operation environment shall be free of flammable liquids and vapors. Combustible materials within a radius of 35 feet of the operation shall be protected from activity residue (flame, sparks, slag, etc.). **(T-0)**

27.5.2.5. Fire extinguishing equipment shall be maintained, ready for use, while welding or cutting operations are being performed. **(T-0)** Equipment may consist of pails of water, buckets of sand, a hose or portable extinguisher, depending upon the nature and quantity of the combustible material exposed. The welding permit issuing authority shall identify the required fire extinguishing equipment. **(T-1)**

27.5.2.6. MAJCOMs/installations having activities involved in numerous daily welding, cutting and brazing operations are permitted to have a certification process whereby qualified and/or certified welding personnel (other than FES Flight personnel) may issue welding permits. If work continues for more than one day, the area shall be inspected prior to each day's operation to ensure no conditions have changed and requirements of the original permit are in effect. **(T-1)** The permit shall be signed and dated daily in Block 12 at the completion of each day's work until completion of the operations or as required by local policy. **(T-1)** Only tasks authorized by the original permit shall be accomplished. **(T-1)** Additional tasks shall require a new permit to be issued. **(T-1)** The following procedures are applicable:

27.5.2.6.1. Personnel certified by the installation FES Flight may authorize welding, cutting and brazing operations, using AF Form 592 for this purpose. **(T-1)**

27.5.2.6.2. The installation FES Flight shall instruct and qualify welding shop supervisors and other selected personnel. **(T-1)** Upon completing the required training, the installation FES Flight shall certify the individuals in writing. **(T-1)** Upon certification, trained personnel shall be qualified to issue permits. **(T-1)**

27.6. Installed Equipment.

27.6.1. Oxygen-Fuel gas system equipment devices or attachments used for the prior mixing of air or oxygen with flammable gases must be approved for that purpose, except devices at the burner or in a standard torch. **(T-0)**

27.6.2. When acetylene cylinders are coupled, approved flash arresters shall be installed between each cylinder and the coupler block. **(T-0)** For outdoor use only, and where the

number of cylinders does not exceed three, one flash arrester installed between the coupler block and regulators is acceptable.

27.6.3. Backflow protection shall be provided by an approved device that shall prevent oxygen from flowing into the fuel-gas system or fuel from flowing into the oxygen system. **(T-0)**

27.6.4. Flashback protection shall be provided by an approved device that shall prevent a flame from passing into the fuel-gas system. **(T-0)**

27.6.5. Back-pressure protection shall be provided by an approved pressure relief device, set at a pressure not greater than the pressure rating of the backflow or flashback devices, whichever is lower. **(T-0)**

27.6.6. These three functions of protective equipment (backflow, flashback and pressure relief devices) may be separate devices or combined into one device.

27.6.7. Clearly marked master shutoff valves shall be provided for installed systems at points where they shall be readily accessible. **(T-0)** If a wrench is required to operate the master shutoff valves, then at least one wrench for this specific purpose shall always be readily available in the immediate area of the master shutoff valves. **(T-0)**

27.7. Clothing and Personal Protective Equipment (PPE). Key portions of 29 CFR 1910.252 covering protective equipment are included here. Personnel engaged in or exposed to welding, cutting or brazing activities shall be provided and use the proper PPE. **(T-0)** The appropriate protective clothing required for specific welding operations shall vary with the size, nature and location of the work to be performed. **(T-0)** Refer to 29 CFR 1910.132, *Personal Protective Equipment*, AFI 48-137, *Respiratory Protection Program*, and **Chapter 14** for additional guidance.

27.7.1. Clothing shall provide sufficient coverage and be made of suitable materials to prevent skin burns caused by sparks, spatter, ultra violet radiation or electrical shock. **(T-0)** Front pockets and upturned sleeves or cuffs shall be prohibited. **(T-0)** Sleeves and collars shall be kept buttoned to prevent hot metal slag and sparks from contacting the skin. **(T-0)**

27.7.2. All welders and cutters shall wear protective flame-resistant gloves. **(T-0)** All gloves shall be in good repair, dry and capable of providing protection from electric shock by welding equipment. **(T-0)** Insulated linings shall be used to protect areas exposed to high radiant energy. **(T-0)** Operators will use hand protection during welder tip changing operations. **(T-0)**

27.7.3. Durable flame-resistant aprons made of leather or suitable materials shall be used to protect the front of the body when additional protection against sparks and radiant energy is needed. **(T-0)**

27.7.4. For heavy work, flame-resistant leggings or other equivalent means shall be used to provide additional protection for the legs. **(T-0)**

27.7.5. Cape sleeves or shoulder covers with bibs made of leather or other flame-resistant materials shall be worn during overhead welding, cutting or other operations, when necessary. **(T-0)**

27.7.6. Caps made from flame resistant material shall be worn under helmets, when necessary, to prevent head burns. **(T-0)**

27.7.7. Properly fitted flame-resistant plugs in the ear canals, or equivalent protection, shall be used where hazardous noise levels exist. **(T-0)** Consult installation BE for additional guidance.

27.7.8. When controls such as mechanical or natural ventilation fail to reduce air contaminants to allowable levels or when the implementation of such controls are not feasible, respiratory protective equipment shall be used to protect personnel from hazardous concentrations of airborne contaminants. **(T-0)** Only approved respirator equipment shall be used. **(T-0)** Consult BE and AFI 48-137 for additional guidance.

27.7.9. Eye Protection Requirements.

27.7.9.1. All welding helmets must meet 29 CFR 1910.252 requirements. **(T-0)**

27.7.9.2. Eye and face protective equipment shall be inspected for serviceability prior to each use. **(T-0)** For sanitary purposes, eye and face protectors shall not be shared by other employees. **(T-0)** Helmets shall be used during all arc-welding or arc-cutting operations, excluding submerged arc-welding. **(T-0)** Where the work permits, submerged arc-welders must be enclosed in an individual booth coated on the inside with a non-reflective material. **(T-0)** When two or more welders are exposed to the hazards of each other's welding operation, goggles shall be worn under the welder’s helmets or use of noncombustible or flameproof screens or shields to provide protection from harmful rays and flying debris. **(T-0)** Helpers or attendants shall be provided with the proper PPE, to include eye protection. **(T-0)**

27.7.9.3. Goggles or other suitable eye protection shall be used during all gas welding or oxygen cutting operations. **(T-0)**

27.7.9.4. All operators and attendants of resistance welding, resistance brazing equipment or while chipping slag shall use transparent face shields or goggles, depending on the particular job, to protect their faces or eyes as required. **(T-0)**

27.7.9.5. Eye protection in the form of suitable tinted goggles or spectacles shall be provided for torch brazing operations or soldering operations. **(T-0)** Spectacles shall be equipped with side shields. **(T-0)**

27.7.10. Specifications for Protectors.

27.7.10.1. Helmets and goggles shall be made of a material which is an insulator for heat and electricity. **(T-0)** Helmets, face shields and goggles shall not be readily flammable and shall be capable of withstanding sterilization. **(T-0)**

27.7.10.2. Helmets shall be arranged to protect the face, neck and ears from direct radiant energy from the arc. **(T-0)**

27.7.10.3. Helmets shall be provided with filter plates and cover plates designed for easy removal. **(T-0)**

27.7.10.4. All parts shall be constructed of a material which shall not readily corrode or discolor the skin. **(T-0)**

27.7.10.5. Goggles shall be ventilated to prevent fogging of the lenses as much as practicable. **(T-0)**

27.7.10.6. Cover lenses or plates shall be provided to protect each helmet or goggle filter lens or plate. **(T-0)**

27.7.10.7. All glass for lenses shall be tempered and substantially free from striae, air bubbles, waves and other flaws. **(T-0)** Except when a lens is ground to provide proper optical correction for defective vision, the front and rear surfaces of lenses and windows shall be smooth and parallel. **(T-0)**

27.7.10.8. Lenses shall bear some permanent distinctive markings by which the source and shade may be readily identified. **(T-0)**

27.7.10.9. All filter lenses and plates shall meet the test for transmission of radiant energy prescribed in American National Standards Institute/International Safety Equipment Association Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices.* **(T-0)**

27.7.10.10. Hand-held screens for shielding the face and eyes shall not be used, since they may be inadvertently held in the wrong position, thus not providing the proper protection. **(T-0)** Refer to National Institute for Occupational Safety and Health for additional guidance.

27.8. Training and Qualification. Trainees may perform welding only under the direct supervision of an instructor. **(T-0)** Each person performing welding operations shall be qualified to perform these operations when they have satisfactorily demonstrated their skill or proficiency to their supervisor. **(T-0)** Welders performing work on aircraft, aircraft components, missile or missile components shall be certified IAW TO 00-25-252, *Intermediate Maintenance and Depot Level Instructions Aeronautical Equipment Welding.* **(T-0)**

27.8.1. Prior to commencing a welding operation outside the welding shop, supervisors shall brief the welder on safety, health, weather and fire protection concerns or issues applicable to the specific job. **(T-0)**

27.8.2. Commanders shall ensure that supervisors and employees who handle, use or are potentially exposed to hazardous materials in the course of official Air Force duties are provided information and training on the Air Force Hazard Communications Program and specific hazards in the workplace. **(T-0)** Refer to AFI 90-821 for additional guidance.

27.8.3. If a welding operator requires specialized safety, health or fire protection guidance not addressed in this standard or in appropriate technical data, the supervisor shall instruct the welder prior to commencement of the job. **(T-1)** Assistance may be requested from the installation Occupational Safety office, FES Flight or BE.

27.9. Gas Leaks.

27.9.1. Check gas line connections for tightness after assembly and before lighting the torch. Use soapy water or the equivalent, not a flame.

27.9.2. If a leak is found around the valve stem when the valve is opened on a fuel-gas cylinder, the valve shall be closed and the gland nut tightened. **(T-1)** If this does not stop the leak, discontinue the use of the cylinder, remove it to the outdoors, and mark it with a DD Form 1577-2, *Unserviceable (Reparable) Tag.* **(T-1)** Place the cylinder in an upright manner well away from an ignition source and secure it to prevent falling. . **(T-1)** In the immediate area within a 50 foot radius of the leaking cylinder, place a sign warning personnel not to

approach the leaking gas cylinder with any ignition source, such as a lighted cigarette or lighter. . **(T-1)** In addition, place similar signs in locations which shall notify personnel of the danger before entering into the area. **(T-1)** These signs are intended to prevent personnel from entering into a danger zone while attempting to read the sign on the cylinder. Refer to **Chapter 29**, *Mishap Prevention Signs and Tags*, for danger signs specifications. Immediately notify the installation FES Flight of any fuel gas leaks. **(T-0)**

27.9.3. If the fuel gas should leak from the cylinder valve and cannot be shut off with the valve seat, follow the instructions in paragraph **27.9.2** **(T-1)**

27.9.4. If a leak should develop at the fusible plug or other safety device on the fuel-gas cylinder, follow the instructions in paragraph **27.9.2** **(T-1)** In addition, slightly open the cylinder valve to allow the fuel gas to escape slowly and immediately notify the installation FES Flight. **(T-1)** **Note:** Emergency cylinder repair kits are available and may be used to contain the leak until it can be moved outside. Signs warning personnel not to approach the leaking gas cylinder with any ignition source, such as a lit cigarette or lighters, shall be placed near the leaking cylinder. **(T-1)**

27.10. Welding Safety.

27.10.1. The welder shall never permit the live metal parts of an electrode holder to touch their bare skin. **(T-1)**

27.10.2. Welding gloves shall be dry. **(T-1)**

27.10.3. Electrode holders shall not be cooled by immersion in water.

27.10.4. Water-cooled holders for gas tungsten-arc, gas metal-arc, and carbon arc-welding shall not be used if there is a water leak or condensation which would adversely affect the safety of the operator.

27.10.5. The welding machines supplying power to the arc shall always be electrically disconnected when changing electrodes in gas tungsten-arc electrode holders. **(T-1)**

27.10.5.1. A mechanical switching device (disconnecting or isolating switch) used for changing the connections in a circuit or for isolating a circuit and/or equipment from a source of power, serves the same purpose as removing a plug from an outlet.

27.10.5.2. Never change electrodes with bare hands or wet gloves or when standing on wet floors or other grounded surfaces. **(T-1)**

27.10.6. Filter Lenses for Protection Against Radiant Energy. **Table 27.1** is a guide for the selection of the proper shade numbers. These recommendations may be varied to suit the individual's needs. Refer to 29 CFR 1910.252 and 29 CFR 1910.133, *Eye and Face Protection*, for additional guidance.

27.10.7. Inert Gas Welding and Brazing. When inert gas welding or brazing is performed in large chambers or furnaces, ensure workers are aware of and trained on dangers of inert gas asphyxiation. **(T-1)** Supervisors shall ensure chambers are completely ventilated and cooled prior to entry. **(T-1)** Also, ensure mechanical ventilation or approved positive pressure air supplied respiratory protection is provided. **(T-1)** Personnel shall comply with confined space requirements outlined in **Chapter 23**. **(T-1)**

27.10.8. Electron Beam Welding. Refer to manufacturer's instructions and applicable TOs. Centers, bases or installations performing electron beam welding shall develop operating instructions covering the specific equipment used. **(T-1)**

27.10.9. Plasma Arc-Cutting. Plasma arc-cutting operations are hazardous because of the high heat, brilliant light and fumes given off. Molten metal splatter and noise are also potential hazards. Engineering controls to mitigate these hazards should be considered during equipment installation. Because of the hazards involved, centers, bases and installations shall at a minimum:

27.10.9.1. Provide shielding and non-reflective surfaces (walls, floors, ceilings, etc.). **(T-0)**

27.10.9.2. Ensure adequate ventilation is provided or that positive pressure air supplied respiratory equipment is used. **(T-0)**

27.10.9.3. Install equipment of this type in an isolated area to prevent exposing workers of other operations. **(T-1)**

27.10.10. Air-Carbon-Arc-Cutting. In addition to normal protective equipment required for welding and cutting, air-carbon-arc-cutting requires shielding so molten slag shall not be blown by compressed air onto personnel or combustibles. **(T-1)**

27.10.11. Induction Welding and/or Brazing. Because of potential burns, induction welders shall pre-place filler materials within induction coils and shall not attempt to adjust the placement while the welding and/or brazing equipment is activated. **(T-1)** Inspect induction coil insulation prior to use to ensure serviceability. **(T-1)** Replace or repair damaged or deteriorated insulation. **(T-1)**

27.10.12. Magnesium-Thorium Welding, Cutting and Grinding. Coordinate proposed welding, cutting or grinding operations on magnesium-thorium and other potentially radioactive materials in advance with the installation Radiation Safety Officer (usually the BE or assigned to BE). **(T-1)** All personnel must comply with the Air Force requirements for handling and processing radioactive materials. Refer to AFI 40-201, *Managing Radioactive Materials In The US Air Force*, for additional guidance.

27.10.13. Electric Arc-Welding. Arc-welding is the fusion process based on the principle of generating heat with an electric arc jumping an air gap to complete an electrical circuit. When an electrode is touched to metal, the electrical circuit is completed and the current flows. Tremendous heat is concentrated at the point of contact. Hazards involved in this process are electrical shock-particularly in hot weather when the welder is perspiring, burns to the skin and eyes, and inadequate ventilation.

27.10.13.1. Safety Precautions. Many mishaps are caused by defective equipment, deliberate violation of safety precautions and/or neglect of safety rules or practices. Consequently, prior to use, welders need to inspect welding equipment to ensure the electrode connections and insulation on holders and cables are in good condition. They must keep hands and body parts insulated from the work, metal electrode and insulation on holders and avoid standing on wet floors or coming in contact with grounded surfaces. They must never perform welding operations outside the rated capacity of the welding cables. When welding must be performed in the open, persons working nearby shall wear

goggles or be warned against the hazard of exposing themselves to, or looking directly at, the arc. **(T-1)**

27.10.13.2. Inspection of Equipment. The welder shall inspect the cables periodically for looseness at the connections, defects due to wear or other damage. **(T-1)** Defective or loose cables are a shock and fire hazard. Defective electrode holders shall be replaced and connections to the holder tightened prior to use. **(T-1)**

27.10.14. Oxyacetylene Welding. This is one of the most common and widely used welding processes available. It can be used for fusion welding, brazing, soldering, cutting and hard surfacing. Hazards include burns to the skin and eyes, gas or oxygen leaks, flashbacks, cut hose whipping, improper handling and storage of cylinders and the potential for a cylinder to become a missile if it is punctured or if the valve should break off. Both oxygen and acetylene cylinders are stored according to instructions in TO 42B5-1-2, *Gas Cylinders (Storage Type) Use, Handling, and Maintenance.*

27.10.15. Gas-Shielded Welding. Gas-shielded welding is a fusion-welding process that uses the heat produced by an electric arc between a metal electrode and the work. An inert gas (helium or argon) is used to shield the electrode. The shielding gas flowing from the orifices in the torch head forms a protective blanket over the weld area. This prevents the air from coming in contact with the molten metal and contaminating the weld.

27.10.15.1. Tungsten-Inert Gas Welding. Tungsten-inert gas welding is a type of gas-shielded welding especially adapted for light gage metal because of its good concentration of heat, precise heat control and the ability to weld with or without filler metals. It is generally used with such metals as aluminum, magnesium and titanium. The principle hazards are the same as electric arc-welding (possible shock, ventilation and burns), except tungsten-inert gas welding takes place with little or no spatter, sparking or fumes.

27.10.15.2. Metal-Inert Gas Welding. Metal-inert gas welding is a type of gas-shielded welding similar to tungsten-inert gas, except it uses a wire fed electrode and is used for heavier gage metals. Metal-inert gas welding has the same hazards as tungsten-inert gas welding, except it does create sparks, spattering and can easily cause ultraviolet radiation burns to exposed skin.

27.10.16. Aircraft Welding.

27.10.16.1. Gas shielded tungsten arc-welding is the approved method for welding on aircraft. Welding on aircraft should be performed outside of hangars, if possible. An AF Form 592 shall be issued prior to all aircraft welding operations IAW **Table 27.2** **(T-1)** Welding shall only be performed on aircraft system components specified in the appropriate aircraft technical data. **(T-1)** Specific hazards associated with the task and emergency procedures shall be listed in Block 10 of the welding permit. **(T-1)** If more space is required to list all precautions, a welding fire safety checklist shall be prepared and attached to the form. **(T-1)** The welding supervisor shall ensure identified precautions and/or checklist items are followed. **(T-1)** The welding supervisor shall ensure the senior flightline supervisor (line chief and/or production supervisor) is cognizant of the restrictions in paragraphs **27.10.16.2** through **27.10.16.11** below. **(T-1)**

27.10.16.2. Ensure the senior flightline supervisor (production supervisor) is thoroughly briefed on the planned welding operation. **(T-1)** This supervisor is responsible for informing other senior flightline supervisors if aircraft from different units are on the ramp.

27.10.16.3. Do not weld on an aircraft while work is in progress on any system or component that contains or did contain fuel or other flammable or combustible liquids. **(T-1)**

27.10.16.4. Prior to the start of welding operations, fuel tank, engine fuel vents and any fuel tank opening shall be closed/plugged on all aircraft within 50 feet from the point of any welding. **(T-1)** All fuel lines, valves, manifolds and other fuel components on the aircraft where welding is being performed shall be in place, secured or capped prior to the start of and during such welding operations. **(T-1)**

27.10.16.5. Do not perform any other work within a 25 foot radius of any gas-shielded arc-welding operation. **(T-1)**

27.10.16.6. Do not weld on an aircraft while work is in progress on the fuel system of any other aircraft within 50 feet from the point of welding. **(T-1)**

27.10.16.7. Whenever welding is being performed in the vicinity of flammable vapors, a qualified person shall conduct an atmosphere analysis with a combustible gas analyzer to assure that flammable vapors do not reach 20 percent of the lower explosive limit. **(T-1)** Such analysis shall be conducted prior to the start of welding and at least every 15 minutes during the welding operation. **(T-1)** For confined spaces the lower explosive limit is lowered to 10 percent. Additionally, when welding in a hangar, check floor drains in the same manner. Refer to National Fire Protection Association 410, *Standard on Aircraft Maintenance*, and 29 CFR 1910.146, *Permit-Required Confined Space*, for additional guidance. National Fire Protection Association standards are normally available for review at the installation Occupational Safety office or FES Flight.

27.10.16.8. Rope off or segregate the welding operation by physical barriers. **(T-1)** Prominently display warning signs reading: "WELDING OPERATIONS IN PROGRESS." Place screens, when possible, around welding operations. **(T-1)**

27.10.16.9. Keep electrical welding equipment components (other than flexible lead cables) at least 18 inches above the floor. **(T-1)** Position all ground leads or cables as close as possible to the area being welded. **(T-1)** The ground leads shall be as close to the weld area as possible, and clamps used on such ground leads shall be of the "C" clamp type. **(T-1)**

27.10.16.10. Assign a trained fire guard to monitor the welding operation and halt the welding operation if a hazardous condition develops. **(T-0)** Provide the fire guard a 20 BC (minimum) rated fire extinguisher in the immediate area and a back-up wheeled extinguisher of 80 BC rating. **(T-1)** Ensure the fire watch is maintained for at least 30 minutes after completion of the welding operation to detect and extinguish smoldering fires. **(T-0)** Operations on combustible metals shall include the availability of a MET-X type fire extinguisher. **(T-1)** Refer to TO 00-25-252 for additional guidance.

27.10.16.11. Aircraft welding operations performed in hangars shall conform to **Chapter 6,** *Fire Protection and Prevention*, and National Fire Protection Association 410. **(T-1)**

27.10.17. Welding and Cutting Tanks, Cylinders or Containers. The following procedures apply only to tanks too small to be entered (compressed gas cylinders and pipelines are excluded). Ensure welding and cutting operations on containers that have held flammable liquids or gases are under the direct supervision of a trained and knowledgeable supervisor. **(T-1)**

27.10.17.1. Inspection. All containers should be considered unsafe for welding or cutting unless they have been rendered safe or declared safe by a qualified person. When welding or cutting containers, possibilities exist for explosions, fires and the release of toxic vapors or fumes. 27.10.17.2. Before any tank, cylinder or other container is cut, welded or other hot work is performed, ensure the container is purged or the item is inert. **(T-1)** Also, ensure there are no substances such as grease, tars or acids present that might produce explosive or toxic vapors when heated. **(T-1)**

27.10.17.2.1. Disconnect or blank any pipe lines or connections to the drums, cylinders, tanks or other containers.

27.10.17.3. Prior to work within, on or near the tank or container, test for flammable vapors with the appropriate combustible gas indicator (1) before commencing alterations; (2) immediately before and after starting any welding, cutting or heating operations; and (3) frequently during the course of the operation. **(T-1)**

27.10.17.4. All work shall be stopped immediately if the concentration of flammable vapors exceeds 10 percent of the lower flammable limit. **(T-1)** The source of vapors shall be located and removed. **(T-1) Warning:** New containers must also be inert or purged; they may contain a flammable preservative which could form explosive vapors when heated. **(T-1)**

27.11. Purging and Inert.

27.11.1. Purging with Steam. Steam may be introduced into the tank or container through a pipe inserted through an opening and bonded to the container, or by connecting a steam hose directly to one of the vessel nozzles. The rate of supply of steam should be sufficient to exceed the rate of condensation so the whole tank or container is heated close to the boiling point of water. The vessel must be steamed long enough to vaporize the residues from all portions of the walls (shell and heads). **(T-1)** When testing the atmosphere in the vessel with a combustible gas indicator, the sample should be drawn through a drying tube filled with calcium chloride or other drying agent to ensure that water vapor does not enter the instrument. If a drying agent is not available, the container must be allowed to cool off until excess water vapor has condensed. **(T-1)** Hazards inherent with steam operations require the use of PPE. **(T-0)** Supervisors must ensure PPE is serviceable and enforce its wear. **(T-0)** Refer to National Fire Protection Association 326, *Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair*, for additional guidance. **Warning:** Steam cleaning, chemical cleaning and high pressure water blasting can generate static electric charges.

27.11.2. Purging with Water. Where the liquid or gas previously contained is known to be readily displaced or easily soluble in water, it can be removed by completely filling the container with water and then draining, repeating this operation several times until clean. When hot work is performed on containers filled with water, extreme care shall be used to eliminate any possible vapor accumulation by the proper venting or positioning of the container during

the filling operation. Consult the installation Environmental Management office for disposal guidelines of purged materials. **(T-2)**

27.11.3. Purging with Air. Hazardous vapors may be displaced from inside containers by purging with air. A safe atmosphere shall be maintained by continuous ventilation. **(T-0)** Every precaution shall be taken to ensure all ignition sources have been removed from the vicinity since the concentration of vapor in the tank or container might reach the flammable range before a safe atmosphere is obtained. **(T-0)** The air mover shall be electrically bonded to the tank or container being cleaned. **(T-0)**

27.11.4. Inert With Gas. Inert gas may be used to displace flammable gas from the container. Adequate ventilation shall be maintained during the operation to ensure gas concentrations remain below hazardous levels. **(T-0)** Supervisors of this operation shall be thoroughly familiar with the limitations and characteristics of the inert gas being used. **(T-0)** Examples of inert gases are carbon dioxide, nitrogen and argon.

27.11.5. Venting. All hollow spaces, cavities or containers shall be vented to permit the escape of air or gases before preheating, cutting or welding. **(T-0)**

27.11.6. Atmospheric Monitoring. In all cases, during welding or cutting operations, continuous monitoring of the vessel's atmosphere with a properly calibrated combustible gas indicator is mandatory. **(T-0)**

27.12. Vehicle Maintenance Shops. Welding or cutting in vehicle maintenance activities shall only be conducted in areas approved by the installation FES Flight. **(T-1)** Maintenance shop supervision shall evaluate each welding or cutting task to determine if batteries or fuel tanks require removal and/or need to be made inert. **(T-1)**

27.13. Portable Gas Welding Units. Ensure portable gas welding, cutting and brazing equipment is a type designed for the use intended. **(T-1)**

27.13.1. Cylinders of compressed gas must have pressure reducing regulators installed. **(T-0)**

27.13.2. Cylinders in use or transport must be stored in an upright position and be secured to prevent them from falling. **(T-0)**

27.13.3. Gaseous systems and containers shall be color coded. **(T-1)** Refer to TO 42B5-1-2 for additional guidance.

27.13.4. Oxygen cylinders and fittings shall be kept free of grease and oil at all times. **(T-1)**

27.13.5. Cylinders shall be kept away from external sources of heat at all times. **(T-1)**

27.13.6. Cylinders shall not be dropped or handled roughly. **(T-1)** Cylinders or welding sets in excess of 40 pounds total weight shall be transported to and from work sites by cart or motorized vehicle. **(T-1)** When cylinders or welding sets are moved by crane or derrick, suitable cradles, boats or platforms shall be used. Slings or electric magnets shall not be used to move cylinders or welding sets.

27.13.7. Flashback protection shall be provided by an approved device that shall prevent a flame from passing into the fuel-gas system. **(T-0)**

27.13.8. Backflow protection shall be provided by an approved device that shall prevent oxygen from flowing into the fuel-gas system or fuel from flowing into the oxygen system. **(T-0)**

27.13.9. The flashback and backflow protection may be combined in one device or may be provided by separate devices. If one device is used, such as an approved mixing handle, additional backflow devices installed on the oxygen and fuel hoses near the regulator may be advisable should the mixing handle malfunction.

27.13.10. An acetylene valve shall not be opened more than one and one-half turns of the spindle and preferably no more than three-fourths of a turn. **(T-1)**

27.13.11. The cylinder valve shall always be opened slowly. **(T-1)** The wrench used to open the cylinder shall be left in position on the stem of the valve while the cylinder is in use. **(T-1)**

27.13.12. If cylinders are manifold or coupled, at least one wrench shall always be available for immediate use. **(T-0)**

27.14. Portable Electric Welding Units.

27.14.1. Circuits shall be de-energized before testing, checking or transporting. **(T-1)**

27.14.2. Motor-generator sets and other electrical welding equipment shall be grounded prior to use. **(T-1)**

27.14.3. Rotary and polarity switches shall not be operated while the equipment is under an electrical load. **(T-1)**

27.14.4. Arc-welding equipment shall be inspected periodically and prior to use following relocation. **(T-1)** Power cables and electrode holders shall be inspected prior to every use. **(T-1)**

27.14.5. These units shall be repaired by qualified electricians only. **(T-1)**

27.15. Arc-Welding.

27.15.1. Arc-welding equipment shall conform to the design and installation criteria of 29 CFR 1910.254, *Arc-Welding and Cutting.* **(T-0)** The frame or case of the welding machine, except engine driven machines, shall be grounded IAW 29 CFR 1910, Subpart S, *Electrical.* **(T-0)**

27.15.2. Before starting operations.

27.15.2.1. All connections to the arc-welding machine shall be checked and the work lead shall be firmly attached to the work. **(T-0)**

27.15.2.2. Contact surfaces of magnetic work clamps shall be free of metal spatter particles. **(T-0)**

27.15.2.3. Coiled welding cable shall be spread out before use to avoid overheating and damage to insulation. **(T-0)**

27.15.2.4. Work and electrode lead cables shall be inspected for damage and wear before use. **(T-0)** Cables with damaged insulation or exposed conductors shall be repaired or replaced. **(T-0)**

27.15.2.5. Electrode cables shall be joined and installed IAW applicable manufacturer's instructions or technical data. **(T-0)**

27.15.3. Grounding of the welding machine frame shall be checked. Special attention shall be given to the ground connections of portable machines. **(T-0)**

27.15.4. When not in use, electrode holders shall be placed where they cannot make electrical contact with persons, conducting objects, fuel or compressed gas cylinders. **(T-0)**

27.15.5. Welding cable connectors shall be used whenever welding cables require splicing or extending. (T-1) Cables with splices within 10 feet of the electrode holder shall not be used. **(T-0)**

27.15.6. Welders shall not place welding cable and other equipment where it shall obstruct passageways, ladders and stairways. **(T-0)**

27.15.7. Machines which have become wet shall be thoroughly dried and tested before being used. **(T-0)**

27.15.8. When welders are working close to each other, where they may touch the exposed parts of more than one electrode holder simultaneously, the machines shall be connected to minimize shock hazard as follows:

27.15.8.1. All direct current machines shall be connected with the same polarity. **(T-0)**

27.15.8.2. All alternating current machines shall be connected to the same phase of the supply circuit and with the same instantaneous polarity. **(T-0)**

27.15.9. Electromagnetic fields are generated by current flowing through welding cables during operation. These fields create a localized heating effect. The strength of the heating effect is increased by loops or coils in the cables. Welding personnel shall not coil or loop welding electrode cables around parts of their body. **(T-0)**

27.15.10. Workers 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-1) Note:** Workers, with pacemakers and other electrically active implanted medical devices, engaged in this type of work shall inform their supervisor. **(T-1)**

27.16. Resistance Welding.

27.16.1. Thermal Protection. Every pair of ignition tubes used in resistance welding equipment shall be equipped with a thermal protection switch. **(T-0)** When used in a series-connected water line, a single switch shall be adequate if related to the downstream tube. **(T-1)**

27.16.2. Control Safeguards. Controls, such as push buttons, foot switches, retraction and dual-schedule switches on portable guns, etc., shall be arranged or guarded to prevent inadvertent activation. **(T-0)**

27.16.3. Guarding Welding Machines. Multi-gun welding machines shall be effectively guarded at the point of operation. **(T-0)** Devices such as electronic eyes, latches, blocks, barriers or two-handed controls shall be installed. **(T-0)** All chains, gears, operating bus linkages and belts shall be protected by adequate guards. **(T-0)**

27.16.4. Electrical Hazards. All external weld-initiating control circuits shall operate on low voltage, not more than 120 volts for stationary equipment and not more than 36 volts for portable equipment. **(T-0)** All electrical equipment shall be suitably interlocked and insulated to prevent access by unauthorized persons to live portions of the equipment. **(T-0)** Only nonferrous welding clamps should be used to prevent magnetic induction during actuation of the equipment. **(T-1)**

27.17. Welding in Confined Spaces.

27.17.1. When a welder must enter and/or perform a welding, cutting or brazing operation in a confined space, the requirements for confined space entry in **Chapter 23** and AFI 48-137 shall be strictly adhered to. **(T-0)** Additionally, any welding, cutting or brazing in a confined space requires an AF Form 592, *USAF Hot Work Permit*, obtained from the installation FES Flight, with coordination by the installation Occupational Safety office and BE. Refer to **Table 27.2** for additional guidance. All welding, cutting or brazing equipment shall be inspected for leaks, abrasions or defective equipment prior to inserting into the confined space. **(T-1)** Equipment which fails the inspection process shall not be authorized within the space.

27.17.2. When working in a confined space, conduct a leak test of all joints in any gas lines (oxygen-acetylene) to prevent introducing gases into the confined space. **(T-1)** Before a welder enters a confined space, a visual inspection shall be conducted on all electrical cables and connections that shall be taken into the confined space. **(T-1)** Also, position the fuel gas cylinders, oxygen supply and welding machines outside of the confined space in a manner which shall not interfere with egress. **(T-1)** When possible, remove unused torches and hoses from the confined space. Before operations are started, heavy portable equipment mounted on wheels shall be securely blocked to prevent accidental movement. **(T-0)** In addition, strictly adhere to all requirements in **Chapter 23**. **(T-1)**

27.17.3. All welding and cutting operations performed within confined spaces shall be adequately ventilated to prevent the accumulation of toxic materials or possible oxygen deficiency. **(T-0)** This applies not only to the welder, but also to helpers and other personnel in the immediate vicinity. As the existing air is withdrawn, it shall be replaced with fresh air which is clear and respirable. **(T-0)** A continuous monitoring system, with audible alarms, shall be used for confined space work. **(T-0)** Gases such as argon, propane and carbon dioxide are heavier than air. Gases such as helium and natural gas are lighter than air. Oxygen shall never be used for ventilation.

27.17.4. In such circumstances, where it is impossible to provide such ventilation, BE shall determine the appropriate level of respiratory protection required. **(T-1)** Only positive pressure air supplied respirators approved for use by BE are authorized. **(T-1)**

27.17.5. Where welding operations are performed within confined spaces, a trained attendant with a pre-planned rescue procedure shall be stationed outside the confined space(s) to ensure the safety of those working within the space. **(T-0)**

27.17.6. When gas welding or cutting, the torch valves shall be closed and the fuel-gas and oxygen supply to the torch positively shut off outside the confined area whenever the torch is not to be used for a substantial period of time, e.g., when left unattended for 30 minutes or more. **(T-1)** Where practicable, torches and hoses shall also be removed from the confined space. **(T-1)**

27.17.7. When arc-welding is to be stopped for any substantial period of time, such as during lunch or overnight, all electrodes shall be removed from the holders and holders carefully located so that accidental contact cannot occur. **(T-1)** Also, the machine shall be disconnected from the power source. **(T-1)**

27.18. Hazards Associated with Fluxes, Coverings, Filler Metals and Base Metals. Note: If any process has not already been evaluated, contact BE for an occupational and environmental health risk assessment.

27.18.1. Fluorine Compounds. The need for local exhaust ventilation or air supplied respirators for welding or cutting in other than confined spaces shall depend upon the individual circumstances. **(T-0)** However, such protection is desirable for fixed-location production welding and for production welding on stainless steel. Where air samples indicate that fluorides liberated are below the maximum allowable concentration, such protection is not necessary. However, before use, read and understand the manufacturer‘s instructions, always consult the SDSs and BE when handling fluorine compounds. Even when air samples are below the allowable levels, ensure employees are aware of the following:

27.18.1.1. The worker shall keep their head out of the fumes. **(T-0)**

27.18.1.2. Use sufficient ventilation or exhaust at the work, or both to keep fumes and gases from the breathing zone. **(T-0)**

27.18.1.3. Avoid contact of flux with eyes and skin. **(T-0)**

27.18.2. Zinc. Indoor welding or cutting involving zinc-bearing base or filler metals coated with zinc-bearing materials shall require mechanical ventilation to remove the fumes. **(T-0)**

27.18.3. Lead. In confined spaces or indoors, welding or cutting involving metals containing lead, other than as an impurity, or involving metals coated with lead-bearing materials including paint, shall be performed using local mechanical exhaust ventilation. **(T-0)** Workers in the immediate vicinity of the cutting operation shall be protected, as necessary, by ventilation, or respiratory protection, as directed by BE’s occupational and environmental health risk assessment. **(T-0)**

27.18.4. Beryllium. Welding or cutting involving beryllium-containing base or filler metals shall be performed using local mechanical exhaust ventilation and positive pressure airline respirators unless atmospheric tests, under the most adverse conditions, have established that the worker's exposure is within permissible concentrations. **(T-0)** Workers in the immediate vicinity of the welding or cutting operations shall be protected as necessary by local mechanical exhaust ventilation or respiratory protection, as directed by BE’s occupational and environmental health risk assessment. **(T-0)**

27.18.5. Mercury. Welding or cutting indoors or in a confined space involving metals coated with mercury-bearing materials, including paint, shall be performed using local exhaust ventilation or positive pressure air supplied respirators unless atmospheric tests, under the most adverse conditions, have established that the worker's exposure is within permissible concentrations. **(T-0)**

27.18.6. Cleaning and Other Operations Involving the Use of Chlorinated Hydrocarbons. Do not locate these operations in areas where vapors or mists may reach the vicinity of welding operations. **(T-0)** In addition, keep trichloroethylene and perchloroethylene away from the

ultraviolet radiation of welding operations. **(T-0) Note:** Refer to SDSs associated with specific chemical hazards and BE for determining exposures and adequacy of ventilation systems, and recommending appropriate respiratory protective devices where chemical hazards exist or may be believed to exist.

27.18.7. Hexavalent Chromium. Welding or cutting on materials containing chromium, such as stainless steel and painted surfaces, to include the use of welding rods, may generate hazardous levels of hexavalent chromium. Contact BE for an occupational and environmental health risk assessment.

Table 27.1. Selection of Proper Shade Number for Welding Operations.

Filter Lenses for Protection against Radiant Energy Minimum *Protective			
Operations	**Electrode Size 1/32 in.**	**Arc Current**	**Shade**
Shielded Metal Arc-Welding			
	Less than 3	Less than 60	7
	3-5	60-160	8
	5-8	160-250	10
	More than 8	250-550	11
Gas Metal Arc-Welding and Flux Cored Arc-Welding (MIG)			
		Less than 60	7
		60-160	10
		160-250	10
		250-500	10
Gas Tungsten Arc-Welding (TIG)			
		Less than 50	8
		50 – 150	8
		150 – 500	10
Air Carbon	(Light)	Less than 500	10
Arc Cutting	(Heavy)	500 – 1000	11
Plasma Arc Welding			
		Less than 20	6
		20 – 100	8
		100 – 400	10
		400 – 800	11
Plasma Arc-Cutting			
	(Light)**	Less than 300	8
	(Medium)**	300 – 400	9
	(Heavy)**	400 – 800	10
Torch Brazing			3
Torch Soldering			2
Carbon Arc-Welding			14

Operation	Plate Thickness (Inches)	Plate Thickness (mm)	Minimum Protection Shade
Gas Welding:			
Light	Under 1/8	Under 3.2	4
Medium	1/8 to 1/2	3.2 to 12.7	5
Heavy	Over 1/2	Over 12.7	6
Oxygen Cutting:			
Light	Under 1	Under 25	3
Medium	1 to 6	25 to 150	4
Heavy	Over 6	Over 150	5
*As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives a sufficient view of the weld zone without going below the minimum. In oxy-fuel gas welding or cutting, where the torch produces a high yellow light, use a filter lens that absorbs the yellow or sodium line in the visible light spectrum of the operation. **These values apply where the actual arc is clearly seen. Lighter filters may be used when the arc is hidden by the item being welded.			

Table 27.2. How To Fill Out AF Form 592, *Hot Work Permit.*

Block 1.	Control Number. Control numbers should be kept in a log so duplicate numbers are not assigned. A control number consists of the year, a dash, and the number from the log. Example: 03-001 would be the first control number assigned in the year 2016.
Block 2.	Date Permit Issued. (Self-Explanatory)
Block 3.	Time Permit Issued. (Self-Explanatory)
Block 4.	Organization/Contractor/Company: Name and Contact Information
Block 5.	Location: Is it located in a Facility? What Floor? Is work being done on an Aircraft? What is the Aircraft Tail Number? Is the Aircraft Inside or Outside a Hangar? Are munitions present?
Block 6.	Description of Work: Give a brief description of work.
Block 7.	Is Fire Watch required? See chart on back of form. Answer Yes or No. Performed by: Who is performing the Fire Watch?
Block 8.	Permit Authorizing Individual fills out Inspection Checklist prior to execution of hot work. If work is to be performed in a confined space, coordinate with SEG/BE/FES Flight & attach to the AF Form 1024, *Confined Space Entry Permit.*
Block 9.	PAI signature granting permission to execute work.
Block 10.	Operator/On-scene supervisor signature stating understanding of responsibilities under AFMAN 91-203 and National Fire Protection Association 51B.
Block 11.	Installation BE signature confirming coordination, as required.
Block 12.	Fire Watch signature confirming Final Check completion.
Block 13.	Any additional information.

Chapter 28

INTERIOR SPRAY FINISHING

28.1. Scope. Painting, doping and paint removal hazards include exposure to toxic materials and flammable or explosive mists, particulates and vapors. Inhalation of mists and vapors from paints, solvents, thinners, cleaning chemicals, strippers and epoxies can be injurious depending upon the agent's toxic characteristics and the amount and method of exposure. Three of the more toxic pigment ingredients are lead, antimony and chromates. Their use shall be avoided. **(T-0)** In addition, paints containing epoxy or polyurethanes can cause respiratory sensitization. Respiratory sensitization results from an allergic reaction to a given substance. This sensitivity develops during the induction period, which may be a few days to a few months. After sensitivity is established, exposure to even a small amount of the sensitizing material can produce a severe reaction. Refer to AFI 90-821, *Hazard Communication (HAZCOM) Program*, and **Chapter 2,** *General Work Procedures,* and BE workplace evaluations for additional guidance and information.

28.2. Safety.

28.2.1. Equipment used in painting operations is hazardous. Therefore, functional managers shall ensure spray painting operations are closely supervised and equipment is in serviceable condition. **(T-0)**

28.2.2. Other Equipment. Painter's ladders, scaffolds, lifelines and other equipment shall be inspected prior to use to ensure all equipment is in a safe condition. **(T-0)** Refer to **Chapter 7,** *Walking – Working Surfaces,* **Chapter 14,** *Personal Protective Equipment (PPE),* and **Chapter 22,** *Flammables and Combustibles,* for additional guidance and information. Powered industrial trucks, man lifts and other aerospace ground equipment shall meet the requirements of 29 CFR 1910.178, *Powered Industrial Trucks,* for Class I, Division I locations. **(T-0)**

28.2.3. Paint Mixing. Paint or dope mixing shall be performed in designated areas, which will be adequately ventilated rooms constructed of fire-resistant materials. **(T-0)** The mixing of paint may be accomplished out of doors with approval of the installation Environmental Management office. Otherwise, paint shall only be mixed in a covered, dust-controlled area and shall not exceed local air emission standards. **(T-0)** All sources of ignition shall be prohibited in mixing areas. **(T-0)** All electrical fixtures or equipment within 20 feet of designated paint preparation areas shall meet the requirements of National Fire Protection Association 70, *National Electrical Code,* for Class 1, Division 1 locations. **(T-0)** Mixing rooms shall have spill control and cleanup measures in place for cleaning up large and small spills. **(T-0)**

28.2.4. Housekeeping. Good housekeeping is essential in paint and dope shops to control leakage and prevent the accidental escape of flammable, combustible or toxic liquids. Spills shall be cleaned up promptly. **(T-0)** Work clothing shall be stored in metal lockers that are vented at top and bottom. **(T-0)** Street clothing and protective clothing shall be kept in separate lockers. **(T-0)** Paint rooms, booths, etc., shall be kept clean with equipment stored in a proper and orderly manner. Rags or waste soiled with sprayed materials shall be deposited in approved self-closing metal waste containers immediately after use. **(T-0)** IAW 29 CFR 1910.107(g) (3), *Residue Disposal,* the contents of waste containers shall be disposed of at the end of each shift

or at least once daily. **(T-0)** Contact the installation Environmental Management office for waste disposal guidance. Paint stored in workshops shall be kept in tightly covered metal containers and meet the requirements of **Chapter 22. (T-0)**

28.2.5. Personal Protective Equipment. Personnel engaged in painting and paint removal shall wear protective clothing, respiratory devices (if required) and appropriate face, eye and hand protection. **(T-0)** Clothing shall be changed, as needed, to minimize body contamination and reduce the fire hazard. **(T-0)** Personnel engaged in the application of dopes and paints will wear an apron or equivalent protection impervious to paints, solvents and dopes. **(T-0)** These aprons and clothing shall be kept clean and, when not in use, shall be hung in ventilated metal lockers. **(T-0)** Refer to **Chapter 14** for additional guidance.

28.2.6. Eye Protection. Personnel using abrasive techniques to prepare surfaces for painting shall wear suitable eye protection to protect their eyes from chips and flying particles. **(T-0)** Eye protection and rubber gloves shall be worn when using acids, lye or noxious cleaning materials. **(T-0)** Refer to **Chapter 14** for additional guidance.

28.2.7. Respiratory Protection. BE's occupational and environmental health risk assessment determines respiratory protection. Refer to **Chapter 14** for additional guidance.

28.3. Health/Environmental Protection.

28.3.1. Radioactive Luminous Paint. This paint presents a potential health hazard and shall not be used without approval of the installation Radiation Safety Officer (usually the BE or assigned to BE). **(T-0)** Refer to AFI 40-201, *Managing Radioactive Materials in the US Air Force*, for additional guidance.

28.3.2. Protective Creams. Hand protective creams are available and may be used by employees engaged in cleaning and painting. These creams, when applied to the skin prior to painting operations, help protect the skin and facilitate the removal of contaminants by washing in water. Refer to BE's occupational and environmental health risk assessment for additional guidance.

28.3.3. Personal Hygiene. IAW 29 CFR 1910.134(g)(1)(i)(A), personnel required to wear tight fitting respiratory protection shall be clean shaven so facial hair will not interfere with the face- piece seal of the respirator. **(T-0)** Employees shall keep hands and faces clean, clothes shall be changed when contaminated, and hands and soiled objects shall be kept out of the mouth. **(T-0)** No food or drink shall be brought into or consumed in paint and dope shops. **(T-0)** Employees shall wash their hands prior to smoking or consuming food outside the work area. **(T-0)**

28.3.4. Air and Water Pollution. Painting and paint removal operations can cause air and water pollution problems impacting both the installation and local community. Liquid, solid and gaseous waste products from painting and paint removal operations shall be disposed of IAW AFI 32-7040, *Air Quality Compliance and Resource Management*, AFI 32-7042, *Waste Management*, and as specified and approved by the installation CE. **(T-0)**

28.4. Fire Prevention.

28.4.1. Fire Prevention. Some painting operations may pose fire hazards, e.g., paint removal, solvent wipe and paint application by means of spray apparatus. Refer to **Chapter 6,** *Fire Protection and Prevention;* National Fire Protection Association 10, *Standard for Portable*

Fire Extinguishers, National Fire Protection Association 13, *Standard for the Installation of Sprinkler Systems*, and National Fire Protection Association 33, *Spray Applications Using Flammable and Combustible Materials*, for additional guidance.

28.4.2. Paints. Certain paints, lacquers, dopes, varnishes, shellacs, solvents, thinners and dilatants are very flammable. Other paints, under certain conditions, will burn violently. These paints, for control purposes, are classified as flammable, unless specifically stated by the manufacture as being combustible.

28.4.3. Paint Remover. Paint removers are corrosive and are considered flammable or combustible based on their flash point. They may contain volatile ingredients and the residue after evaporation may also be flammable or combustible.

28.4.4. Solvents. Solvent materials used for residual cleanup, after the initial removal, will have a flashpoint of 140°F or above. Cleaning operations using flammable or combustible solvents shall be conducted inside spray areas with ventilating equipment operating. **(T-0)**

28.4.5. Methyl Ethyl Ketone. Methyl ethyl ketone used as a solvent wipe-down on aircraft just prior to painting. Methyl ethyl ketone is extremely flammable with a flashpoint of 21°F. At normal working temperatures, methyl ethyl ketone presents a constant fire hazard. Use extreme caution to ensure there are no ignition sources in the area and ventilation is adequate to remove flammable vapors. Employees shall use approved respiratory protection IAW AFI 48-137, *Respiratory Protection Program,* and minimize skin contact. **(T-0)**

28.4.6. Storage. Paints and solvents shall be stored IAW **Chapter 22**. **(T-0)**

28.4.7. Spray Painting. Spray painting presents varying degrees of fire hazards, depending on the materials used. Some are particularly dangerous, and the same precautions pertaining to solvent wipe-down apply. Any material having a flashpoint below 140°F shall be handled carefully, and precautions are in order even for those having a flashpoint higher than this. **(T-0)**

28.4.8. Housekeeping. Solvent or paint-soiled rags, paper towels and kraft paper can produce spontaneous ignition. Contaminated materials shall be removed and placed in approved self-closing metal containers plainly marked to indicate the contents. **(T-0)** At the end of each shift or at least once daily, these containers shall be emptied or removed to an approved location outside the shop for pickup and disposal. **(T-0)** Contact the installation Environmental Management office for waste disposal guidance. Refer to 29 CFR 1910.107(g)(3) for additional guidance.

28.4.9. Sprinklers. Fire suppression sprinklers installed in spray finishing areas shall conform to National Fire Protection Association 13. **(T-0)** Dry chemical or carbon dioxide extinguisher systems may be installed where automatic sprinkler protection is not available. Refer to National Fire Protection Association 12, *Standard on Carbon Dioxide Extinguishing Systems*, and National Fire Protection Association 17, *Standard for Dry Chemical Extinguishing Systems,* for additional guidance.

28.4.10. Extinguishers. Portable fire extinguishers shall be installed near all paint spraying areas. Refer to **Chapter 6** for additional guidance. **(T-0)**

28.5. Ventilation Systems.

28.5.1. Ventilation. Each spray area shall be provided with mechanical ventilation capable of confining and removing vapors and mists to a safe location and capable of confining and controlling combustible residues, dusts and deposits. **(T-0)** Mechanical ventilation shall be kept in operation whenever spray operations are conducted and for a sufficient time thereafter to allow ventilation of vapors from drying coated objects or material and residues. **(T-0)** An adequate supply of makeup air shall be provided. **(T-0)** BE shall be consulted for questions concerning makeup air requirements. **(T-0)** Ventilation and exhaust systems shall be installed and conform to the provisions of this chapter and National Fire Protection Association 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Noncombustible Particulate Solids*. **(T-0)** Refer to American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance*, for additional guidance.

28.5.2. Exhaust and Ventilation Units. The rotating elements of the exhaust fan shall be of nonferrous materials or the fan shall be constructed so that a shift of the impeller or shaft shall not permit two ferrous parts to rub or strike together. **(T-0)** There shall be ample clearance between the rotating element and fan casing to avoid a fire caused by friction. **(T-0)** Necessary allowances shall be made for ordinary expansion and loading, and to prevent contact between moving parts and the duct or fan housing. **(T-0)** Fan blades shall be mounted on a shaft rigid enough to maintain alignment when the fan is operating under full load. **(T-0)** All bearings shall be of the self-lubricating type or shall be lubricated from a point outside the duct and, preferably, shall be located outside the duct and the booth. **(T-0)**

28.5.3. Exhaust Ducts. Exhaust ducts shall be protected against mechanical damage, properly supported and shall normally have a separation of at least 18 inches from combustible materials. **(T-0)** Ducts shall be periodically inspected for accumulation of paint deposits and shall be cleaned as needed. **(T-0)**

28.5.4. Exhaust. Exhaust air from spray operations shall be directed so it shall not contaminate makeup air introduced into the spraying area or other ventilation intakes. **(T-0)** Unless the spray booth exhaust is from a water wash spray booth, the terminal discharge point shall be at least 6 feet from any combustible exterior wall or roof and will not discharge within 25 feet of any combustible construction or unprotected opening in any noncombustible exterior wall. **(T-0)**

28.5.5. Drying. Freshly sprayed articles shall only be dried in spaces with adequate ventilation to prevent the accumulation of explosive vapors. **(T-0)** If adequate and reliable ventilation is not provided, such drying spaces shall be considered as spraying areas. **(T-0)**

28.5.6. Motors. Unless approved for use in a flammable vapor/dust environment, electric motors driving exhaust fans shall be placed outside of booths or ducts. **(T-0)** Drive belts shall not enter the duct or booth unless the belt and pulley within the duct or booth are enclosed and guarded. **(T-0)**

28.5.7. Minimum safety, fire prevention and occupational health requirements pertaining to ventilation are addressed in this chapter. Ventilation and exhaust systems details, including information on flow-rate requirements, and the design of ventilation and exhaust systems are in the most current edition of the American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance.* BE will determine what, if any, periodic testing of ventilation systems is required. **(T-0)**

28.6. Storage and Handling.

28.6.1. Storage. Limit the quantity of paints, lacquers, thinners, solvents and other flammable and combustible liquids kept near spraying operations to the minimum required for operations, but not to exceed one day's supply. Storage in process areas shall be no more than three (3) approved flammable liquids storage cabinets in any single process area without the approval of the authority having jurisdiction. **(T-0)** Storage shall be listed or designed and constructed to meet the requirements of National Fire Protection Association 30. **(T-0)** Any single cabinet shall contain no more than 454 liters (120 gallons) of Class I, Class II or Class IIIA liquids, of which no more than 227 liters (60 gallons) shall be Class I and Class II liquids. **(T-0)** Bulk storage of these liquids shall be in a separate detached building or in rooms specifically designed and constructed to meet flammable storage requirements, e.g., inside smaller paint booth installations. **(T-0)** Operations involving water-base latex paints are exempt from the above requirements. Refer to **Chapter 22** for additional guidance and information.

28.6.2. Containers. Flammable or combustible liquids brought into spray finishing rooms shall be in original closed containers, approved portable tanks, approved safety cans or by a properly arranged system of piping. **(T-0)** Containers shall be marked IAW AFI 90-821. Open or glass containers shall not be used. **(T-0)**

28.6.3. Liquid Transfer. The withdrawal of liquids from containers and the filling of containers, including portable mixing tanks, shall be done only in a mixing room or in a spraying area. **(T-0)** The ventilating system shall be in operation. **(T-0)** Precautions shall be taken to prevent liquid spillage. **(T-0)**

28.6.4. Grounding. Whenever flammable or combustible liquids are transferred from one container to another, both containers shall be effectively bonded and grounded. **(T-0)** Piping systems used to transfer fluids shall also be properly bonded and grounded. **(T-0)**

28.7. Electrical.

28.7.1. Electrical Wiring. Electrical wiring and equipment shall conform to the provisions of National Fire Protection Association 33, *Standard for Spray Application Using Flammable or Combustible Materials*. **(T-0)** Electrical wiring located in spray areas must be in rigid metal conduit, Type MI cable, or in metal boxes or fitting containing no taps, splices or terminal connections. **(T-0)** There are alternative electrical wiring options when the location is adjacent to, rather than inside, a spray area. Refer to National Fire Protection Association 33 for additional guidance.

28.7.2. Electrical Equipment. Electrical equipment outside, but within 20 feet horizontally and 10 feet vertically, of any spraying area and not separated from it by partitions extending at least to the boundary of the Division 2 location shall be of a non-spark-producing design. **(T-0)** This equipment shall also conform to the provisions of the *National Electrical Code* for Class 1 or Class 1, Division 2 locations, as applicable. **(T-0)** Refer to the illustrations in National Fire Protection Association 33 for examples of how these space limitations apply. If spraying operations are confined to an enclosed spray booth or room, the space adjacent to the booth or room shall be considered non-hazardous except for the space within three (3) feet (in all directions) of any opening in the booth or room. **(T-0)**

28.7.3. Electric Lamps. Electric lamps outside of, but within 20 feet, of any spraying area and not separated by a partition, shall be totally enclosed to prevent hot particles from falling should

breakage occur, and shall be protected from mechanical damage by guards or by location. **(T-0)** Portable electric lamps shall not be used in any spraying area during spraying operations. **(T-0)**

28.7.4. Grounding. All metal parts of spray booths, exhaust ducts and piping systems conveying flammable or combustible liquids or aerated combustible solids shall be electrically grounded in an effective and permanent manner. **(T-0)**

28.7.5. Heaters. If a heater is used to heat the liquid being sprayed, it shall be low-pressure steam, low-pressure hot water or electricity. **(T-0)** If electric, it shall be approved and listed for the specific location in which it is used. **(T-0)** Heaters shall not be located in spray booths or other locations subject to the accumulation of combustible residue. **(T-0)** Agitators, if used, shall be driven by compressed air, water, low-pressure steam or electricity. **(T-0)** If powered by an electric motor, the motor shall meet the requirements of National Fire Protection Association 33. **(T-0)**

28.8. Location of Paint Shops, Dope Shops and Spray-Finishing Operations.

28.8.1. Paint Shops. Paint and dope shops shall be located in separate one-story buildings with fire-resistant floors, walls and ceilings. **(T-1)** They may be located in specially constructed rooms if separated from other operations by fire-resistant walls. Paint and dope shops shall be provided with automatic sprinkler protection. **(T-0)** Supervisors will avoid locating these shops near ignition sources. **(T-1)** Refer to National Fire Protection Association 33 for additional guidance.

28.8.2. Spray Booths. When possible, paint spray booths shall be located in the paint and dope shop. In industrial facilities, spray-finishing operations shall be located and protected to minimize possible damage to other property by fire or by extinguishing agents. **(T-1)** All spray booths shall be installed and conform to the requirements in National Fire Protection Association 33, the BE occupational and environmental health risk assessment and American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance*. **(T-0)**

28.8.3. Prohibited Locations. Spray-finishing operations shall not be conducted in an administrative, educational or public assembly facility, unless in a room specifically designed for the purpose, protected with an automatic sprinkler system and separated vertically and horizontally from such occupancies by not less than 2-hour fire-resistance construction. **(T-0)**

28.9. Paint Spray Booths.

28.9.1. Construction. American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance,* provides guidance on construction and installation of ventilating systems for paint spraying operations and includes illustrations of both dry and water wash paint spray booths.

28.9.2. Exhaust Filters.

28.9.2.1. Filter pads and filter rolls shall be inspected after each painting operation and replaced when necessary or from a tracking log based on the number of hours in use. **(T-1)** Consult the manufacturer's manual or the installation Environmental Management office for the proper replacement interval.

28.9.2.2. Automatic-advance roll filters shall be equipped with interlocks to stop the spraying operation should the roll advance mechanism fail. **(T-1)**

28.9.2.3. Filter pads and rolls shall be made of noncombustible materials. **(T-0)**

28.9.2.4. Both filter pads and rolls shall be changed when changing coating materials if the two materials are susceptible to spontaneous combustion when in contact with each other. **(T-0)**

28.9.2.5. Discarded filter pads and rolls shall be removed from the area daily unless water-filled metal containers are provided to hold them immersed until disposal. **(T-0)**

28.9.3. Baffle Plates. Baffle plates, if used, shall be made of noncombustible material and readily removable or accessible on both sides for cleaning. **(T-0)** Such plates shall be grounded. **(T-0)**

28.9.4. Extinguishers. The appropriate type and size portable fire extinguishers shall be located within the work area IAW National Fire Protection Association 10 and the installation FES Flight. **(T-0)** Refer to **Chapter 6** for additional guidance.

28.9.5. Floor Covering. The floor of paint spray booths shall be covered with a noncombustible mat, removable for cleaning or disposal. **(T-0)** If an overspray covering is not feasible, consult the installation Occupational Safety office for additional guidance.

28.9.6. Flame-Producing Devices. Using or carrying of matches, lighters or other spark or flame-producing devices in or adjacent to paint spray booths is prohibited.

28.9.7. Containers. Containers supplying spray nozzles shall be a closed type or provided with metal covers, which shall be kept closed. **(T-0)** Original shipping containers shall not be subjected to air pressure above atmospheric for supplying spray nozzles. **(T-0)** Containers under pressure exceeding atmospheric pressure shall be designed and approved for such use, shall be provided with a visible pressure gauge and shall be provided with both a relief valve and a shutoff valve. **(T-0)**

28.9.8. Hoses and Couplings. Pressure hoses and couplings shall be regularly inspected for condition and shall be replaced, as needed. **(T-0)** When positive displacement pumps are used, a relief valve shall be installed in the discharge line to prevent overpressure. **(T-0)**

28.10. Compressed Air Paint Spraying.

28.10.1. On compressed air spraying equipment, a pressure regulator valve shall be installed in the air line between the compressor and painting equipment. **(T-0)** A pressure relief valve and a pressure gauge shall be installed between the pressure regulator and pressurized paint containers and/or spray guns. **(T-0)** Pressure relief valves shall be set to open at pressures not more than 10 pounds above the required working pressure. **(T-0) Warning:** Compressed air shall not be directed toward a fellow employee. **(T-0)**

28.10.2. Air Hoses. All hoses shall be checked prior to each shift to ensure they are properly connected to both their pipe outlets and the equipment to be used. **(T-0)** Air hoses shall not be connected to a pipe outlet unless the loose end is secured, since a loose hose connected to a compressed air outlet will whip. **(T-0)** Hose couplings shall be incompatible with airline respiratory protection hoses and/or respirators. **(T-0) Note:** Quick release fittings or similar

devices that prevent flow or air when hose is not attached to a tool or other equipment, may be used in place of securing the loose end of an air hose.

28.10.3. Any hose showing signs of deterioration, leakage or weakness in its carcass or at the coupling shall be withdrawn from service and repaired or discarded. **(T-0)**

28.10.4. Portable Paint Spray Equipment**.**

28.10.4.1. Description. Equipment usually consists of an air compressor, paint spray gun and hose. The paint reservoir on most portable spray guns holds one quart of fluid or less. When a considerable amount of paint is to be applied, a 2-1/2 or 5-gallon pressure tank is usually employed.

28.10.4.2. Compressor. The air compressor shall be equipped with an American Society of Mechanical Engineers-rated air tank, a visible pressure gauge on the tank, a pressure reducer with its own gauge, a guard fully enclosing the drive belt and pulleys and a pressure-limiting switch to shut down the compressor when the system's working pressure has been reached. **(T-0)** The equipment shall be securely mounted on a wheeled carriage for portability. **(T-1)** For interior painting, where the compressor shall be located inside the facility, only electric motor-driven equipment shall be used. **(T-0)**

28.10.4.3. Overpressure Protection. When separate paint pressure tanks are used, they shall be equipped with a gauge and a relief valve to prevent overpressure. **(T-0)** Hoses shall be rated for the maximum working pressure of the system. **(T-0)**

28.10.5. Maintenance.

28.10.5.1. A preventive maintenance program covering periodic inspection and testing of all components shall be implemented by all organizations using this equipment. **(T-1)**

28.10.5.2. Compressors, hoses, paint pressure tanks and spray guns shall be stored in areas designated and approved by the installation FES Flight. **(T-1)**

28.10.5.3. All paint pressure tanks and spray guns shall be cleaned after use and before the equipment is stored. **(T-1)** If solvents are used in the cleaning process, provisions of **Chapter 22** shall be followed. **(T-1)**

28.10.5.4. Respiratory Protection. If process not already evaluated, contact BE for an occupational and environmental health risk assessment. Respiratory protective devices shall meet the requirements of AFI 48-137. **(T-1)**

28.11. Drying Ovens.

28.11.1. Overview. Most drying ovens use gas or electricity to heat air which is blown across the components being dried, although infrared and microwave drying ovens are also used. Refer to the SDS for the specific equipment to use.

28.11.2. Fire Prevention. When used to dry flammable finishes, the ovens must meet or exceed National Fire Protection Association 86, *Standard for Ovens and Furnaces*, requirements for Class A ovens. **(T-0)** Avoid using spray booths or rooms for drying purposes. Raising the temperature of a spray booth increases the chance of spontaneous combustion of paint residues. Do not install drying ovens in a spraying area if the oven contains an open flame or a spark-producing element. Never conduct spraying operations in proximity to an operating drying oven.

28.11.3. Ventilation. Adequately vent the exhaust air from the oven. The oven shall have its own ventilation system. **(T-0)** If spray booth ventilation systems are utilized, the oven vent shall enter the system downstream from filters and baffles. **(T-0)** In addition, an interlock shall be installed which will automatically start the blower when the oven is turned on and automatically shut down the oven if the blower stops operating, either by accident or intentionally. **(T-0)**

28.11.4. Electrical Wiring. Make sure electrical wiring for drying ovens and associated equipment conforms to the *National Electrical Code.* **(T-0)**

28.11.5. Grounding. Ensure metal parts of drying ovens are bonded and grounded. **(T-0)**

28.11.6. Warning Signs. Post signs in the vicinity of operating drying ovens to warn of heat and to caution against conducting spraying operations. **(T-0)**

28.12. Spray Painting of Aircraft.

28.12.1. Aircraft Painting. Spray painting of an entire aircraft is permitted only in hangars specifically designed for this purpose. **(T-1)**

28.12.2. Fire Prevention. When painting aircraft, the aircraft shall be isolated and adequate fire prevention measures taken. **(T-1)** Solvents used for cleaning operations shall have flashpoints at or above 100° F. **(T-1)** The aircraft shall be properly grounded and all sources of ignition removed from the area. **(T-0)** All electrical devices and equipment shall be of an approved explosion-proof type. **(T-0)** Except when essential to perform concurrent operations, all aircraft electrical systems shall be de-energized during cleaning, painting and paint removal. **(T-0)** Smoking shall be prohibited. **(T-0)** To prevent the accumulation of static charges, all materials or objects shall be effectively grounded. **(T-0)** Refer to **Chapter 6** for additional guidance.

28.12.3. Ventilation. Ventilation shall be provided and BE shall periodically check the adequacy of ventilation IAW paragraph **28.5.7** **(T-1)**

28.12.4. Housekeeping. All spraying areas shall be kept free from the accumulation of deposits of combustible residues. **(T-0)** Cleaning shall be conducted daily. **(T-1)** Scraping tools shall be non- sparking. **(T-0)** Roof trusses, light fixtures and other overhead equipment shall be checked for accumulation of over-spray at least annually. **(T-1)** Rags or waste soiled with sprayed materials shall be deposited in approved self-closing metal waste containers immediately after use. **(T-0)** IAW AFI 32-7042, *Waste Management*, and 29 CFR 1910.107(g)(3), the contents of waste containers shall be disposed of at the end of each shift or at least once daily. **(T-0)**

28.12.5. Limited Painting. Refer to TO 1-1-8, *Application and Removal of Organic Coatings, Aerospace and Non-Aerospace Equipment,* for additional guidance and information.

28.12.6. Grounding. Aircraft surfaces shall be grounded to preclude the build-up of static electricity whenever operations involving sanding, rubbing, painting or wiping surfaces are performed. **(T-0)**

28.13. Painting Radio and Radar Equipment.

28.13.1. Fire Prevention. The paints used to spray coat radio and radar equipment are very flammable and shall not be used near any open flames. **(T-0)** IAW **Chapters 6** and **22**, smoking shall be prohibited within 50 feet of painting operations. **(T-1)**

28.13.2. These paints are toxic and shall only be used in ventilated spray booths IAW American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance*. **(T-0)**

28.13.3. Personal Protective Equipment. Paint shop personnel shall wear PPE as identified in BE's occupational and environmental health risk assessment. **(T-0)** While painting, personnel shall wear gloves to guard against skin irritation, and shall wear any other necessary PPE needed to complete the task. **(T-1)** Refer to **Chapter 14** for additional guidance.

28.13.4. Drying. Radio and radar equipment that has been spray painted, shall be placed in the open air for several hours or, if possible, for a full day. **(T-1)** This will prevent vapors from off gassing during the drying process and from being ignited by sparks generated when the equipment is put into operation. Emery paper or steel wool shall not be used on radio or radar equipment until the vapors have totally dissipated.

28.14. Electrostatic Paint Spraying.

28.14.1. Overview. In electrostatic paint spraying, low velocity particles of paint are passed through a negatively charged electrostatic field. The particles of paint assume the negative polarity of the electrodes and are then attracted to the work, which is positively charged, usually by being attached to a grounded conveyor.

28.14.2. Fire Prevention. Fire hazards involved in electrostatic paint spraying include solvents used with the paint, possible sparking of the unit and the use of oil-filled transformers. Fire-protective equipment shall be checked regularly with particular attention given to automatic sprinkler heads. **(T-0)** Sprinklers protecting spraying areas shall be kept free from deposits by frequent or, if necessary, daily cleaning. **(T-0)** Portable fire extinguishers shall be available for use. Refer to **Chapter 6** for additional guidance. **(T-0)**

28.14.3. Daily Inspection. Spraying equipment, including spray gun tips, shall be checked daily. **(T-0)** The entire electrostatic unit shall also be checked daily, including the electrical terminals, electrodes and insulators. **(T-0)** On humid days, condensation shall be carefully removed from insulators. **(T-0)** The conveyor system shall be checked for jerky operation, loose hooks or other defects that could permit swinging of the units being painted. **(T-0)** Moisture shall be removed from the compressed air storage tanks. Refer to the manufacturer's operating instructions or **Chapter 25,** *Civil Engineering*, for drainage requirements. **(T-0)**

28.14.4. Insulators. The insulators on electrodes and conductors shall be kept dry and cleaned frequently to prevent flashover. **(T-0)**

28.14.5. Maintenance. Before cleaning a nozzle or attempting any work on a spray gun, the power unit shall be turned off and the nozzle shall be grounded to discharge any static charge remaining in the system. **(T-0)** Maintenance shall not be completed until enough time has elapsed to permit the solvent vapors to be drawn out of the area. **(T-0)** In the absence of automatic grounding equipment, sufficient time shall be allowed to permit any remaining electrical charge to drain off. **(T-0)** Only approved spark-resistant tools shall be used during

cleaning operations, unless other type tools are permitted by the equipment manufacturer or TO. **(T-0)**

28.14.6. Grounding. All metal parts, including guard rails, shields, barriers and enclosures in the vicinity of a unit, shall be grounded to prevent static build-up. **(T-0)** Manual grounding wires shall be available and employees shall be familiar with their use. **(T-0)** Grounding shall be IAW AFI 32-1065, *Grounding Systems*. Items being painted in an interior spray booth shall be bonded or grounded to lessen possibility of static discharge and explosion. **(T-0)**

28.14.7. Manual Spraying. To prevent build-up of a static charge on the operator's body, the spray gun handle shall be electrically connected to ground so the operator, in normal operating position, is in contact with the handle by a resistance of not more than 1 megohm to ground. **(T-0)**

28.14.8. Personnel. Only properly trained, qualified and physically-fit persons shall be permitted to work around electrostatic apparatus. **(T-0)** Medical examinations shall be scheduled with base medical services, as needed. **(T-0)**

28.14.9. Warning Signs. Signs shall be conspicuously posted, designating the process zone as dangerous and indicating the necessity for grounding personnel entering the spray area. A red *ON* light shall be installed to the interlocked power transformer circuit. **(T-0)**

28.15. Airless Paint Spraying.

28.15.1. Principle. The principle of the airless spray method is to force paint through a small orifice at pressures from 1,800 to 4,000 pounds per square inch (psi). An electric or air-powered pump increases the hydraulic pressure of the paint in the hose and pressure vessel, if so equipped, and forces the paint, which may be heated to decrease its viscosity, from the spray gun. When the paint is forced through the orifice under high pressure, it expands and breaks into small particles. The atomized particles have enough velocity to carry them to the surface to be painted, but not enough to rebound. A spray pattern of wide coverage is created rapidly and with very little mist. Since the pattern has unusually sharp edges, masking and shielding are not necessary on most jobs. **Warning:** Never point an airless spray gun at any part of the body.

28.15.2. Operation.

28.15.2.1. Paint can be hypodermically injected into the body by high operating pressures. Injected paint may be life threatening and requires immediate medical treatment.

28.15.2.2. Do not disconnect the gun from the fluid hose or the hose from the pump until the pressure has been released from the hose and other components. This is accomplished by first closing off the electric power or air pressure to the pump and then bleeding off pressure in the fluid hose, by triggering the gun, before disconnecting it.

28.15.2.3. When handling the gun, but not actually spraying (e.g., when changing parts or work position), hold the gun by the grip and remove the fingers from the trigger. This shall prevent the gun from being activated if the operator's hold shall inadvertently tighten due to slipping or stumbling. **Note:** Guns shall be equipped with trigger guards and a safety lock. **(T-0)** The lock shall be positioned to prevent operation, except when the gun is actually in use. **(T-0)**

28.15.2.4. Ensure all hoses connections and fittings are tight and not leaking. **Note:** The fluid hose shall be designed to withstand the high pressure of the system. **(T-0)** The hose, gun and pressure vessel, if so equipped, shall be equipped with special fittings that are not interchangeable with low pressure fittings or any other fittings. **(T-0)**

28.15.2.5. Employees will inspect hoses prior to use to ensure they have no weak or worn spots. **(T-0)** Make certain the hoses do not contact moving parts of machinery, lie over or around sharp edges and corners, or come into contact with objects that would damage them. **(T-0)** Check for deterioration caused by exposure to chemicals and ordinary wear and tear. **Warning:** High-pressure leaks from hoses or connections may also cause hypodermic injection of paint. Injected paint may be life threatening and requires immediate medical treatment.

28.15.2.6. Cleaning. Consult the manufacturer's operating instructions for cleaning procedures. **(T-0)** Never pass a finger over the gun orifice to clean it, as this can result in hypodermic injection of paint into the finger. Injected paint may be life threatening and requires immediate medical treatment.

28.15.2.7. Ground the object being sprayed, as well as the spray gun, to prevent accumulating of static electricity. A static electricity discharge may ignite vapors in the confined atmosphere. Fluid hoses with a ground wire will prevent the accumulation of a static charge if the airless unit is grounded and the object being sprayed is also grounded. Periodic continuity checks shall be performed to ensure hose grounding is intact. **(T-0)**

28.15.2.8. Operators shall wear eye protection and gloves to guard against accidental contact with the spray. **(T-0)** Also, BE-approved respiratory protective equipment shall be worn if exhaust ventilation is inadequate or not available. **(T-0)**

28.16. Aerosol Cans of Spray Paint.

28.16.1. Availability. Pressurized cans of general purpose spray lacquers or enamels are available through the General Services Administration and commercial supply systems. The lacquers are available in acrylic, styrene/acrylic and nitrocellulose bases in a variety of colors.

28.16.2. Precautions. The same general safety and health precautions apply to spray painting from pressurized cans as to spray painting by other means.

28.16.3. Storage. Cans of spray paint shall be considered flammable materials and stored IAW criteria in **Chapter 22. (T-0)** Office desks shall not be used to store cans of spray paint. **(T-0)** Office storerooms shall not be used to store cans of spray paint, unless the storage area has been approved by the installation FES Flight. **(T-0)**

28.16.4. Disposal.

28.16.4.1. Dispose of empty and malfunctioning cans IAW AFI 32-7042, 29 CFR 1910.107(g)(3), other approved hazardous waste disposal procedures and applicable environmental regulations. **(T-0)** Contact the installation Environmental Management office for local guidance.

28.16.4.2. Wiping rags and other hazardous waste materials shall be disposed of in self-closing metal containers labeled to indicate the contents and IAW the procedures established by the installation Environmental Management office, AFI 32-7042, 29 CFR 1910.107(g)(3), other approved hazardous waste disposal procedures and applicable

environmental regulations. **(T-0)** Do not dispose of cans of spray paint, wiping rags and other hazardous waste materials in office waste receptacles. **(T-0)**

28.16.4.3. PPE. The same general rules governing the use of PPE apply to painting with pressurized cans. Refer to other sections of this chapter and **Chapter 14** for additional guidance.

28.17. Powder Coating.

28.17.1. Overview. These operations deposit air suspended powders on components in specially constructed containers called fluidized beds. Some beds are designed to place an electrostatic charge on the powder and the opposite charge on the component being coated. These aerated solid powders must be trapped and not allowed to escape to the atmosphere. **(T-0)** Refer to manufacturer's specifications and National Fire Protection Association 33, *Standard for Spray Application Using Flammable or Combustible Materials,* for fluidized bed use.

28.17.2. Fire Prevention. Electrostatic fluidized beds and associated equipment shall be approved types. **(T-0)** The maximum surface temperature of equipment in the coating area shall not exceed 150° F. **(T-0)** The high voltage circuits shall be designed to not produce a spark of sufficient intensity to ignite any powder-air mixtures or result in an appreciable shock hazard upon contact with a grounded object, under normal operating conditions. **(T-0)** Transformers, power packs, control apparatus and all other electrical portions of the equipment, with the exception of the charging electrodes and their connections to the power supply, shall be located outside the powder coating area. **(T-0)**

28.17.3. Ventilation. Forced exhaust ventilation is mandatory to maintain a safe atmosphere. **(T-0)** Dust collectors shall be incorporated within the ventilation system to trap all excess powder. **(T-0)** Where applicable, exhaust ventilation shall be sufficient to maintain the atmosphere below the lowest explosive limits for the materials being applied. **(T-0)** The electrical equipment shall be interlocked with the ventilation system so the equipment cannot be operated unless the ventilation fans are in operation. **(T-0)**

28.17.4. Housekeeping. All areas shall be kept free of the accumulation of powder coating dusts, including horizontal surfaces such as ledges, beams, pipes, hoods, booths and floors. **(T-0)** Surfaces shall be cleaned in a manner that does not scatter powder or create dust clouds. **(T-0)** Vacuum sweeping equipment, where used, shall be of a type approved for use in hazardous locations. **(T-0)** Water-saturated cleaning cloths shall be used to remove powder dust and to preclude scattering dust deposits. **(T-0)**

28.17.5. Grounding. Objects being coated shall be maintained in contact with the conveyor or other support to insure proper grounding. **(T-0)** Hangers shall be regularly cleaned to ensure effective electrical contact and areas of contact shall be sharp points or knife edges where possible. **(T-0)** The powder coating equipment shall carry a prominent, permanently installed warning regarding the necessity for bonding and grounding all metal parts of the fluidized bed and the objects being coated. **(T-0)**

28.18. Organic Peroxide Coating.

28.18.1. Principle. This type coating is applied using a special purpose spray gun. The peroxide acts as a catalyst and is introduced through one nozzle of the gun. A second material,

a polyester, is introduced through a second nozzle. When the two mix at the application point, a chemical reaction occurs producing a plastic polymer coating. Refer to the manufacturer's label for the specific material in use and National Fire Protection Association 33 for additional guidance.

28.18.2. Training. Only designated personnel, trained to use and handle organic peroxide formulations, shall be permitted to use these materials. **(T-0)**

28.18.3. Fire Prevention. Do not interchange equipment used for organic peroxide coating with that used for any other application. **(T-0)** Peroxides are oxidizers and shall not be mixed with other materials. **(T-0)** Promptly clean up any overspray or spills. **(T-0)** Use noncombustible absorbent material for cleanup purposes. **(T-0)** Do not store or place organic peroxide materials near any source of heat. Avoid rough handling, since these materials are sensitive to shock. **(T-0)** Smoking is prohibited and *NO SMOKING* signs shall be posted in any area where organic peroxides are stored, mixed or applied. **(T-0)** Use non-sparking tools in areas where these materials are stored, mixed or applied. **(T-0)** Dispose of this material IAW AFPAM 32-7042, 29 CFR 1910.107(g)(3), other approved hazardous waste disposal procedures and applicable environmental regulations. **(T-0)** Contact the installation Environmental Management office for local guidance. **Note:** Copper beryllium tools must not be purchased, kept or dressed. **(T-0)** If a copper beryllium tool is found that has lain undisturbed for more than three (3) years, notify BE for assistance in removal. **(T-0)** If there is no copper beryllium non-sparking tool substitute, consult with BE to determine how to apply for an exception to this requirement.

28.18.4. Protective Equipment. Ensure respirators, gloves and protective clothing are used, as recommended or required in BE's occupational and environmental health risk assessment. **(T-0)**

28.18.5. Ventilation. Ensure all spraying operations involving the use of organic peroxides are conducted in spray booths meeting the requirements of the BE occupational and environmental health risk assessment, American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance* and National Fire Protection Association 13. **(T-0)**

28.18.6. Storage of Organic Peroxides. Ensure personnel keep only the minimum quantity of peroxides needed for daily operations in the processing area. **(T-0)** Organic peroxide formulations shall be stored IAW National Fire Protection Association 42, *Code for the Storage of Organic Peroxide Formulations*, and the manufacturers' recommendations. **(T-0)**

28.18.7. Mixing of Organic Peroxides with Promoters. Organic peroxide formulations shall not be mixed directly with any cobalt compounds or other promoters or accelerations, as violent decomposition or explosion can result. **(T-0)** To minimize the possibility of such accidental mixing, these materials shall not be stored adjacent to each other. **(T-0)**

Chapter 29

MISHAP PREVENTION SIGNS AND TAGS

29.1. Scope. This chapter outlines Air Force requirements for safety, health and fire prevention signs and tags. It applies to all work environments, but is not intended to cover signs or tags unique to aircraft, motor vehicle, railroad or marine operations. It also establishes requirements for hazard-information devices (signs and tags) at facilities and workplaces with conditions that pose significant hazards to personnel or property. Such conditions include, but are not limited to, areas with flammable or toxic materials, lethal electrical sources and other potentially hazardous equipment and materials. Rapid identification and warning of existing and potential hazards to workers is important, especially for individuals not routinely in these work areas.

29.2. Specific Information.

29.2.1. Interior and other installation specific signs shall be designed IAW UFC 3-120-01, *Design: Sign Standard*, where applicable. **(T-0)** This chapter also adopts occupational safety and health signs in 29 CFR 1910.144, *Safety Color Code for Marking Physical Hazards*, and 29 CFR 1910.145, *Specifications for Accident Prevention Signs and Tags*. Where OSHA has specific requirements, they shall be followed in addition to applicable federal, state or municipal regulations. **(T-0)**

29.2.2. Availability of Safety Signs and Tags. The functional manager or supervisor shall ensure an adequate supply of safety signs and tags is available to workers. **(T-1)**

29.2.3. Other signs or tags prescribed by Air Force directives for site-specific hazards shall be brought to the attention of HQ AFSEC/SEG, e.g., signs or tags that may be included in this standard or clarification of usage. **(T-1)**

29.3. Requirements. Signs and tags are an effective means for communicating hazard information to workers to prevent injuries. They provide additional safety guidance and increase workers' awareness of potentially hazardous conditions. However, signs and tags are not substitutes for abatement action such as engineering controls, substitution, isolation or safe work practices. Wording on signs and tags shall be concise, accurate, easily read, contain sufficient information to be easily understood and make a positive, rather than negative, statement. **(T-1)**

29.3.1. Specifications and Use of Safety, Fire Prevention and Health Signs. Signs shall be uniform, properly worded and located, with a meaning immediately and clearly understood as an automatic warning, caution or notice to all personnel no matter where they work. **(T-1)**

29.3.1.1. Standard Proportions for Signs. Commercially manufactured signs are designed and proportioned for uniformity and legibility and shall be used, if available. If not available, signs may be manufactured locally IAW **Table 29.1** through **Table 29.6**

29.3.1.2. Sign Placement. Signs shall be located to alert personnel in time to avoid the hazard, not be in harm's way before seeing the sign. **(T-1)** Signs may provide directions to eliminate or reduce the hazard and may state consequences of not avoiding the hazard.

29.3.1.2.1. Signs shall be placed so they are visible, do not cause distractions and are not a hazard themselves; for example, avoid low-hanging signs or ones that protrude into a walkway. **(T-1)**

29.3.1.2.2. Signs shall have rounded corners and be free of burrs and splinters. **(T-0)**Sign fasteners shall have no protruding parts that could cause abrasions or lacerations. **(T-0)**

29.3.1.2.3. To prevent confusion, avoid grouping too many signs together in the same location.

29.3.1.2.4. Signs shall not be placed on moveable objects or adjacent to moveable objects like wheeled equipment, removable partitions, on doors, etc., which, if moved, will obscure the sign. **(T-1)**

29.3.1.2.5. Signs shall have adequate illumination. **(T-1)** If illumination is inadequate under emergency conditions, signs shall be equipped with emergency (battery operated) illumination, be luminescent or both. **(T-1)** Consult the local CE facility design section for lighting guidance for specific locations.

29.3.2. Lettering. Lettering shall be of sufficient size and contrast to be readily visible and legible. **(T-0)** Legibility of text is influenced by letter height, the ratio of letter height to width (stroke width), and spacing between letters, words and lines. Refer to UFC 3-120-01 for guidance on lettering size. **Table 29.1** shows distances that well-proportioned letters of different heights can be read by persons with 20/40 visual acuity under good lighting conditions.

29.3.2.1. Overall lettering size shall be determined by the distance from which the sign can be safely and easily read. **(T-0)** Letters shall be adequately spaced, not crowded and the message as concise as practical. **(T-0)**

29.3.2.2. A safe viewing distance shall be determined for each location where a safety sign is needed. **(T-1)** The message panel text shall also meet safe viewing distance legibility criteria. **(T-0) Note:** A rule- of-thumb of 35-40 feet viewing distance per inch of letter height may be used.

29.3.3. Safety Symbols. Safety symbols may be used to clarify, supplement or as a substitute for part or all words in the message panel. A symbol may only be used if it is comprehensible. Training materials and manuals can be used to train workers on a symbol's meaning.

29.3.3.1. Safety symbols are pictorials, pictographs or other graphic representations chosen to clearly convey a specific safety message. Ideally, a symbol should be graphically simple, readily understood, make a strong impact and be easily remembered.

29.3.3.2. A symbol shall illustrate the type of hazard, potential consequences or evasive/ avoidance actions needed and be compatible with the word message(s). **(T-1)**

29.3.3.3. Well-designed safety symbols cross language and literacy barriers and communicate hazard information quickly. Although standards allow for word-messages-only, safety symbols are encouraged when practical.

29.3.3.4. Multi-lingual signs. The effectiveness of word-only signs is complicated by workers whose native language is not English. Whenever possible, use international signs and ensure all workers understand warnings. If additional languages are needed on safety signs, it is strongly encouraged to use symbols, in addition to words, to better communicate hazard information across language barriers.

29.3.4. Criteria for Warning Colors. Safety color coding for warning signs and markers helps alert persons to the presence of hazards. Refer to **Tables 29.6** and **29.7** for examples of color use. Color specifications in this standard are IAW 29 CFR 1910.144 and 29 CFR 1910.145.

29.3.4.1. Black or White. Black or white lettering provides contrast with basic warning and cautionary colors. Black lettering shall be used on a yellow, white or orange background. **(T-0)** White lettering shall be used on a red, green or black background. **(T-0)**

29.3.4.2. Green. Green shall be the basic color for safety and first-aid equipment locations. **(T-0)** Solid green, green and white stripes, green cross on white background, or white cross on green background can be used. Green is also used for identifying compressed gas cylinders and piping systems containing oxidizing materials.

29.3.4.3. Magenta. Magenta is used to letter piping systems containers, housings, equipment, etc., containing radioactive substances. Approved tags and signs exhibiting the standard, 3-bladed magenta radiation symbol on a yellow background shall be used to identify the nature and magnitude of the radiation hazard, together with specific hazard control instructions. **(T-0)**

29.3.4.4. Orange. Orange, with the exception of fluorescent orange or orange-red used to designate biohazards, shall be used to designate electrical conduit and unguarded, dangerous parts of machines or energized equipment which may cut, crush, shock or otherwise injure, and to emphasize such hazards when equipment guards are open or removed. **(T-0)**

29.3.4.5. Red. Red shall be used to mark danger and stop. **(T-0)**

29.3.4.6. Yellow. Yellow shall be used to designate caution, flammable materials and to mark physical hazards, such as strike against, stumble, trip, fall and caught-between types. **(T-0)**

29.3.4.7. Solid Yellow, Yellow and Black Stripes, and Yellow and Black Checks. These colors and color combinations may be used interchangeably. Using combination colors creates the most attention for housekeeping or aisle markings.

29.3.5. Types of Signs - Color Identification, and Use. **Note:** For laser hazard warning signs and labels refer to AFI 48-139, *Laser and Optical Radiation Protection Program.* DoDI 6055.1., *DoD Safety and Occupational Health (SOH) Program*, outlines the military exemption for laser hazard communication.

29.3.5.1. Signs For Fire Hazards of Materials. A standardized system exists for identifying the hazards of materials. Explained in detail in National Fire Protection Association 704, *Standard System for the Identification of the Hazards of Material for Emergency Response*, and used by CONUS installation FES Flights, it uses three categories: health hazard, flammability hazard and reactivity hazard. This simple, readily recognized and easily understood system provides general information on the hazards of a material and the severity of these hazards to emergency responses. The installation FES Flight can provide additional information on fire hazards of materials.

29.3.5.2. Signs and Symbols Used to Identify Explosive Materials. The Air Force and North Atlantic Treaty Organization (NATO) identify items and substances assigned to

United Nations dangerous goods Class I (explosives, munitions, propellants and pyrotechnics) according to the hazard they present IAW AFMAN 91-201, *Explosives Safety Standard*.

29.3.5.3. AF Form 1118, *Notice of Hazard*. The *Notice of Hazard* is considered a sign. It is posted at or near the identified hazard until the hazard is corrected. Standard colors for these signs are black letters on a white background with a red border.

29.3.5.4. Asbestos Warning Signs. Asbestos warning signs shall meet requirements of 29 CFR 1910.1001, *Asbestos*. **(T-0)**

29.3.5.5. Lead Warning Signs. Lead warning signs shall meet requirements of 29 CFR 1910.1025, *Lead*. **(T-0)**

29.3.5.6. Danger Signs. Danger signs shall indicate an immediate hazard. **(T-0)** The sign shall be red, black and white and sized IAW **Table 29.1** **(T-0)** Examples of messages for Danger signs are shown in **Table 29.7**

29.3.5.7. Warning Signs. Warning signs shall be used to warn of hazards which could cause damage to equipment, death or serious injury to personnel. **(T-0)** Warnings represent a hazard level between "Danger" and "Caution." The sign shall be orange and black. **(T-0)**

29.3.5.8. Caution Signs. Caution signs shall be used to warn of potential hazards. **(T-1)** The sign shall be yellow and black with dimensions as given in **Table 29.2** **(T-1)**

29.3.5.9. Radio Frequency Radiation Warning Signs. Radio frequency radiation warning signs signify the presence of hazardous electromagnetic energy frequencies from 10 megahertz to 100 gigahertz. These signs shall define specific radio frequency hazards and provide warning data or instructions about the hazard. **(T-1)** "WARNING - RADIO FREQUENCY HAZARD," or appropriate instructional or warning statements, shall be inserted on the sign's lower half of the triangle as specified in AFI 48-109 *Electromagnetic Field Radiation (EMFR) Occupational and environmental health Program*. **(T-1)**

29.3.5.10. Exit Signs. Exit signs shall clearly identify the means of egress from facilities when required. **(T-0)** These signs shall conform to design and color requirements in National Fire Protection Association 101, *Life Safety Code*, and have lettering on an opaque background. **(T-0)** Each sign shall be provided with adequate lighting to illuminate the sign's surface. **(T-0)** Incandescent lighting may be used in existing fixtures, but new internally illuminated exit signs shall be a light emitting diode, electroluminescent or cold cathode type. **(T-0)** Illumination of exit signs shall be continuous whenever building occupancy may require the means of egress be available for use. **(T-0)** Refer to UFC 3-600-01, *Fire Protection Engineering for Facilities*, for further guidance. Exit signs containing radioactive material shall not be procured.

29.3.5.11. Directional Signs. Directional signs, other than emergency exit signs, indicate the way to stairways, medical offices, health stations, emergency showers, etc., and shall be designed IAW UFC 3-120-01. **(T-0)**

29.3.5.12. Instruction and Identification Signs. Instruction and identification signs, designed IAW UFC 3-120-01, shall be used to convey general instructions or identify PPE or systems. **(T-0)**

29.3.5.13. Biological Hazard Signs. Biological hazard signs shall signify the actual or potential presence of a biological hazard and identify equipment, containers, rooms, experimental animals, etc., which contain or are contaminated with viable hazardous agents. **(T-0)** The sign symbol shall be the standard fluorescent orange or orange-red color, with background color optional, provided there is sufficient contrast to clearly define the symbol. **(T-0)** The symbol may be used on signs, warning tags or identification labels along with appropriate wording to indicate the nature or identity of the hazard. Wording shall include precautionary information and the name or job classification of the individual responsible (such as chemical or laboratory supervisor) for control of the biological hazard, but this information shall not be superimposed on the symbol. **(T-0)** These signs shall be designed with letters sized IAW UFC 3-120-01. **(T-0)**

29.3.5.14. Ionizing Radiation Warning Signs, Placards and Forms. Refer to AFI 48-148, *Ionizing Radiation Protection,* AFI 40-201, *Managing Radioactive Materials in the U.S. Air Force,* and 10 CFR 20, *Standards for Protection Against Radiation*. Electrical equipment labeling and placarding shall comply with UFC 3-560-01, *Operation and Maintenance: Electrical Safety.* **(T-0)**

29.4. AF Form 1118 and AF Form 979.

29.4.1. Use AF Form 1118, *Notice of Hazard,* to post notices of hazards for facilities or equipment. **Note:** AF Form 979, *Danger Tag,* or equivalent DoD or commercial Danger Tags may be used temporarily until an AF Form 1118 is issued.

29.4.2. AF Forms 1118 are issued only by Occupational Safety office, FES Flight and BE to permanently identify a hazardous condition that could result in serious injury, disability or death. These 8" x 10" red bordered forms identify hazardous conditions, any interim control measures in effect and permanent corrective actions underway or programmed. AF Forms 1118 are issued for hazards assigned a Risk Assessment Code of 1, 2 or 3. See AFI 91-202 for instructions on Risk Assessment Codes and preparing the AF Form 1118.

29.4.2.1. Once issued, the AF Form 1118 shall be posted by the workplace supervisor as near as possible to the hazard. **(T-1)** In areas where this is not practical, the AF Form 1118 shall be posted in a prominent location visible to all affected workers and shall remain posted until the hazardous condition is abated, or for three (3) days, whichever is greater. **(T-1)** Removal is authorized only after correction of hazard and verification by the issuing authority.

29.4.2.2. The AF Form 979, *Danger Tag*, equivalent DoD or commercial Danger Tag, a temporary means of identifying hazardous conditions, can be issued by the supervisor as an interim device until an AF Form 1118 is posted. The Danger Tag provides a means for supervisors to immediately alert workers to existing and/or potential hazards. The Danger Tag may be removed once an AF Form 1118 is posted.

29.5. Specifications For and Use of Safety, Fire Prevention and Health Tags.

29.5.1. Tags are a temporary means of warning workers of hazardous conditions, defective equipment, etc., including hazards that are out of the ordinary, unexpected or not readily apparent. Tags are not a complete warning method and shall only be used until a positive means can be used to eliminate the hazard. **(T-1)** For example, a "Do Not Start" tag is affixed to a machine until the machine can be locked out, de-energized or inactivated. "Do Not Start" tags

shall be placed in conspicuous locations and, if possible, block the starting mechanism that would cause hazardous conditions if equipment was energized. **(T-1)**

29.5.1.1. Supervisors shall ensure workers are informed of the meaning of the various tags used throughout the workplace and what special precautions are necessary. **(T-1)**

29.5.1.2. Tags shall be affixed as close as safely possible to their respective hazards by a positive means such as string, wire or adhesive that prevents their loss or unintentional removal. **(T-0)**

29.5.1.3. Tags shall be used until the identified hazard is eliminated or hazardous operation is completed. **(T-0)**

29.5.2. All safety tags shall contain a signal word and a major message such as "DANGER," "WARNING," "CAUTION" or "BIOHAZARD." **(T-0)**

29.5.2.1. *Danger* tags shall only be used where an immediate hazard (RAC 1 through 3) exists and specific precautions are required to protect personnel or property or when required by TOs or other manuals. **(T-0)** Risk Assessment Codes assigned by the installation Occupational Safety office, FES Flight or BE shall be included in the "Hazard" description block on the front side of the tag. **(T-1)**

29.5.2.2. *Warning* tags shall identify items which could cause damage to equipment or death or serious injury to personnel. **(T-1)**Some events that pose a hazard to personnel and equipment can also be identified/classified as a warning. Warnings represent a hazard level between "Caution" and "Danger." When in doubt, contact the unit supervisor or installation Occupational Safety office, FES Flight or BE for guidance on the appropriate tag to use.

29.5.2.3. *Caution* tags shall only be used where a hazard can damage equipment, or a non-immediate, potential hazard or unsafe practice presents a lesser threat of worker injury. **(T-0)**

29.5.2.4. *Biohazard* tags shall identify the actual or potential presence of a biological hazard and to identify equipment, containers, rooms, experimental animals or combinations thereof, that contain or are contaminated with hazardous biological agents. **(T-0)**

29.5.2.5. Other tags may be used in addition to those required or in situations that do not require tags, provided they do not detract from the impact or visibility of the signal word and major message of any required tags.

29.5.3. Major messages shall indicate the specific hazardous condition or the instruction being communicated to workers. **(T-0)** Major messages shall be presented in pictographs, written text or both. **(T-0)** The major message portion of a tag's inscription shall be more specific than the signal word. **(T-0)** Example: "High Voltage," "Do Not Start," etc., or a corresponding pictograph used with a written text or alone.

29.5.4. Signal words, used to call attention to the tag and designate the level of hazard seriousness, shall be readable at a minimum distance of five feet (1.52m) or a greater distance if warranted by the hazard. **(T-0)**

29.5.5. Recommended Color Coding. While not mandatory, colors may be used on accident prevention tags. Color schemes should follow standard color schemes of signs. OSHA recommends the following color scheme:

29.5.5.1. DANGER – Red, or predominately red, with lettering or symbols in a contrasting color.

29.5.5.2. WARNING – Orange, or predominately orange, with lettering or symbols in a contrasting color.

29.5.5.3. CAUTION – Yellow, or predominately yellow, with lettering or symbols in a contrasting color.

29.5.5.4. BIOHAZARD – Fluorescent orange or orange-red, or predominately so, with lettering or symbols in a contrasting color.

29.6. General Requirements for Use of Tags.

29.6.1. The following apply to all Air Force tags prescribed by this standard. Requirements unique to a particular tag appear in the tag‘s instructions. All mishap prevention tags used to warn of specific hazards shall be standardized Air Force forms with no variation in design of tags. **(T-1)**

29.6.1.1. User Instructions. Workers shall immediately advise supervisors of unsafe conditions. **(T-1)**

29.6.1.2. Notification. Supervisors shall evaluate the situation, ensure an appropriate tag is attached, if needed, and coordinate placement of tags and assignment of Risk Assessment Codes with the installation Occupational Safety office, FES Flight or BE, as appropriate. **(T-1)** The supervisor, or person in charge at the time, is responsible for issuing tags; if unavailable, the worker shall contact the installation Occupational Safety office, FES Flight or BE, as appropriate. **(T-1)**

29.6.1.3. Risk Assessment Codes shall be assigned by installation Occupational Safety office, FES Flight or BE, as appropriate. **(T-1)** A Risk Assessment Code shall not be assigned to equipment issued during routine maintenance or servicing. For example, TO-directed tagging of the starter switch during engine maintenance does not require a Risk Assessment Code.

29.6.1.3.1. Verification of Risk Assessment Code, when required by AFI 91-202, shall be accomplished as soon as possible and shall not exceed 10 days from hazard identification. **(T-1)**

29.6.1.3.2. Tag placement shall not be delayed awaiting Risk Assessment Code verification. Changing an initial tag from *Danger* to *Caution*, *Out of Order*, *Do Not Start*, etc., or vice-versa, is the responsibility of the supervisor upon verification of Risk Assessment Code by the installation Occupational Safety office, FES Flight or BE.

29.6.1.4. Notification requirements do not apply when *Danger* tags are installed IAW applicable TOs, AF instructions or other directed requirements, including routine maintenance functions on aircraft or missile systems. For example, occupational safety personnel need not be notified when tagging out the circuit breaker of an air compressor

where the motor has been removed for bearing replacement, or when machines or equipment are locked out for maintenance or servicing.

29.6.1.5. Equipment records, when maintained, shall be annotated to reflect current tag status. **(T-1)** Tag logs may be maintained to identify tags currently in use in a work area.

29.6.1.6. Local commanders shall implement internal procedures to ensure coordination of tags between supervisors and installation Occupational Safety office, FES Flight and BE. **(T-1)**

29.6.1.7. Removal of *Danger* and *Caution* Tags. The supervisor, with coordination from the installation Occupational Safety office, FES Flight or BE, as appropriate, is responsible for removing the tag after the hazardous condition has been corrected. Maintenance logs, if maintained, shall be annotated that the hazardous condition has been corrected and tag removed. **(T-1)** The installation Occupational Safety office shall be notified, during normal duty hours that the tag has been removed. **(T-1)** Notification shall not be later than the following duty day.

29.7. Specific Requirements For Use of Tags. Tag Identification and Use. Mishap prevention tags prescribed below (Danger, Caution, Out of Order and Do Not Start) shall meet requirements of AFI 91-202 and 29 CFR 1910.145. **(T-0)**

29.7.1. AF Form 979, *Danger Tag*, equivalent DoD or commercial Danger Tag.

29.7.1.1. Danger tags shall only be used where an immediate hazard (Risk Assessment Code 1 through 3) exists and specific precautions are required to protect personnel or property—or as required by TOs, AF instructions or other requirements. **(T-1)**

29.7.1.2. All workers shall be instructed that Danger tags indicate immediate danger and special precautions are necessary. **(T-0)**

29.7.1.3. A Danger tag shall be placed on damaged equipment and immediate arrangements made to take the equipment out of service until repaired. Tag wording shall read, "DO NOT USE THIS EQUIPMENT" or "DEFECTIVE EQUIPMENT, DO NOT USE." **(T-1)**

29.7.1.4. Removal. Only the worker, or their supervisor, responsible for installing the Danger tag may remove the tag only if the hazard has been abated. The installation Occupational Safety office shall be notified of tag removal, during normal duty hours, no later than the following day. **(T-1)**

29.7.1.4.1. Removal of Danger tags prescribed by TOs or AF instructions for routine aircraft or missile/munitions maintenance actions need not be coordinated with the installation Occupational Safety office, FES Flight or BE. Refer to paragraphs **29.6.1.7** for additional information.

29.7.1.4.2. Tag text shall be provided by, and reverse side completed by, the responsible on-duty supervisor. **(T-1)**

29.7.2. AF Form 980, *Caution Tag*, equivalent DoD or commercial Caution Tag.

29.7.2.1. AF Form 980, equivalent DoD or commercial Caution Tag shall be used by any AF worker, in coordination with the work area or activity supervisor, only to warn against potential hazards, caution against unsafe practices and to prescribe precautions to protect

personnel and property. **(T-1)** Assignment of Risk Assessment Code shall be coordinated with the installation. Occupational Safety office, FES Flight or BE, as appropriate. **(T-1)** Tags for routine maintenance actions, required by TOs or AFI 32-1064, *Electrical Safe Practices,* need not be coordinated with Occupational Safety office, FES Flight or BE.

29.7.2.2. Removal. Caution tags shall only be removed by the work area or activity supervisor when the hazard is abated. **(T-1)** If tag placement was coordinated with the installation Occupational Safety office, FES Flight or BE, the supervisor shall coordinate with these agencies prior to removal. **(T-1)**

29.7.2.3. Tag text shall be provided by, and the reverse side completed by, the responsible on-duty supervisor. **(T-1)**

29.7.3. AF Form 981, *Out of Order Tag*, equivalent DoD or commercial Out of Order Tag. Out of Order tags shall only be used to indicate a piece of equipment, machinery, utility or system is out of order and its use might be hazardous. **(T-1)** If reparable, a TO prescribed green tag may be used in place of the Out of Order Tag.

29.7.3.1. Applicable equipment records, when available, shall be annotated in addition to completing the Out of Order tag. The energy source shall be locked out per **Chapter 21,** *Hazardous Energy Control (Lockout and Tagout),* if turning on the equipment could result in an injury or damage. **(T-1)**

29.7.3.2. Removal. *Out of Order* tags shall only be removed by the supervisor assuming responsibility for the tag after the hazard is corrected. **(T-1)**

29.7.3.3. Tag text shall be provided by, and reverse side completed by, the responsible on-duty supervisor. **(T-1)**

29.7.4. AF Form 982, *Do Not Start Tag*, equivalent DoD or commercial Do Not Start Tag.

29.7.4.1. AF Form 982, equivalent DoD or commercial Do Not Start Tag shall only be used to alert personnel of hazards associated with restarting the equipment and only for a very short time until the energy isolating device can be locked out. **(T-1)** Do Not Start tags shall be placed in conspicuous locations or in a manner that they effectively block the starting mechanism should the equipment be energized. **(T-1)**

29.7.4.1.1. The Do Not Start tag may be used in conjunction with AF Form 979, *Danger Tag.* If a Danger tag is attached to equipment, it is not always necessary use a Do Not Start tag.

29.7.4.1.2. It is the on-duty supervisor‘s responsibility to attach the Do Not Start tag on the equipment in question. If in doubt, contact the installation Occupational Safety office, FES Flight or BE, as appropriate.

29.7.4.2. Removal. Do Not Start tags shall be removed by the supervisor only after the condition has been corrected. **(T-1)**

29.7.4.3. The text shall be provided by, and reverse side completed by, the responsible on-duty supervisor. **(T-1)**

29.8. Administrative Devices. Locks/tags used for purposes other than hazardous energy control are considered administrative devices. Administrative devices and tags shall be clearly distinguishable from an issued/assigned authorized lockout device and (i.e., if red banded locks

are used for lockout/tagout (LOTO), they shall not be used as an administrative device) the danger or equipment lockout tag shall not be used as an administrative tag. **(T-1)**

29.8.1. Application of Administrative Devices. When machinery/equipment is placed in an "out of service" status for business or production purposes (e.g., poor efficiency, recycled, sold, etc.) and not related to servicing or maintenance, an administrative device and tag shall be attached by the work center/shop supervisor. **(T-1)**

29.8.1.1. The administrative tag (can be integrated on the lock) shall contain the supervisor's contact information, the purpose of the lock and the authorized person's organization. Use appropriate tags for the hazard type, e.g., Danger, Do Not Start or Out of Order.

29.8.1.2. Administrative devices and tags shall not be transferred at shift change.

29.8.2. Removal of Administrative Devices for Servicing/Maintenance. When servicing/maintenance of machinery/equipment is to begin (active service/hazardous energy control) by an authorized worker, the work center/shop supervisor shall remove the administrative device and the authorized worker shall place the authorized lockout/tagout device on the machinery/equipment IAW paragraph **21.4** **(T-1)**

Table 29.1. Standard Criteria & Proportions for Locally Manufactured Signs (Letter Size vs. Legibility Distance).

Height of Letters (Inches)	Distance Visible (Feet)	Height of Letters (Inches)	Distance Visible (Feet)
3 1/2	105	1	33
3	90	7/8	28
2 1/2	75	3/4	23
2	60	5/8	18
1 3/4	52	1/2	15
1 1/2	45	3/8	12
1 1/4	40	1/4	10
Note: Whenever possible, commercially manufactured signs shall be procured. When it is necessary to locally manufacture signs, the following criteria and proportions are recommended. - Crowding of letters and words reduces legibility and shall be avoided. - A rule-of-thumb of 35-40 feet viewing distance per inch of letter height may be used. - Above letter size versus legibility distance values assume at least 20/40 visual acuity of viewer, adequate lighting of sign and does not include allowance for color combinations.			

Table 29.2. Standard Proportions for Danger Signs.

Sign Size, Inches Height/Width	Black Rectangular Panel, Inches Height/Width	Red Oval, Inches Height/Width	Wording DANGER, Inches/Height	Minimum Space Available for Sign Wording, Inches
Horizontal Pattern				

7 x 10	3 x 9	2 x 8	1	2 x 9
10 x 14	4 x 13	4 x 11	2	4 x 13
14 x 20	6 x 19	5 x 17	2	6 x 19
20 x 28	9 x 27	8 x 23	4	9 x 27
Upright Pattern				
10 x 7	2 x 6	2 x 5	1	6 x 6
14 x 10	3 x 9	2 x 8	1	9 x 9
20 x 14	4 x 13	4 x 11	2	14 x 13
28 x 20	6 x 19	5 x 17	2	20 x 19

Table 29.3. Standard Proportions for Caution Signs.

Sign Size, Inches Height Width	Black Rectangular Panels; Inches/Height/Width	Wording CAUTION, Inches/Height	Maximum Space Available for Sign Wording, Below Panel; Inches/Height/Width
Horizontal Pattern			
7 x 10	2 1/4 x 9 3/8	1 5/8	3 1/4 x 9 3/8
10 x 14	3 1/4 x 13 3/8	2 1/4	5 1/2 x 13 3/8
14 x 20	3 3/4 x 19 3/8	2 3/4	9 x 19 3/8
20 x 28	4 1/4 x 27 3/8	3 1/4	14 1/2 x 27 3/8
Upright Pattern			
10 x 7	1 5/8 x 6 3/8	1 1/8	7 x 6 3/8
14 x 10	2 1/4 x 9 3/8	1 5/8	10 1/2 x 9 3/8
20 x 14	3 1/4 x 13 3/8	2 1/4	15 1/2 x 13 3/8
28 x 20	3 3/4 x 19 3/8	2 3/4	24 x 19 3/4

Table 29.4. Standard Proportions for Instruction and Identification Signs.

Sign Size, Inches/ Height/Width	Height of Letters, Inches For One Line	Height of Letters, Inches For Two Lines	Height of Letters, Inches For Three Lines	Maximum Space Available for Sign Wording, Inches/ Height/Width
Horizontal				
7 x 10	3	1 1/2	1 1/2	6 x 9
10 x 14	6	2 1/2	2	9 x 13
9 x 20	3	2 1/2	1 1/2	8 x 19
14 x 20	N/A	3	3	13 x 19

Table 29.5. Standard Proportions for Directional Signs.

Sign Size; Inches/	Black Rectangular Panel;	Overall Length	Arrow Head; Height/Width	Arrow Shaft Height	White Arrow, Arrow Tail; Height/Width	Maximum Space Available for Inches Sign

Height/Width	Inches/Height/Width					Wording Below Panel; Inches/Height/Width
6 1/2 x 14	3 1/4 x 13 3/8	12 5/8	2 3/4 x 3	1 1/8	2 3/8 x 3 1/4	2 1/4 x 13 3/4
9 x 20	4 1/2 x 19 3/8	18 5/8	3 3/4 x 4 1/8	1 5/8	3 1/4 x 4 1/2	3 3/8 x 19 3/8
12 x 28	6 x 27 3/8	26 7/8	5 1/8 x 5 5/8	2 1/8	4 3/8 x 6	4 3/4 x 27 3/8
15 x 36	7 1/2 x 35 3/8	34 5/8	6 3/8 x 6 7/8	2 5/8	5 1/2 x 7 1/2	6 1/4 x 35 3/8

Table 29.6. Examples of Color Applications.

Black and White		
Dead-ends of aisles	Location of aisle ways	Direction signs
Location of refuse cans	Lettering on piping systems and compressed gas cylinders	Piping systems containing raw or potable water
Orange		
Inside of movable guards (solid panel)	Lower traveling blocks on cranes and hoists	Exposed edge of pulley, gears, rollers, cutting devices, etc.
Green		
Location of health station	Location of PPE	Location of emergency showers
Safety bulletin board	Piping system containing oxidizing materials	Compressed gas cylinders containing oxidizing materials
Magenta		
Radioactive filter housings	Radiation ion exchanger	Radioactive waste containers
Radioactive sampling connections	Radiation signs	Lettering on piping systems containing radioactive substances
Red		
Danger signs	Stop signs	Stop buttons and Bars equipment
Yellow		
Corner markers for storage piles	Coverings or guard for guide wires	Fixtures extending into operating area
Guardrails on top and bottom	Horizontal lips of vertically sliding, counterbalanced elevator doors	Pillars or posts which might be struck
Caution signs	Piping systems containing radioactive substance	Flammable liquid container
Piping systems containing flammable materials	Compressed gas containing flammable materials	

Table 29.7. Examples of Wording for Mishap Prevention Signs.

Caution	Danger
Close Clearance	Acid
Electrical Fence	Ammonia
Electrical Trucks, Go Slow	Crane Overhead
Eye Protection Required	Cyanide
Goggles Must be Worn When Operating This Machine	No Not Energize Switch, Personnel Working on Line
Hearing Protection Required	Do Not Operate, Personnel Working on Equipment
Keep Aisles Clear	Energized Equipment
Keep Door Closed	ExplosivesKeep Out
Keep This Space Clear at All Times	Explosives Magazine
Operators of This Machine Will Wear Snug-Fitting Clothing No Gloves	ExplosivesTurn Off Two-Way Radios
Keep Away	Respirator Required in This Area
Keep Off, Electric Current	Safety Fuse, Burning Rate 40 Feet Per Second, Plus or Minus 10 Percent
Employees in Boiler	Step Down
Employees on Cars	Stop Machinery to Clean, Oil or Repair
Employees Working Above	Use Ladder Climbing Safety Devices
Employees Working on Machines, Do Not Start	Watch Your Step
Not Room Enough to Clear	No Smoking or Open Flames
Directional	Instructional and Identification
Fire (inside arrow) Extinguisher (below arrow panel)	Compressed Breathing Air Station
Walkway (below arrow panel)	Do Not Eat or Drink in This Area
This Way to (inside arrow) First-Aid Station (below arrow panel)	Emergency Shower
This Way Out (below arrow panel)	Eyewash Station
To (inside arrow) First Aid (below arrow panel)	Report All Unsafe Conditions to your Supervisor

Chapter 30

COMMUNICATION CABLE, ANTENNA AND COMMUNICATION SYSTEMS

30.1. General Information.

30.1.1. Housekeeping. Good housekeeping shall be maintained, with all flammable wastes disposed of in approved self-closing metal waste containers. **(T-1)** At the end of each day or shift, these containers shall be emptied or removed to an approved location outside the shop for pickup and disposal. **(T-1)** If solvents are required, use only approved and authorized solvents. Provide adequate ventilation IAW MIL-HDBK-1190, *Facility Planning and Design Guide*. Storage is not allowed in electrical and/or electronic areas. Storage is only permitted in areas approved by the installation FES Flight. Consult BE for guidance on safe use of solvents and the adequacy of the ventilation system, and the installation Environmental Management office for waste disposal guidance. Refer to paragraph **2.4** for additional guidance and information.

30.1.2. Food and beverages shall not be stored or consumed in the immediate area of communications equipment where spills or foreign particles could present a hazard to personnel or cause damage to equipment. **(T-1)**

30.1.3. Electromagnetic Interference Sensitive Medical Implants. 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)** All communications equipment employees should be made aware of this requirement. If there are questions, refer the employee for a medical assessment, in coordination with BE.

30.2. Specific Hazards.

30.2.1. Electrical Hazards.

30.2.1.1. Shock. The severity of electric shock is determined by the amount of current flowing through the body, the time of exposure, and the body's physical condition. Normally, any voltage capable of producing a current flow of 50 milliamperes or more through the body can cause a shock that may result in cardiac arrest. Any individual receiving an electric shock will seek immediate medical attention. **(T-1)** Some effects of electrical exposure to the body are:

30.2.1.1.1. Contraction of the chest muscles, which may interfere with breathing to such an extent that death will result from asphyxiation with prolonged exposure.

30.2.1.1.2. Temporary paralysis of the nerve center, which may result in failure of respiration, a condition which often continues long after the victim is freed from the circuit.

30.2.1.1.3. Ventricular fibrillation, an irregular and erratic heartbeat, which may result in cardiac arrest.

30.2.1.1.4. Serious internal injuries to nerve and bone can occur with the passage of electrical current through limbs. Externally, apparent damage does not always appear severe. If pain, loss of sensation or function occur, seek medical attention immediately.

30.2.1.2. Arcing. When a metal object, such as a tool, comes in contact with an electric current, it will become a conductor. The electric current may result in an arc, which may cause serious burns to the body and temporary or permanent blindness.

30.2.1.3. Other. A natural reaction after making contact with an electric current or seeing an arc is to push oneself away from the source. This can result in falls or abrupt contact with fixed objects causing serious or fatal injuries.

30.2.2. Climbing Hazards. The primary hazards associated with climbing are falls and contact with electrical systems. Examples of climbing hazards include:

30.2.2.1. 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.

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

30.2.2.3. 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.

30.2.2.4. Improper clothing such as badly worn shoes (e.g., loose heels, thin soles), low-cut shoes, trouser legs not folded properly under climbing irons and jackets too loose or too long.

30.2.2.5. 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.

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

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

30.2.2.8. Failure to maintain good physical condition.

30.2.3. Radiation Hazards.

30.2.3.1. Non-ionizing Radiation. Non-ionizing radiation produces heat in body tissues. Absorption by the body is both frequency and body-shape dependent. Thus, it is possible for a person to selectively absorb damaging amounts of non-ionizing radiation in deep tissue and organs with little or no sensation of skin heating. 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.

30.2.3.2. Ionizing Radiation. Radioactive material contained in electron tubes presents no significant hazard as long as the tube is intact. The level of radiation from a small number of electron tubes at maintenance shops does not approach a dangerous level; however, at major supply points, the storage of large quantities of radioactive tubes in a relatively small area may create a hazard. Further, a broken radioactive tube is potentially hazardous since the radioactive material may be inhaled or ingested. Radio frequency generators such as certain klystrons, thyratrons, magnetrons, transmit-receive tubes and similar high voltage devices emit ionizing radiation. Refer to 29 CFR 1910.1096, *Ionizing Radiation*, for additional guidance.

30.2.3.3. Electron Tubes. Many electron tubes such as spark gap, glow lamp, cold cathode, transmit-receiver and anti-transmit-receiver contain radioactive materials. The amount of radioactive material is such that no significant external radiation hazard is present when the items are handled singly or in small numbers. However, breakage of one or more may present a potential hazard to personnel in the area. Broken tubes may release radioactive material that may be ingested or inhaled by exposed personnel. Radioactive material may also contaminate exposed skin or clothing. If breakage does occur, do not touch the tube or the immediate area. Seek immediate medical attention if personnel are exposed to broken electron tube material. Notify the immediate supervisor plus the installation Radiation Safety Officer. Carefully handle tubes and ensure they are packaged correctly to prevent breakage. The use of cushioning material is necessary. Leave tubes in the packing, shipping or storage container and remove them just prior to installation. Control of the disposition operations, e.g., packaging, marking, identifying temporary storage and shipping, is the responsibility of assigned radiological monitors with guidance from the installation Radiation Safety Officer.

30.2.3.4. Chemical. Chemicals used in conjunction with communications equipment maintenance can present health hazards due to skin contact and/or inhalation of toxic vapors. Disposal of hazardous waste will be coordinated with the host installation environmental management office. **(T-1) Note:** Ensure all personnel receive hazard communication training IAW AFI 90-821, *Hazard Communication (HAZCOM) Program*, and have access to SDSs for chemicals used in work processes. **(T-1)** Refer to CFR 1910.1200, *Hazard Communication*, for additional guidance.

30.2.4. Fabrication with Lead. Maintain a clean working area free of combustible materials. **(T-0)** Ensure fire extinguishers are accessible in the work area. **(T-0)** Set lead pots on a noncombustible level surface to prevent turnover and do not leave them unattended. **(T-1)** Do not drop cold lead or any cold liquid into molten lead. This action may cause splashing, rapid separation and serious burns. Wear a face shield or safety goggles and gloves when fabricating in place. Ensure the work area is well ventilated IAW the requirements in the BE occupational and environmental health risk assessment and American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance*. **(T-0)** Consult with the installation Public Health office or BE for appropriate training on working with lead and to determine if medical examinations are required.

30.2.5. Compressed Gases. When using or transporting compressed gas cylinders (such as dry nitrogen cylinders) in a horizontal position, special compartments, racks or adequate blocking shall be provided to prevent cylinder movement and the cylinders shall be secured with safety straps or chains. **(T-0)** Regulators shall be removed and safety caps installed before a cylinder is transported or when not in use. **(T-0)**

30.2.5.1. Compressed gas cylinders shall be kept away from excessive heat and protected from direct rays of the sun, and shall not be stored where they might be damaged or knocked over by passing or falling objects. **(T-0)** Cylinders shall be secured and stored at least 50 feet away from combustible materials. **(T-1)** Refer to TO 42B5-1-2, *Gas Cylinders Use, Handling, and Maintenance*, for additional information.

30.2.5.2. Cylinders shall be stored and used in a vertical position only, valve-end up. **(T-1)**

30.2.5.3. Dispose of compressed gas cylinders in a manner consistent with approved hazardous waste disposal procedures and applicable environmental regulations. **(T-1)** Contact the installation Environmental Management office for guidance.

30.3. General Safety Practices.

30.3.1. Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from the direct or indirect electrical contacts, when work is performed near or on equipment or circuits which are or may be energized. **(T-0)** Specific safety-related work practices shall be consistent with the nature and extent of the associated electrical hazards and comply with **Chapter 21,** *Hazardous Energy Control,* requirements. Employees near exposed electrical circuits or maintenance and installation activities, regardless of location, shall not wear rings, watches or other conductive objects that may increase the shock risk or be the source of potentially severe burns when energized. **(T-0)** Do not use or carry in pockets metallic measuring rules, tools or metal-cased objects. **(T-0)** Metal-framed eyeglasses may be worn if secured with a nonmetallic cord to prevent them from falling into an energized circuit. Additionally, avoid working in wet clothes. Never attempt adjustments on a potential ground when any portion of the body may come into contact with equipment frames or other ground connections. **(T-0)** Recommend placing one hand in a pocket or under a layer of clothing while making adjustments on energized circuits, except where use of both hands is necessary to perform the work.

30.3.2. Two qualified technicians or one qualified technician and one safety observer will work together when exposed to high voltage of 600 volts, nominal, or more or current flow of 50 milliamperes or more. All necessary PPE and special tools shall be available and used. **(T-0)**

30.3.3. Protect the hearing of assigned personnel by ensuring protective engineering controls, administrative controls and PPE are used correctly by all employees; ensure workplace complies with all OSHA, DoD and Air Force Hearing Conservation Program requirements. When exposed to potentially hazardous noise levels, consult BE for guidance on hearing protection. Refer to AFI 48-127, *Occupational Noise and Hearing Conservation Program*, for additional information.

30.3.4. Supervisors shall consult installation medical services personnel to determine if first aid equipment should be available and determine the type and quantity of supplies needed. **(T-1)**

30.3.5. Electrical circuits shall always be de-energized and locked and tagged out before attempting any work, unless the nature of the work requires the circuits remain energized. Do not rely on safety devices such as interlocks, high voltage disconnect relays or automatic circuit grounds. Each of these is subject to failure. When working on exposed circuits of 50 volts or more, arc-fault protective clothing shall be worn IAW UFC 3-560-01, *Operation and Maintenance: Electrical Safety*. **(T-0)**

30.3.6. All employees, including safety observers, will know the location and on-off operation of the power distribution panels, power control switches and stations, and electrical danger areas in their work area. **(T-0)** This knowledge is essential to de-energize equipment in the

event of a fire or accidental electrical contact. In addition, emphasis shall be placed on the need to maintain clear, unrestricted access to these controls at all times. **(T-0)** Employees will open and close all equipment switches quickly and positively. **(T-0)** The doors to high voltage racks shall be closed at all times except for authorized maintenance and repairs. **(T-0)**

30.3.7. Interlocks shall not be permanently disconnected or bypassed. **(T-0)** Interlocks can be disconnected during maintenance or adjustments only when prescribed by applicable TOs. During these periods, AFVA 91-305, *DANGER—INTERLOCKS DISABLED*, or a sign, either locally manufactured or the nearest commercially available equivalent, shall be placed on the equipment or nearest available equipment. **(T-0)** If the equipment has a defective interlock, all employees shall be made aware of the hazardous condition, and a warning sign or tag shall be posted on the equipment. **(T-0)**

30.3.8. Grounded railings, barriers or enclosures shall be used to protect employees from shock resulting from contact with conductors, bus bars, switches, control panels, etc. **(T-0)** All contacts, terminals, and devices having voltages between 50 and 599 volts root-mean-square or direct current with respect to ground will have barriers or guards to prevent accidental contact by personnel. **(T-0)** Holes in the barrier may be provided for maintenance testing. Assemblies operating at potentials in excess of 600 volts root-mean-square or direct current shall be completely enclosed from the remainder of the assembly. **(T-0)** The barrier, guard, or enclosure shall be marked to indicate the approximate highest normal voltage (nearest round number) which may be encountered upon its removal. **(T-0)**

30.3.9. Suitable eye protection shall be worn during unpacking, removal and installation of transformers, capacitors and diode stacks or when the potential for exposure to arc flash exists. **(T-0)** Employees shall be especially watchful for any sign of oil or fluid leakage, as it is possible this oil or fluid is Askarel. Askarel, used for many years as a dielectric, contains high concentrations of polychlorinated biphenyl, which is extremely toxic. Any sign of leakage from components mentioned above 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)**

30.3.10. 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. Normally, the supervisor is also the safety observer.

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

30.3.10.2. Safety observers shall be trained IAW paragraph **30.4.1,** current in CPR procedures and familiar with local installation procedures to obtain medical assistance. **(T-1)**

30.3.10.3. While the task is being performed, the safety observer shall stand where he or she 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

lockout and/or tagout procedure shall be used. **(T-0)** Additionally, the safety observer will have ready access to safety equipment when high voltage is involved. **(T-0)**

30.3.10.4. When performing aerial work on communication cable and antenna systems, safety observers must be qualified to operate the equipment in use and shall have a current climbing aerial rescue certification, be proficient in CPR and administering emergency first aid treatment that involves control of bleeding, shock, open wounds and burns and procedures for obtaining medical assistance. **(T-0)**

30.3.10.5. Ensure a means of communication is available in remote locations. **(T-0)**

30.3.11. Provide the installation FES Flight and the emergency response units with maps indicting routes to locations of remote sites. **(T-1)** Where practical, establish a letter of agreement with the installation FES 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)**

30.3.12. Ensure all grounding of electrical and electronic equipment is sized IAW the *National Electrical Code*. Where possible, use a copper strap or heavy gauge copper wire as the ground connection. **(T-1)** Ensure water or cooling pipes meet the requirements of UFC 3-520-01, *Interior Electrical Systems*, AFI 32-1065, *Grounding Systems*, and *National Electrical Code*, Article 250.52(A)(I). **(T-1)** Never use nonmetallic water or cooling pipes as the grounding electrode. Do not fill ground strap ends with solder to facilitate clamping, as the solder may melt and leave a loose connection, thus defeating the ground. Install an earth electrode subsystem, consisting of a ring ground or interconnected ground rods, for lightning protection purposes and for grounding of all communications systems equipment utilizing high voltages. **(T-1)** If possible, provide duplicate bleeder circuits on high voltage capacitors to reduce the voltage to a non-hazardous level as rapidly as practical. Dual resistor banks are recommended.

30.3.13. Grounding or Shorting Sticks. Electronic equipment with high voltage shall have grounding sticks installed for discharging capacitors in case of automatic discharge circuit failure. **(T-1)** They shall be used to check for and discharge residual and stray high voltage. **(T-1)** Where physical size precludes using a permanently attached grounding or shorting stick, a portable grounding or shorting stick shall be used. **(T-1)** At least one grounding stick shall be provided at every communications equipment area and shall be supplied in addition to any that may be included as integral components of electronics equipment. **(T-1)** If an electrical safety board is utilized, the grounding stick provided with the electrical safety board shall suffice if readily accessible.

30.3.14. 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 TO 31-10- 24, *Communications Systems Grounding, Bonding, and Shielding*.

30.3.14.1. Electrical and electronics equipment shall be grounded so a potential cannot exist between the unit and the ground. **(T-1)** Fixed electrical equipment shall be electrically bonded to a grounding connector. **(T-1)** Special protection shall be provided to safeguard grounding wires from mechanical damage. Metal workbenches and metal framed or legged workbenches used for repairing and testing of electronic equipment shall be grounded. **(T-1)** The size and type of material for grounding conductors will be selected according to the *National Electric Code*, Article 250, *Grounding*. **(T-0)** All workbenches used for "power on" maintenance of any electronic equipment shall be provided with a means for grounding the equipment. **(T-1)** This shall be interconnected to the facility ground system. **(T-1)**

30.3.14.2. Grounding circuits, as a minimum, shall have a separate circuit for each chassis, cabinet and frame. **(T-1)** Each chassis ground may terminate at its cabinet or frame ground. Additionally, ground circuits shall have a neutral circuit and connections that are mechanically secured by:

30.3.14.2.1. A spot-welded terminal lug. **(T-1)**

30.3.14.2.2. A portion of the chassis or frame that has been identified as a grounding point. **(T-1)**

30.3.14.2.3. The use of a terminal on the ground wire by a lock washer and screw or a lock washer and nut. **(T-1)**

30.3.14.2.4. Grounding braids installed on panels and cabinets that are removable or hinged so bonding is not accomplished through hinges, slides or mounting hardware. **(T-1)** Nonconductive panels and cabinets that are removable or hinged need not be equipped with grounding braids. **(T-1)**

30.3.14.3. System grounding within mobile equipment shall be by means of a grounding conductor. **(T-1)** As these grounding conductors are replaced, they shall be of the appropriate gauge and shall have a green insulated cover. **(T-1)**

30.3.14.4. Bus bars shall be clean and free of corrosion, splices shall be tight, and paint shall be removed from all vertical angles at the point of attachment to the ground bus bar. **(T-1)**

30.3.15. 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)**

30.3.15.1. Wear a face shield or safety goggles when soldering. **(T-1)** Normal prescription glasses or plain safety glasses may be used in place of safety goggles for light electronic equipment soldering.

30.3.15.2. Ensure the work area where soldering is performed is well ventilated IAW the requirements in the BE occupational and environmental health risk assessment and American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of 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, *Respiratory Protection Program*, and **Chapter 23,** *Confined Spaces*, for additional guidance and information.

30.3.16. 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)**

30.4. Training.

30.4.1. First Aid, Cardiopulmonary Resuscitation (CPR) and Bloodborne Pathogen Training. Refer to paragraphs **1.8** and **1.9** for guidance.

30.4.2. Rescue Training.

30.4.2.1. Climbing. Pole Top rescue shall only be attempted by personnel who are certified or in a training status under the supervision of an instructor. **(T-1)** A record of climbing certification shall be maintained on AF Form 1098, *Special Task Certification and Recurring Training*, for military, or an approved computer automated system. **(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 re-certification is accomplished. **(T-1)** Consult the installation FES Flight for all other rescues. Refer to paragraph **30.9** for additional guidance.

30.4.2.2. 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 information.

30.4.2.3. Hazard Communication Training. All employees who may be potentially exposed to chemical hazards during the course of work shall require hazard communication training IAW AFI 90-821 upon initial assignment and thereafter when a new hazard or chemical is introduced into the work area/shop or an employee is assigned new or different tasks with new hazards. **(T-0)** Prior to any task requiring the use of or exposure to hazardous materials, safety precautions for materials shall be covered in the pre-task safety briefing. **(T-0)**

30.4.3. Training Documentation. All training shall be documented on the AF Form 55 or AF Form 623 for military or an approved computer automated system. **(T-1)** Additionally, initial safety-related training shall be documented on the individual's training records IAW AFI 91-202. **(T-1)** Recurring safety-related training may be documented in a computer automated system.

30.5. Safety Equipment and Devices.

30.5.1. 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.

30.5.2. 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,** *Fall Protection,* 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 1910.66, and Appendix C, *Personnel Fall Arrest System*, 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 IAW 29 CFR 1910.268. **(T-0)** Supervisors shall ensure all safety climbing equipment is inspected by a qualified individual to determine if it is in safe working condition. **(T-1)** Each person using safety harnesses, straps and lanyards shall inspect the equipment prior to each use. **(T-0)**

30.5.3. 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)**

30.5.4. Signs or Visual Aids.

30.5.4.1. Signs. Portable emergency signs shall be constructed of nonconductive materials. **(T-0)** Refer to **Chapter 29**, *Mishap Prevention Signs and Tags,* for additional information and guidance. **Note:** Consideration shall be given to providing bilingual signs when located in areas where people speak or read a primary language other than English.

30.5.4.1.1. AFVA 91-303, *DANGER — DO NOT ENERGIZE — PERSON WORKING ON ANTENNA.* This sign shall be placed on the radio frequency power control switch or transmitter before any work is started and when the alternating current power to the transmitter has been disabled. **(T-0)** If lockout capability exists, the RF control switch shall also be locked out IAW local lockout procedures. **(T-1)** Refer to **Chapter 21** for additional guidance on lockout/tagout requirements and procedures and **Chapter 29** for additional guidance on signs.

30.5.4.1.2. AFVA 91-304, *DANGER — DO NOT ENERGIZE — WORK IN PROGRESS ON EQUIPMENT*. This sign may be used in applications where power has been de-energized. In all cases where lockout capability exists, the signs shall be used in conjunction with lockout procedures. **(T-0)**

30.5.4.1.3. HARD HAT AREA. This sign shall be placed around any job site when work is being performed aloft, e.g., where falling object hazards are present. **(T-0)**

30.5.4.1.4. AFVA 91-305, *DANGER — INTERLOCKS DISABLED*. This sign shall be placed on equipment that has had interlocks temporarily disabled during maintenance as required by TOs. **(T-0)**

30.5.4.1.5. AFVA 91-306, *DANGER — HIGH VOLTAGE*. This sign shall be prominently posted around areas containing circuits, conductor sets or exposed points of contact with the potential of exceeding 600 volts alternating current or direct current, nominal or more, or current flow of 50 milliamperes. **(T-0)**

30.5.4.1.6. *UNAUTHORIZED CLIMBING PROHIBITED*. This sign shall be placed at the installation aerial structures. **(T-0)** Several signs strategically located will satisfy warning requirements for antenna farms.

30.5.4.1.7. *RADIO FREQUENCY RADIATION (RFR)*. These signs shall be posted at access points to all areas where RFR levels exceed permissible exposure limits. **(T- 0)** Specific requirements are provided in AFI 48-109.

30.5.5. 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)**

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

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

30.5.8. Hard Hats.

30.5.8.1. Commanders, supervisors and team members shall ensure all those working on or near underground or aerial installation, removal and maintenance jobs wear an approved hard hat at all times. **(T-1)** Specifically, it shall be worn while working on or around poles, overhead structures, vaults, manholes, excavations, demolition areas and tower and antenna construction jobs. **(T-1)** The chinstrap shall be worn during work aloft. **(T-1)**

30.5.8.2. Electrical employees will wear Class G safety helmets/hard hats, IAW **Chapter 14. (T-0)** The preferred color for hard hats is yellow due to its high visibility during inclement weather and darkness. Hard hats shall not be painted. Markings on hard hats shall be of the stick-on type and shall be limited to the name of the owner (letters no more than 1/2-inch high by 1/2-inch wide) and a unit emblem (no more than 3 inches in

diameter). **(T-1)** All markings shall be conservative and will not degrade the effectiveness or non-conductivity of the hard hat. **(T-1)**

30.5.9. Reflective Clothing. When mission requirements dictate, light-reflective clothing or accessories shall be worn IAW **Chapter 14** or other applicable guidance. **(T-1)**

30.5.10. Electrical Hazard Shoes. Electrical hazard shoes are not a replacement for electrically rated matting in high voltage situations. Shoes are designed to be used when working on low voltage circuits and, even then, as a secondary means of protection. Additional information can be found in **Chapter 14**.

30.5.11. Fire Extinguishers. Supervisors/functional managers shall ensure appropriate fire extinguishers shall be provided. **(T-1)** The installation FES Flight shall be consulted to determine types, quantities and locations of this equipment. **(T-1)**

30.6. Tools and Equipment.

30.6.1. The supervisor shall ensure all tools and equipment are maintained in a safe condition. **(T-1)** All employees are responsible for the condition and correct use of the tools and equipment they use.

30.6.2. 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)**

30.6.3. All tools shall be kept clean and free of grease, oil, paint or other foreign material IAW TO 32-1-101, *Use and Care of Hand Tools and Measuring Tools*. **(T-0) Exception:** This does not prevent the use of a light film of oil on tools for rust protection.

30.6.4. Wood or reinforced fiberglass ladders shall be used for work performed on or near electrical equipment. **(T-0)** Wood ladders shall not be used on electrical equipment if ladder is wet. **(T-0)**

30.6.5. Metal ladders or ladders with metal reinforced side rails shall not be used when work is being performed in, on or near electrical equipment, and shall not be stored in any area where electronic equipment may be in operation. **(T-0)** If ladders are not marked by manufacturer with a safety statement that reads, "Do not use around electrical equipment," then stencil ladder with *DANGER — DO NOT USE AROUND ELECTRICAL EQUIPMENT,* in two-inch high red letters or contrasting letters on both ladder side rails. Refer to **Chapter 7,** *Walking – Working Surfaces,* for additional guidance.

30.6.6. 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)** Refer to **Chapter 11,** *Hands Tools, Portable Tools and Machinery,* for additional guidance and information.

30.6.7. Test Equipment 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 permitted 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)**

30.6.8. 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 enclosed. **(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)**

30.6.9. 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)**

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

30.6.11. 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.

30.7. High Voltage. 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. Operators and technicians shall not attempt to adjust any electronic equipment when there is a possibility of injury from unprotected high voltage. Adjustments on operating high voltage equipment, other than those specified by TO or manufacturer‘s manuals, shall only be authorized by the unit commander. **(T-1)** The unit commander shall consider all operational requirements, TOs, manufacturer‘s guidance, 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)**

30.7.1. Only qualified personnel shall perform work near energized overhead power lines**. (T-0)** Approach distances for qualified workers shall be IAW 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. IAW 29 CFR 1910.268, *Telecommunication,* and 1910.333, *Selection and Use of Work Practices,* the following safety precautions shall be considered when working near overhead power lines:

30.7.1.1. Any vehicle or mechanical equipment which may have parts of its structure elevated near energized overhead power lines shall be operated so a clearance of at least 10 feet (305 centimeter [cm]) is maintained. **(T-0)** If the voltage is higher than 50 kilovolt (kV), the clearance shall be increased 4 inches (10 cm) for every 10 kV over that voltage or twice the length of the line insulator, but never less than 10 feet. **(T-0)**

30.7.1.2. If the vehicle is in transit with its structure lowered, the clearance may be reduced to 4 feet (122 cm). If the voltage is higher than 50 kV, the clearance shall be increased 4 inches (10 cm) for every 10 kV over that voltage. **(T-0)**

30.7.1.3. If insulating barriers are installed to prevent contact with the lines, and if the barriers are rated for the voltage of the lines being guarded and are not a part of or an attachment to the vehicle or its raised structure, the clearance may be reduced to a distance within the designed working dimensions of the insulating barrier.

30.7.1.4. If the equipment is an aerial lift insulated for the voltage involved, and if the work is performed by a qualified person, the clearance (between the uninsulated portion of the aerial lift and the power line) may be reduced to the distance given in UFC 3-560-01, Table 3-1.

30.7.2. 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)**

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

30.7.4. 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)**

30.7.5. 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)**

30.8. Rubber Insulating Floor Matting.

30.8.1. Insulating matting shall be used near electrical apparatus or circuits in high voltage maintenance areas as an additional safety measure to protect employees. **(T-0)** Insulating matting is for protection against accidental shock only and shall not be depended upon for protection when handling energized wires and circuits. Refer to TO 00-25-232, *Control and Use of Insulating Matting for High-Voltage Application*, TO 00-25-234, *General Shop Practice Requirements for the Repair, Maintenance and Test of Electrical Equipment*, and MIL-DTL-15562G, *Matting or Sheet, Floor Covering Insulating for High Voltage Application*, for information and instructions for the control, use and marking of insulating matting. Approved electrical insulating matting is permanently marked IAW MIL-DTL-15562G.

30.8.2. Upon request, the supervisor, with the assistance of the installation Occupational Safety office, shall inspect areas where electrical facilities are located and determine whether insulating matting is required for employee protection. **(T-1)** Typical examples of high voltage areas requiring insulating matting are where potential shock hazards exist and additional resistance is required; floor resistance is lowered due to dampness; high voltages (above 600 volts) may be encountered, such as high voltage consoles; and areas with electrical repair or test benches (shops), motors or equipment and control panels.

30.8.3. Cleaning shall be accomplished as often as necessary to prevent contamination, utilizing domestic cleaners such as carpet cleaner or any other locally approved cleaner required for special situations. **(T-1)**

30.8.4. Insulating matting shall be replaced when worn to one-half its original thickness or the manufacturer's suggested replacement requirements. **Note:** Shoes with nails shall not be worn on insulating matting. **(T-1)**

30.8.5. Insulating matting on floors in front of and around electronic workbenches, high voltage cabinets, switch panels, etc., shall be of one continuous length or strip. **(T-0)** Where possible, the matting shall continue for 24 inches beyond the end of the equipment. Overlapping at corners is not required if it produces a tripping hazard. If more than one run or strip of matting is required, the activity supervisor shall determine the amount needed. **(T-0)**

30.8.6. Insulating matting shall be seamless and markings shall be non-conducting and not impair the insulating qualities of the equipment. **(T-0)**

30.8.7. The voltage test shall be applied continuously for three (3) minutes for equipment other than matting and applied continuously for one minute on matting. **(T-0)**

30.8.8. Insulating matting shall not be used for nonskid applications such as walkways or hallway runners, in front of workbenches (non-electronic) or on work- and test-benches, etc. **(T-0)** For these applications, general-purpose matting shall be used. **(T-0)** This is a low-cost matting and is satisfactory for use in areas where shock protection is not required. No certification for use of general-purpose matting is required.

30.9. Aerial Work.

30.9.1. The only personnel authorized to climb poles and towers are those who have been properly trained and who are certified or in a training status under the observation of a qualified instructor. Appropriate safety equipment shall be worn while performing aerial work. **(T-0)**

30.9.1.1. CE will maintain records on the inspection and maintenance of poles and towers considered real property IAW AFI 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.

30.9.1.2. CE must ensure inspection and maintenance records are provided upon request by using agencies. **(T-1)**

30.9.1.3. Safety offices will review these records during annual inspections to ensure they are current. **(T-2)**

30.9.2. Commander Responsibilities.

30.9.2.1. Unit commanders shall designate, in writing, all personnel required to maintain climbing proficiency. **(T-1)**

30.9.2.2. Commanders shall restrict climbing authorizations to structures that must be climbed to accomplish mission requirements. **(T-1)**

30.9.2.2.1. Commanders will coordinate with CE 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.

30.9.2.2.2. Ensure employees who must climb structures are provided to access inspections/maintenance records.

30.9.3. Initial Certification Procedures.

30.9.3.1. 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)** The requirements ensure

employees who must climb use proper PPE, are fully qualified and physically capable of climbing and working aloft.

30.9.3.2. For Air Force Specialty Codes (AFSEC) other than 3D1X7, commanders shall restrict climbing authorizations to those structures that must be climbed to accomplish mission requirements. **(T-1)**

30.9.4. Supervisors/trainers responsibilities.

30.9.4.1. Climbing recertification is an annual requirement.

30.9.4.2. Annual recertification may be satisfied by demonstrating climbing proficiency any time climbing is performed while completing actual job requirements or training events under supervision of qualified certifier.

30.9.4.3. Decertify personnel not qualified to perform climbing tasks and restrict from climbing until recertified. **(T-1)** The certifier will determine the training requirements. **(T-1)**

30.9.4.4. Supervisors must have a rescue plan in place in the event a climber cannot descend the tower on their own. **(T-1)**

30.9.4.5. Supervisors shall ensure personnel on the ground or in the air do not remove or tamper with guy wires, guying hardware or supporting ropes when employees are aloft. **(T-1)**

30.9.4.6. Supervisors and each team member have the responsibility to prohibit persons from climbing if it would be potentially unsafe due to mental or physical condition, such as a fear of heights or dizziness, fainting or lack of experience.

30.9.4.7. Supervisors will ensure climbing training includes how to access tower inspection/maintenance records to validate safety of the structure. **(T-2)**

30.9.5. Climbing Certifier Requirements. Climbing certifier must:

30.9.5.1. Complete a climbing certification training course or commercial equivalent. **(T-1)** Tower certifier training, J3AZR3D157 0C1A, can be found at website: **https://etca.randolph.af.mil/**.

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

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

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

30.9.5.5. Be certified to train individuals in pole top and tower rescue. **(T-1)**

30.9.5.6. Use a training plan to conduct pole top and tower rescue training and climbing certification. **(T-1)**

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

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

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

30.9.6. Climbers responsibilities.

30.9.6.1. Each team member has the responsibility to ensure all personnel are prepared for the climbing task. **(T-1)**

30.9.6.2. Personnel handling or using the equipment will inspect to determine if the climbing equipment is in safe working condition. **(T-1)** Refer to TO 00-25-245 for additional guidance.

30.9.6.3. Climbers must maintain three points of contact while climbing at all times. **(T-1)** Either one hand and two feet or two hands and one foot must be in contact with the tower or pole at all times while ascending or descending.

30.9.7. Safety Observers. When performing aerial work on communication cable and antenna systems, safety observers must be qualified to operate the equipment in use and shall have a current climbing certification, be proficient in CPR and administering emergency first aid treatment that involves control of bleeding, shock, open wounds and burns, and procedures for obtaining medical assistance. **(T-1)**

30.9.8. Documentation. Document certification in the Integrated Maintenance Data System training subsystem. A record of climbing certification shall be maintained on AF Form 1098, *Special Task Certification and Recurring Training*, and AF Form, 623 *Individual Training Record Folder*, or an approved automated system. **(T-1)**

30.9.9. The potential of falling is the most obvious hazard encountered while climbing. It is extremely important that your safety gear is used and worn properly. The personal fall arrest system, e.g., climbing harness, lanyard and other safety equipment must be inspected prior to each use. **(T-0)** Employees shall inspect the equipment prior to use. **(T-0)** Refer to paragraph **30.9.15** for additional guidance on personal fall arrest systems.

30.9.10. Steps and ladders shall be installed on all antenna towers and structures when the design permits. **(T-0)** These steps and ladders shall be equipped with cages or safety devices where possible. **(T-0)** Exceptions to this requirement are 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. Safety cages, ladder devices or similar equipment are not required on wooden poles. Design specifications for protective devices on existing facilities shall be retrofitted as required in coordination with the installation CE. New towers, poles and masts shall have protective devices included in the original design. **(T-0)** When installed, use of protective devices shall be strictly enforced. **(T-0)**

30.9.11. Certification is not required, for example, to walk up and down stairways. Refer to **Chapter 7**, 29 CFR 1910.24, *Fixed Industrial Stairs*, and 29 CFR 1910.27, *Fixed Ladders*, for additional precautions and guidance.

30.9.12. Employees engaged in climbing communication poles, antenna supports, etc., shall be issued suitable PPE, e.g., line worker boots, hard hat with chinstrap, safety harnesses and safety straps, which shall be worn at all times while climbing and working aloft. **(T-0)** When PPE is not used during climbing, it shall be attached to the harness or elsewhere as prescribed. **(T-0)** It shall not be carried in the hand, over the shoulder or by other unauthorized methods.

(T-0) Hard hats shall be worn and secured with chinstraps while climbing and working aloft. **(T-0)** Climbing equipment shall be inspected IAW **Chapter 13**. **(T-0)**

30.9.13. Elevated Areas. Elevated areas of Communications Electronics (C-E) facilities and mobile electronic equipment vans, where work such as calibration, adjustment and maintenance of electronic equipment is required on a frequency of more than once per month, shall be provided with safety railings IAW **Chapter 7**. **(T-0)**

30.9.14. Environmental Factors.

30.9.14.1. Check Weather Forecast Prior to Climbing. **(T-1)**

30.9.14.2. Personnel shall not climb if lightning is within five miles. **(T-0)**

30.9.14.3. Personnel shall not climb if winds are in excess of 25 MPH. **(T-0)**

30.9.15. Personal Fall Arrest System.

30.9.15.1. OSHA requires that employers provide fall protection for any employee whose work requires them to be four (4) feet or more above a lower level or off the ground. The use of full body harness is required. This harness shall be part of a personal fall arrest system. **(T-0)** There are three parts to a personal fall arrest system: an anchor, a body harness and a connecting device. Refer to **Chapter 13** for additional guidance.

30.9.15.2. Users of personal fall arrest systems shall comply with TO 00-25-245 regarding inspection, maintenance, cleaning and storage of personal fall arrest systems equipment. **(T-1)** Refer to **Chapter 13** for additional guidance.

30.9.15.3. Kernmantle rope is rope that is constructed with the interior core (the kern) surrounded by and protected by a woven sheath (the mantle) designed to maximize strength, durability and flexibility. Kernmantle ropes come in a variety of different sizes and ratings; for example, the 5/8” diameter kernmantle rope is rated at 12,000 lbs. and the 1/2” diameter is rated at 10,000 lbs.

30.9.15.4. There are mainly two (2) different types of kernmantle rope: static and dynamic. Static rope is used in situations where little stretching is required, mainly for hauling items, rappelling and other applications. Dynamic rope is used to secure climbers and is designed to stretch under heavy loads to absorb the shock of a fallen climber. Dynamic ropes are only rated to handle a certain number of falls and shall be discarded once signs of stress appear. **(T-1)** These signs show up as a tapered appearance in the rope.

30.9.15.5. Kernmantle rope shall never be stepped on. **(T-1)** Getting fine rock and dust particles in the sheath (mantle) will happen with everyday work. However, stepping on the rope will grind these particles into the inner core (kern) and cause damage to the rope internally.

30.9.15.6. Test the rope grab for proper operation. Ensure the rope grab is installed with the arrow pointed in the up position and properly locked down onto the rope. **(T-1)** Slide the rope grab up and down the rope to ensure it slides freely. When a sharp downward pull is applied, the braking mechanism shall activate, preventing the rope grab from moving downward. The rope grab must be the proper size for the rope used, for example, use a 5/8” rope grab on a 5/8” rope.

30.9.15.7. Some towers are equipped with a safety rail and sliding sleeves. Sliding sleeves are similar to rope grabs in that they have an arrow on them which shows the proper installation direction. The arrow must be installed pointing up or the brake won't activate during a fall. Inspect the sliding sleeve for cracks, corrosion and pitting before use. If any of these conditions exist, the sliding sleeve must be replaced before use.

30.9.15.8. Carabineers are simply a clip or hook. When used for climbing, they must have a spring loaded gate (keeper) and the gate must self-lock. Carabineers must be rated to handle 5,000 lbs.

30.9.16. Equipment For Un-stepped Communications Poles. All C-E field technicians required to climb un-stepped communications poles will use the squeeze pole fall protector (pole choker) arrest system. **(T-1)** Users of the pole chokers will comply with TO 00-25-245 and manufacturer‘s instructions regarding inspection, maintenance, cleaning and storage of personal fall arrest systems equipment. **(T-1)**

30.9.17. Tower Rescue.

30.9.17.1. All tower workers shall be qualified in first aid, buddy care and CPR. **(T-0)**

30.9.17.2. Use the following steps for descending/suspension method of rescue.

30.9.17.2.1. Climb the tower using the "Y" lanyard and attach a snatch block to the tower. **(T-0)**

30.9.17.2.2. Install a rope through the snatch block. **(T-0)** This shall be used to raise the other equipment that shall be used for rescue. **(T-0)**

30.9.17.2.3. Attach the canvas bucket to the rope and raise it to the anchor position. **(T-0)**

30.9.17.2.4. Attach the anchors; one for the victim's rope grab, and another for the rescuer's rope grab. The third anchor for the Fisk Descender, which shall be attached in the middle, with the victim to the right and the rescuer to the left. **(T-0)**

30.9.17.2.5. Rig the three termination plates and attach them to the anchor straps.

30.9.17.2.6. The rescuer shall attach to the rope grab and rig the descender and prepare to rescue the victim. **(T-0)**

30.9.17.2.7. The rescuer shall not disconnect from the rope grab until on the ground. **(T-0)**

30.9.17.2.8. Once in position, the rescuer shall descend to the victim and permanently lock-off the Fisk Descender. **(T-0)**

30.9.17.2.9. After permanent lock-off has been accomplished, the rescuer shall attach to the victim using a carabiner. **(T-0)**

30.9.17.2.10. After connecting to the victim, the rescuer shall cut the mule tape which will cause the victim to fall about two (2) inches. **(T-0)** The Fisk Descender shall take on the weight of the victim, and the rescuer will not feel the effects of the victim's weight. **(T-0)**

30.9.17.2.11. Once attached to the victim, the rescuer shall position the victim on his/her right hip. **(T-0)**

30.9.17.2.12. After getting the victim positioned properly, the rescuer shall place the descender in the descend position and lower him or herself and the victim to the ground. **(T-0)**

30.9.17.2.13. The rescuer shall apply first aid, buddy care or CPR, if needed, while awaiting the arrival of emergency services. **(T-0)**

30.9.18. General Tower Climbing Precautions.

30.9.18.1. Check tower antenna supports and mounts for corrosion. **Note:** Check bolts on towers, because they corrode before tower sections. Refer to TOs 31-10-19, *Antenna Systems —Anchors and Supports*, and 31R-10-5, *Air Force Comm Commands (E-I Standards) – Antenna Systems, Maintenance, Repair and Testing,* for additional guidance.

30.9.18.2. Before starting work, ensure power to antennas is turned off and locked out, the capacitors are discharged and appropriate signs or tags are posted. **(T-0)**

30.9.18.3. Check natural fiber, nylon and wire ropes, used in dismantling of antenna supports, for deterioration and splices, and discard them if found to be unsafe. Make sure wire ropes are made of improved plow grade steel. Ensure loads placed on ropes do not exceed the safe working load limits prescribed for the diameter of the rope. **(T-0)**

30.9.18.4. Do not carry bulky and heavy tools, parts or other materials on safety harnesses while climbing.

30.9.19. Pole Top Rescue.

30.9.19.1. Pole top rescue shall only be attempted by personnel who have been properly training and who are certified or in a training status under the observation of a qualified instructor. **(T-1)**

30.9.19.1.1. All pole workers shall be qualified in first aid, buddy care and CPR. **(T-1)**

30.9.19.1.2. If no aerial lift devices are available for rescue, get help and call or assign someone to call the local Emergency Medical Service or FES Flight. Artificial respiration can be applied to an unconscious victim on a pole, and the best position shall be slightly above the victim. If CPR is required, the victim must be lowered as quickly as possible, and then CPR administered. **(T-0)**

30.9.19.1.3. Climb to Rescue. Climb the pole and free the victim from the energized line if necessary. **(T-0)** Take great care to ensure the rescuer is not also electrocuted. If CPR is not required, mouth-to-mouth resuscitation can be attempted before lowering the injured employee to the ground. If resuscitation necessary, the best position for the rescuer is slightly above the victim. When the victim begins breathing naturally, keep the victim in position and under control until additional help is available for lowering the victim to the ground, using rope rigging if possible. Take a position below the victim on the pole and place your safety strap around the pole. **(T-0)** Then climb up the pole with the victim's legs straddling your safety strap, and with the victim's body

between you and the pole. **(T-0)** When the safety strap is sufficiently high, the victim's weight can then be taken on your safety strap. Do not unfasten the victim's safety strap.

30.9.19.1.4. Use a handline to lower the victim for either one or two rescuers. **(T-0)**

30.9.19.2. Pole Top Rescue Training Requirements. Graduates of the communications cable and antenna systems apprentice course or other accredited climbing courses are recognized by the Cyber Systems Air Force Career Field Manager as qualified climbers for a period of 90 days from the graduation date. At those units with existing climbing capabilities, the gaining unit must evaluate the graduates within 90 days from the graduation date to verify and document qualifications. **(T-0)** The individual shall be tested, orally and/or in writing and by practical demonstration, to ascertain knowledge of standard climbing safety practices and proficiency in climbing practices and procedures. **(T-0)** This requirement ensures individuals who must climb and use protective devices are fully qualified and physically capable of climbing and working aloft. Decertify the individual if the initial evaluation exceeds the 90-day period. **(T-1)**

30.9.19.3. General Pole Climbing Precautions.

30.9.19.3.1. Inspect the pole for unsafe conditions both before and during the climb. **(T-0)**

30.9.19.3.2. Check poles for deterioration. **(T-0)** Prior to placing body weight on step, check steps on poles for proper depth and tightness. **(T-0)**

30.9.19.3.3. Unsafe conditions include such things as rake (leaning of the pole), shell rot, cracks, breaks, knots, woodpecker holes and foreign attachments to the pole.

30.9.20. 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. Prior to each use, the rope shall be inspected for frayed or worn spots and replaced, if required.

30.10. Antenna Supports (Towers and Poles).

30.10.1. Before starting work, ensure power to antennas is turned off and locked out, the capacitors are discharged and appropriate signs or tags are posted IAW **Chapter 21**. **(T-0)** Check poles for deterioration. **(T-0)** Prior to placing body weight on step, check steps on poles for proper depth and tightness. **(T-0)** Do not carry bulky and heavy tools, parts or other materials on safety harnesses while climbing.

30.10.2. Check guy wires for proper tension and attachment hardware and anchor rods for corrosion. **(T-1)** If hardware shows signs of corrosion, dig down 18 inches around the anchor rod to determine the extent of corrosion to the anchor rod. **(T-1)** Additionally, check tower antenna supports and mounts for corrosion. **(T-1) Note:** Check bolts on towers because they

corrode before tower sections. Refer to TOs 31-10-19, *Antenna Systems —Anchors and Supports*, and 31R-10-5, for additional guidance and information.

30.10.3. Check natural fiber, nylon and wire ropes, used in dismantling of antenna supports, for deterioration and splices, and discard them if found to be unsafe. Make sure wire ropes are made of improved plow grade steel. Ensure loads placed on ropes do not exceed the safe working load limits prescribed for the diameter of the rope. **(T-1)**

30.10.4. Ensure only special purpose vehicles designed for heavy antenna erection and removal, which are capable of handling the maximum weight of items to be lifted, are used. **(T-1)** Check the vehicle manufacturer's specifications and handbook for safe operation and proper use. **(T-1)**

30.11. Single Phase Portable and Vehicle-Mounted Generators.

30.11.1. 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:

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

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

30.11.2. 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:

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

30.11.2.2. 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.

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

30.11.3. 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.

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

30.11.5. Fixed Wiring Systems. Portable and vehicle-mounted generators that supply fixed wiring systems shall be grounded IAW *National Electrical Code,* Article 250, *Grounding*. **(T-0)**

30.12. Repairs and Adjustments.

30.12.1. 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.

30.12.2. 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 manuals 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 manuals. **(T-1)** Additionally, insulated gloves shall be used when directed by TOs or the manufacturer's manuals. **(T-1)** Ensure insulated matting is used and a qualified safety observer is present. **(T-1)**

30.13. Power Distribution Panels.

30.13.1. 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. Refer to **Chapter 29** and paragraph **30.5.4** for additional guidance and information on signs and visual aids.

30.13.2. 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)** Blown fuses shall be replaced by the type required by the manufacturer. **(T-0)** When possible, clip type or flat-mount cartridge fuses shall only be removed and replaced by using insulated fuse pullers. **(T-0)** Wire, foil, solder and similar materials shall not be used as substitutes for fuses. **(T-0)**

30.13.3. 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)** Carbon blocks and/or heat coils shall not be removed or replaced if the foreign electromotive force is still present. **(T-1)**

30.14. Cathode Ray Tubes. Precautions shall be taken to minimize the danger of breaking the glass envelope of a cathode ray tube. **(T-1)** For protection of both tubes and personnel, tubes are packaged and centrally positioned in shipping and storage containers. They shall be retained in their original containers until removed for actual installation or for inspection and test. **(T-1)** A tube shall not be stored without its original packaging. **(T-1)** In addition to the danger of implosion due to breakage, rough handling may also cause displacement of the electrodes within the tube. A sharp blow on the service bench can displace the electrodes enough to cause faulty operation of the tube and even destroy it. Tubes shall be exposed or changed only in areas where a minimum number of personnel are present. **(T-1)** All personnel working in the vicinity shall wear eye protection whenever a cathode ray tube is removed from its container. **(T-1)** Handling of large diameter tubes shall be done by two (2) employees. **(T-1)** Employees who handle tubes will:

30.14.1. Wear PPE, consisting of an apron, gauntlet-type gloves, goggles and full-face shield, during tube installation or removal of cathode ray tubes larger than six (6) inches in diameter. **(T-1)**

30.14.2. Remove tube from its shipping or storage container face up by grasping the larger, or bell end. **(T-1)** Avoid handling large tubes by the neck since the narrow portion of the tube is particularly susceptible to breakage from bumping or striking other objects. **(T-1)** This will also minimize strain due to mechanical misalignment. Do not place a tube on its side on a flat surface. Instead, place the tube face down on a nonabrasive pad or suitable material. Avoid scratching the glass of a tube since such scratches weaken the tube and can cause failure.

30.14.3. Special handling instructions are normally provided by the manufacturer for tubes having an external insulation coating applied to areas of the bell end. If not otherwise instructed, grasp the rim of the bell, holding the neck end only to guide the base into position. **(T-1)**

30.14.4. Permanently mount a protective shield on tubes used regularly for testing equipment. **(T-1)** For those tubes not having integral implosion protection, use a safety glass faceplate over the screen. **Note:** New tubes use a bonded faceplate or a similar method of integral implosion protection, eliminating this requirement. However, the older type tubes may still be in use and the safety precautions cited herein shall be observed. **(T-1)**

30.14.5. Handle old or unusable tubes with the same precautions for new tubes. **(T-1)** Unless otherwise directed, destroy old or unusable tubes prior to disposal. Place the tube into a steel container or sealed carton that has a hole in the top just large enough for a crowbar or similar instrument and smash the tube. An alternate method is to break the evacuation tube located at the end of the neck. After destroying the tube, and before placing into bulk waste containers, seal the residue in the original or an equivalent container, using tape. Contact the installation Environmental Management office and BE for potential radiation issues prior to destroying the tube and for disposal guidance.

30.14.6. Immediately wash the cut(s) to remove dirt, phosphorus or other particles, and obtain immediate medical attention if broken glass from a tube cuts the skin. **(T-1)**

30.14.7. In the event of equipment fires, use only approved extinguishers on cathode ray tubes. Refer to paragraph **30.5.11** and the installation (FES) Flight for additional guidance.

30.14.8. Contact BE for an evaluation of the X-ray hazard of all color video display tubes manufactured before 1970 and operating at voltages greater than 16 kV, or for video display tubes manufactured after 1970 when maintenance procedures have the potential for violating manufacturer-applied warning labels.

30.15. Radar and Microwave Equipment.

30.15.1. 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)**

30.15.2. Exercise caution when working on or adjacent to transmitter antennas. Special precautions shall be taken to ensure a transmitter, connected to an antenna that is being inspected or worked on, is locked out IAW **Chapter 21** requirements and cannot be energized. **(T-1)** Ensure adjacent antennas, which create hazardous levels of RF radiation at the work location, are also secured. 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)**

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

30.15.4. 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.

30.16. Entering Manholes and Unvented Vaults.

30.16.1. **Chapter 23** requirements shall be met during all entry operations. **(T-0)** Manholes and vaults shall be evaluated and tested to determine the classification of the confined spaces and whether entry permits shall be required. **(T-0)** Additionally, 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 and contact the appropriate installation organizations to establish positive identification. **(T-1)** These shall normally include the installation CE electrical shop, communication unit and FES Flight. **(T-1)**

30.16.2. 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 civil engineering electrical shop shall provide an electrician to assist in determining guarding and safe procedures. **(T-1)**

30.17. Cables.

30.17.1. 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)**

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

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

30.17.4. 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.

30.17.5. Never ride a cable car over power lines (primary or secondary).

30.17.6. 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)**

30.17.7. 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)**

30.17.8. 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.

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

30.17.10. 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.

30.18. Special Purpose Vehicles. See AFI 24-302, *Vehicle Management*, for guidance.

30.18.1. Inspection. Prior to operation, visually inspect the vehicle and check vehicle documentation, e.g., AF Form 1800, *Operator's Inspection Guide and Trouble Report*, and AF Form 1807, *Operator's Inspection Guide and Trouble Report (Fuel Servicing Vehicles/Equipment)* to determine if it is safe, serviceable and in good condition. Inspect for correct assembly, storage of equipment and worn equipment. After operation, document and correct any operating deficiencies, report defects that require repair to the unit vehicle control officer and/or organizational maintenance section, and replace unserviceable equipment.

30.18.2. 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)**

30.18.2.1. 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)** Never rig a winch line so it will pull against the flange of the winch drum. **Note:** Some winches are designed for pulling while others are designed for raising or lowering. Ensure each winch is being used for its designed purpose. **(T-1)**

30.18.3. 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)**

30.19. 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)**

30.19.1. 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 information on lockout and tagout requirements and paragraph **30.5.4** for signs and visual aids.

30.19.2. TO 35-1-3, *Corrosion Prevention and Control, Cleaning, Painting, and Marking of USAF Support Equipment (SE)*, 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 3/4-inch-wide red dashes.

Chapter 31

BATTERIES – MAINTENANCE, HANDLING AND STORAGE REQUIREMENTS

31.1. General Information. This standard provides basic background information for safe battery operations and is not intended to be all-inclusive.

31.1.1. Air Force battery shops, rooms and areas contain space and equipment for shipping, receiving, cleaning, charging, discharging, storing and repairing storage batteries for aircraft, vehicles and ground support equipment. Personnel engaged in these activities shall use approved Air Force TOs. **(T-1)** Commercial manufacturer's manuals are not authorized for Air Force use on aircraft batteries and must be converted to TO guidance by the appropriate AF Engineering Support Specialist or Systems Program Office. **(T-1)**

31.1.2. The battery shop, room or area shall be designed to eliminate certain hazards associated with battery maintenance and shall conform to the specific requirements in this document and 29 CFR 1910.178, *Powered Industrial Trucks*, 29 CFR 1926.403, *General Requirements (Electrical),* 29 CFR 1926.441, *Batteries and Battery Charging*, National Fire Protection Association 70, *National Electrical Code*, including Articles 480, *Storage Batteries*, and Chapter 5, *Special Occupancies*, which includes Article 500, *Hazardous (Classified) Locations*, Article 501, *Class I Locations*, and Article 503.14, *Storage – Battery Charging Equipment*. **(T-0)** The installation Occupational Safety office, BE, FES Flight and Environmental Management office shall evaluate and certify battery rooms, shops or areas to ensure they conform to safe design and operating practices. **(T-1)** Refer to the provisions of AFMAN 32-1084, *Facility Requirements,* for additional guidance.

31.1.3. Whenever a facility deficiency is identified, appropriate controls and corrective actions are required. If the deficiency involves a local requirement and cannot be corrected, a waiver letter shall be obtained from the applicable base agency. **(T-1)** For deficiencies involving AF or AFOSH requirements, identify the deficiency to the parent Numbered Air Force or MAJCOM for additional guidance on resolving the deficiency. **(T-1)**

31.2. Safety.

31.2.1. Appropriate PPE, approved and certified in BE's occupational and environmental health risk assessment, shall be worn whenever charging, maintaining, removing and/or replacing batteries. **(T-0)** PPE required when working with batteries shall be documented IAW AFI 91-202. **(T-1)** PPE is required when:

31.2.1.1. Cleaning batteries, battery connection points and/or cables, servicing fluid level, connecting or disconnecting a battery charger at the battery, jump-starting a battery installed in a vehicle or piece of equipment, or any other type of service activity, requires American National Standards Institute/International Safety Equipment Association Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices,* approved eye protection with side shields. When handling electrolyte, a face shield, splash resistant chemical goggles and chemical resistant gloves and apron shall be worn. **(T-0)** Refer to **Chapter 14,** *Personal Protective Equipment (PPE),* or additional guidance and information.

31.2.1.2. Handling vented lead acid vehicle or support equipment batteries (removing or installing in vehicles or equipment or transporting them) or when working in the battery

room or maintenance area, requires personnel to wear acid resistant gloves, arm gauntlets, aprons, face protection and American National Standards Institute/International Safety Equipment Association Z87.1 approved eye protection with side shields. Acid resistant safety shoes or acid resistant rubber knee length safety toed boots shall also be worn. **(T-1)** Refer to **Chapter 14** for additional guidance and information.

31.2.2. Electrical components and systems shall be de-energized and isolated from other energized circuits and/or power sources before working on, servicing, removing or replacing a battery, unless specifically directed by a TO or specific requirement. **(T-1)**

31.2.3. In areas where battery maintenance is performed on a regular basis, a permanent eyewash station shall be installed. **(T-0)** If battery electrolyte comes in contact with the skin, the employee shall immediately flush the skin with tepid water. **(T-1)** If electrolyte is splashed into the eyes, they shall be flushed with tepid water for at least 15 minutes. **(T-1)** The employee shall seek immediate medical attention. **(T-1) Note:** Portable eyewash stations shall be located in areas not affected by extreme temperatures (under 60°F or over 95°F), unless protected from such temperature extremes. **(T-1)**

31.2.4. Battery Safety Practices. Nickel-cadmium and silver-zinc batteries shall be serviced in an area isolated from lead-acid batteries. **(T-0)** When both acid and potassium hydroxide electrolyte batteries are handled in the same shop, specific equipment for the two kinds of batteries shall be kept separate and carefully labeled. **(T-0)** Tools and implements used to service nickel-cadmium, silver-zinc, nickel-iron or other alkaline batteries shall be used on those types only. **(T-0) Note:** Basic safety practices for all lead-acid batteries are similar and only vary with specialized construction or conditions of use. Therefore, guidance given for one type of battery usage can and shall be followed with other uses, when applicable. **(T-0)**

31.2.5. Battery Equipment and Charging Operations. Only trained and qualified personnel shall be permitted to change, maintain or charge batteries. **(T-1)** Personnel assigned to the battery shop shall be qualified on all equipment and TO procedures. **(T-1)** Qualification shall be documented in their individual training records. **(T-1)** Only qualified personnel or those accompanied by qualified personnel shall be allowed access to battery shops, rooms or areas. **(T-1)** Refer to American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance* and National Fire Protection Association 410, *Standard on Aircraft Maintenance*, for additional guidance and information.

31.2.5.1. Battery charging operations shall be conducted in adequately ventilated areas designated for that purpose. **(T-0)**

31.2.5.2. "No Smoking" signs shall be posted in plain view of incoming personnel, to prohibit smoking in the charging area. **(T-0)**

31.2.5.3. Tools and other metallic objects shall be kept away from the top of uncovered batteries. **(T-0)**

31.2.5.4. When charging batteries, the vent caps shall be kept in place to avoid electrolyte spray. **(T-0)**

31.2.5.5. The battery compartment or covers shall be open to dissipate heat. **(T-0)**

31.2.6. Servicing Batteries. Servicing of batteries, e.g., changing and charging, shall only be performed by trained and qualified equipment operators. **(T-1)** If services other than removal and replacement of batteries are performed, operators shall wear appropriate protective equipment, e.g., rubber apron, face shield and gloves. **(T-1)** Additionally, when working with corrosives, an emergency shower or eyewash unit shall be provided for emergency use. **(T-1)** Rings, watches and similar jewelry shall not be worn. **(T-1)** Refer to **Chapter 9,** *Emergency Shower and Eyewash Units,* for additional information on emergency showers and eyewash units.

31.3. General Facility and Equipment Requirements for Battery Rooms and Areas. A battery shop, room or area is where batteries are charged, maintained or stored. The shop, room or area shall be sized to accommodate the operation and workload. **(T-1)** Storage batteries shall be located within a protective enclosure or area accessible only to qualified personnel. **(T-1)** There are three common lead- acid battery technologies: flooded, gel and absorbed glass mat. A valve-regulated lead-acid battery, e.g., the absorbed glass mat and the gel battery (gel cell), is a type of low- maintenance lead-acid rechargeable battery. Because of their construction, valve-regulated lead-acid batteries do not require regular addition of water to the cells. The charging, maintaining or storage of the valve-regulated lead-acid batteries shall follow the manufacturer's recommendations and guidance. **(T-1)** The requirements apply to flooded (wet) lead-acid batteries.

31.3.1. Emergency Eyewash. Procedures shall be developed for flushing and neutralizing spilled electrolyte in work areas where batteries are charged, maintained or stored. **(T-1)** Emergency eyewash and/or water facilities for rinsing eyes and skin shall be provided in the battery charging rooms and areas IAW **Chapter 9. (T-0)**

31.3.2. The FES Flight shall prescribe the quantity and placement of extinguishers for battery shops, rooms or areas based on the size of the operation. **(T-1)** Battery shops shall have ready sources of running tap water, with a hose provided for washing the work area and emergency eyewash/showers. **(T-1)**

31.3.3. Doors.

31.3.3.1. Exit Doors. Battery shop, room or area doors shall swing outwards. **(T-1)**

31.3.3.2. Roll-up Doors. See paragraph **2.7** for roll up door requirements.

31.3.4. Floors shall be of acid-alkali-resistant construction or be protected from acid-alkali accumulations. **(T-1)** Floors, walls, ceilings, doors and other painted surfaces in battery rooms and areas shall be painted with an acid-alkali-resistant epoxy-poly-urethane paint. **(T-1) Note:** The battery shop can be painted any color. It is highly suggested to paint the floors gray and the walls white. An acid-alkali-resistant epoxy-poly-urethane paint with primer (e.g., Grainger Company, or equivalent, as listed below) shall be used. **(T-1)** These paints provide the most protection against corrosion. Always follow the manufacturer's Technical Data Sheets, the applicable SDS and the Electro-Environmental Maintenance Standardization Evaluation Program checklist for these paints.

31.3.5. All mechanical equipment and fixtures shall be designed and specified to withstand the corrosive acid-alkali atmosphere from battery operations. **(T-1)**

31.3.6. Racks and Tools. Racks used to support batteries during charging shall be made of or coated with non-sparking materials and designed to permit free access for servicing batteries.

(T-1) Metal racks shall be protected with an acid-alkali resistive coating and the actual supports on which a battery rests shall be made of non-conductive materials or be suitably insulated. **(T-1)** To facilitate battery handling and proper maintenance, low racks (close to the floor) shall be used when feasible. **(T-1)** Tools used during battery charging or servicing shall be non-conductive or coated with non-conductive materials. **(T-1)**

31.3.7. Work Surfaces. Work surfaces shall be non-conductive, and resistant to both acid and alkali. **(T-1)** Whenever possible, battery servicing and maintenance shall be performed on elevated, non-conductive racks. **(T-1)** These racks shall allow air to flow under the battery to provide additional cooling to dissipate heat generated during charging and discharging. **(T-1)**

31.3.8. Charging Bench Floor Matting. Provide three-foot wide non-slip matting in front of all charging benches. **(T-1)** The matting protects personnel from electric shock and slipping hazards. Matting shall conform to TO 00-25-232, *Control and Use of Insulating Matting for High- Voltage Application.* **(T-1)**

31.3.9. Warning signs shall be posted inside and outside the battery shop, room or area, prohibiting smoking, sparks or flame-producing items. **(T-0)** Signs shall also be posted warning of electric shock and slipping hazards. **(T-0)** For guidance on construction and use of warning signs, refer to **Chapter 29**, *Mishap Prevention Signs and Tags.*

31.3.10. Battery Chargers.

31.3.10.1. Chargers shall be turned off before a battery is connected or disconnected. **(T-1)** Failure to follow this practice can cause sparks, arcing and pitting of contact surfaces of mating plugs or connectors. Connections between a battery and charger shall be through a mating plug or connector assembly. **(T-1)**

31.3.10.2. Some multiple battery and charger installations are equipped with polarized connectors of identical form on the battery and charger cables. Employees shall trace each plug or connector assembly back to its original source to ensure the correct interconnection between the battery and charger. **(T-1)** This practice shall also be used to prevent inadvertent connection of two batteries or two chargers. **(T-1)**

31.3.10.3. If charger or battery connectors are the same, additional steps shall be taken. **(T-1)** Some connectors are available in various colors to identify a series of integral, mechanical interlocks, while others can be field-equipped with interlocking voltage keys to avoid improper voltage connections. If interlocking devices are not available, consideration shall be given to another means of identification, such as number coding. **(T-1)**

31.3.10.4. To prevent ignition of accumulated gases, work shall not be conducted on batteries while they are being charged or discharged unless otherwise specified by the applicable TO. **(T-1)**

31.3.10.5. Before performing work on charger plug contacts, employees shall ensure chargers are turned off and disconnected from the input power source. **(T-0)** Refer to **Chapter 21**, *Hazardous Energy Control*, for additional lockout/tagout guidance.

31.3.10.6. Provide chargers in the battery charging area ample ventilation and protection from damage by nearby vehicles, hand trucks or batteries. Charger leads shall be kept off the floor and out of aisles to avoid damage and potential tripping hazards. **(T-1)** Overhead

leads shall be plainly marked and be high enough to keep personnel from walking into them. **(T-1)**

31.3.10.7. A carboy tilter or siphon shall be provided for handling electrolyte. **(T-0)**

31.3.10.8. When charging batteries, acid shall be poured into water; water shall NOT be poured into acid. **(T-0) Warning:** A severe reaction occurs when water is poured into acid and splattering of the acid can cause acid burns on exposed personnel. When pouring acid, the required PPE shall be worn. **(T-0)** Refer to paragraph **31.2.1** for further guidance.

31.4. Fire Prevention.

31.4.1. Explosive Hazards. Always assume explosive gases exist in and around batteries, unless positive steps have been taken to eliminate them. For this reason, smoking, open flames, sparks, arcs and other sources of ignition shall be prohibited in the immediate vicinity of batteries that are being charged or discharged. **(T-1)** The following ignition sources shall not be permitted in the vicinity of batteries:

31.4.1.1. Sparks, from any source, which could ignite explosive gases in or around batteries. Avoid shorting out a battery with metal tools or objects. Extreme care must be taken not to short out a battery with tools or metal objects. **(T-1)**

31.4.1.2. Sparks from connecting or disconnecting batteries while they are in use. Also, connecting or disconnecting a battery from a charger before turning the charger off, or while removing or installing a battery in a vehicle when current is flowing in the battery circuit.

31.4.1.3. Sparks occurring during vent cap removal. Combustible gases shall be flushed out of each cell with a gentle stream of air, i.e., by fanning each vent opening with a stiff piece of cardboard or other suitable non-conductor. **(T-1)**

31.4.1.4. Sparks or short circuits in the presence of flammable or combustible liquids. If installing or replacing electrical components in the presence of flammable or combustible liquids, the employee shall keep battery ground cable disconnected until liquids are no longer present. **(T-1)**

31.4.1.5. Sparks occurring when cleaning batteries or terminals. Never clean batteries with metal brushes or other metal devices which may generate sparks or contact both terminals and short circuit the cells.

31.5. Ventilation Systems.

31.5.1. Battery shops, rooms and areas shall be ventilated, either by a natural or powered ventilation system, for dispersal of airborne contaminants from batteries. **(T-0)** The ventilation system shall ensure the maximum gas-air mixture generated during charging is maintained below 25 percent of the lower explosive limit. **(T-1)** The ventilation system shall provide for automatic cutoff of charging equipment if the ventilation blower or fan fails. **(T-0)** BE's occupational and environmental health risk assessment will identify ventilation needs for battery shops, rooms and areas IAW American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance*. **(T-1) Note:** *National Electrical Code* Article 480.9(A), *Ventilation*, requires adequate ventilation to prevent classification of a battery location as a hazardous (classified) location. Without adequate ventilation, *National Electrical Code* Article 500, *Hazardous*

(Classified) Locations, requires installation of explosion proof lighting fixtures and receptacles.

31.5.2. Ventilation in battery charging rooms shall be sufficient to keep batteries and chargers from overheating and shall conform to applicable local codes and ordinances. **(T-0)** Ventilation in battery charging rooms shall be sufficient to keep rooms or areas maintained between 68° F and 85° F, unless permitted by a TO or other appropriate guidance. **(T-1)** Consult the installation Occupational Safety office, BE, CE and Environmental Management office for guidance on ventilation requirements.

31.5.3. Vented lead-acid and vented nickel-cadmium battery rooms, shops or areas shall have their own ventilation systems. **(T-0)** They cannot share a ventilation system. This ventilation system shall be either a natural or powered ventilation system, which must be able to disperse airborne contaminants from gassing batteries. **(T-0)**

31.5.4. Floor fans with explosion-proof motors can help keep battery temperatures from rising above 120° F. Batteries shall never be operated, charged or discharged at temperatures above 120° F, if normal service life is expected. **(T-1)**

31.6. Storage and Handling.

31.6.1. Chemical Spills and Environmental Issues.

31.6.1.1. Precautions shall be taken to prevent the electrolyte from spilling. **(T-1)** Batteries shall not be laid on their side unless permitted by TO. **(T-1)** Batteries shall not be transported without being properly secured with straps or other restraint devices. **(T-1)**

31.6.1.2. BE shall provide instructions on how to flush and neutralize electrolyte spilled on employees. **(T-1)** Spill control procedures shall be developed and coordinated with the installation Occupational Safety office, BE, CE and Environmental Management office. **(T- 1)** 31.6.1.3. Dispose of waste batteries and fluids in a manner consistent with approved hazardous waste disposal procedures and applicable environmental regulations. Contact the installation Environmental Management office for waste disposal guidance.

31.6.2. Vented lead-acid and vented nickel-cadmium batteries shall be maintained and stored in separate rooms or areas. **(T-0)** The battery shop supervisor shall ensure all visitors entering the battery shop receive a safety briefing on the hazards located in the battery room or area before entry is authorized. **(T-0)** If maintenance is performed while visitors are in the battery shop, the visitors shall also wear required PPE as prescribed in paragraph **31.2.1** **(T-0)**

31.6.3. Sealed lead-acid batteries and sealed nickel-cadmium batteries do not require a dedicated battery room or area, and can be charged in the same battery room or area as long as a five-foot minimum clearance is maintained between the different batteries. A sealed lead-acid battery can be charged in a dedicated nickel-cadmium battery shop as long as a minimum distance of five feet is maintained between the different battery chemistries.

31.6.4. The electrolyte in lead-acid batteries contains water. These batteries are subject to damage in freezing temperatures and shall be stored in temperature-controlled areas. **(T-1)** Lower battery charges shall allow for freezing at higher temperatures. **(T-1)**

31.6.5. Batteries of different chemistries shall be stored as directed by the installation Occupational Safety office, BE, CE and Environmental Management office. **(T-1)** Ensure nickel-cadmium and silver-zinc batteries are serviced in areas isolated from lead-acid batteries.

Batteries of different chemistries must be kept at least five feet apart when charging, discharging or being serviced. **(T-1)**

31.6.6. Batteries received during cold weather or which cannot be disposed of during warm weather, shall be stored in heated or protected storage areas (temperature-controlled) to avoid broken cases and/or contamination of storage areas from electrolyte spill caused by freezing or overheating. **(T-1)**

31.6.7. Industrial motive power batteries vary widely in the number of cells, size, weight and configuration. Handling these batteries is different from handling automobile batteries and shall not be attempted without proper equipment. The battery weight is usually stamped on the steel tray near one of the lifting ears. The battery manufacturer shall be consulted if the weight of a battery is not known and it cannot be weighed. **(T-1)**

31.7. Electrical.

31.7.1. Electrical test equipment shall be de-energized prior to being disconnected from energized circuits or power sources unless specifically directed by the appropriate TO. **(T-1)**

31.7.2. Receptacles and lighting switches shall be located outside the battery maintenance or storage area. **(T-1)** Lighting fixtures shall be protected from physical damage by guards or isolation. **(T-1)**

31.7.3. Flexible cords used for charging shall be suitable for the type of service used and approved for extra-hard usage. **(T-1)** Connectors shall have a rating not less than the current-carrying capacity of the cord. **(T-1)**

31.7.4. Refer to paragraph **2.3** on the wear of jewelry and eyeglasses/safety goggles.

31.8. Installation and Care of Vehicle and Support Equipment Batteries.

31.8.1. Proper installation and care of batteries shall help ensure maximum life and performance. **(T-1)** Batteries shall always be installed in a level position to prevent leakage of electrolyte. **(T-1)** Excessive tightening of hold-down brackets can distort or crack the battery case. Cable clamps shall not be pounded on battery terminals, but shall be spread until they can be seated properly. **(T-1)** Battery housings shall be free of dirt, moisture, corrosion and electrolyte to prevent self-discharge of the battery. **(T-1)** When handling batteries, take precautions not to short the battery terminals together.

31.8.2. When removing a battery from a vehicle, the battery ground cable shall be disconnected first to prevent the possibility of a spark. **(T-1)** Upon reinstallation, the battery ground cable shall be installed and tightened last to prevent a short or spark and possible explosion. **Caution:** Some vehicles have two or more batteries, hooked in parallel, with one or more of the batteries remotely located. When the positive and negative cables are removed from one battery, the spark potential can still exist until the ground cable has been removed from the other batteries. Personnel shall consult the appropriate TO to determine the number of batteries within the vehicle or equipment before maintenance is performed. **(T-1)**

31.8.3. Use straps for lifting and carrying batteries. If straps cannot be used, exercise extreme caution when lifting to prevent employee strain, particularly when removing batteries installed in vehicles. Consider team lifting when the person doing the lifting (or their supervisor) considers the item to be too heavy or awkward to lift safely, or the item or lifter is in an awkward position or location.

31.8.4. Use mechanical lifting devices when handling batteries that cannot be safely handled by two people. Chain hoists that are used to handle batteries shall have a chain container or bucket to prevent the dangling chain from shorting out a battery. **(T-1)**

31.8.5. When removing or replacing a battery, if there is a possibility of shorting out the battery, the battery terminals shall be covered with a non-conductive material, such as rubber or a piece of plywood. **(T-1)**

31.8.6. Ensure tools and other metallic objects are kept away from the top of uncovered batteries and stored such that there is no possibility the tool will fall on the batteries. **(T-1)**

31.8.7. Vent Cap Maintenance. Vent caps are designed to help keep the electrolyte or chemical paste within the battery and to keep dirt and other contaminants out. Vent caps shall be kept clean and firmly in place to avoid electrolyte spray, unless authorized by the applicable TO. **(T- 1)**

31.8.8. Vehicle Battery Jump-Starting. Battery jump-starting procedures shall only be accomplished by trained and qualified personnel. **(T-1)** Follow TO guidance for proper jump-start procedures. If not available, follow manufacturer‘s guidance. **Warning:** Employees shall NOT connect positive (+) to negative (-) or negative (-) to positive (+) when jump-starting a vehicle. Serious injury to personnel and/or damage to equipment will occur.

31.8.9. Exercise care when handling and storing batteries to prevent damage to the cases and to avoid electrolyte spills. **Caution:** Use care when handling broken battery cases to avoid acid- alkali burns from spilled electrolyte. When handling damaged batteries, follow specific equipment TO maintenance procedures for damaged batteries.

31.8.10. The battery in most industrial trucks also serves as a counterweight for the carried load. A replacement battery shall never be installed when its service weight is not within the range of battery weights marked on the truck nameplate. A lighter weight battery could change the truck‘s center of gravity and upset a loaded truck.

31.8.11. Batteries encased in steel trays have lifting holes for moving the battery. Lifting devices shall be designed so vertical lifting stresses are confined to the battery tray. **(T-1)** Lifting batteries with two chains attached to a hoist at a single central point (to form a triangle with the battery) is unsafe. Not only does the safe load capacity of a double sling decrease as the angle increases, but the angular stress on the lifting ears of the battery may cause the chain hook to tear out of the steel battery case. A properly insulated spreader bar, or other device as permitted by the applicable TO or manufacturer‘s instructions, of ample size shall be used with any overhead hoist. **(T-1)**

31.8.12. Before a battery is removed from a truck or is recharged in a truck, the electrical circuit of the truck shall be open, the battery unplugged from the truck and the brakes set or the wheels chocked. **(T-1)** When moving a battery to a recharging location by overhead crane, the battery shall not be pulled or led by the battery cables. Personnel shall not stand under suspended loads.

31.8.13. When an enclosed/covered battery is charged, the cover of the steel tray of the battery shall always be kept open throughout the entire recharging period. **(T-1)** If a battery remains in the truck for recharging, all battery compartment covers of the truck shall be kept open to help promote cooling of the battery and release of the gases freed during the recharging

process. **(T-1)** Excessive charging of batteries shall not be permitted, as hydrogen gas is generated. Batteries shall not be disassembled when taken directly from the charger or worked on immediately after being discharged under a heavy load. In either case, the battery may be off-gassing rapidly and may explode if an ignition source is present. **Warning:** Excessive charging of batteries shall not be permitted, as hydrogen gas is generated.

31.8.14. The contact surface of mating plugs or connectors on vehicles/equipment, batteries and chargers shall be maintained free of pitting or oxidation to prevent a high-resistance contact condition. **(T-1)** Such a condition can result in a decrease of voltage delivered to the truck, with possible premature or sudden stopping of the vehicle. This could be a hazard if rapid withdrawal from a hazardous situation is required. Any work on battery plug contacts shall include precautions to avoid shorting out the battery. **(T-1)**

31.8.15. Visual inspections are usually sufficient to determine the condition of contacts, which shall be cleaned or replaced if they show evidence of oxidation or pitting. **(T-1)** Excessive heating of current-carrying parts indicates a poor electrical contact which shall be investigated. **(T-1)**

31.9. Aircraft Battery and Electrical System Specific Requirements.

31.9.1. Aircraft Electrical System Maintenance. Only personnel qualified on aircraft battery and electrical systems shall perform maintenance on aircraft battery and electrical systems. **(T-1)** Potential hazards involving aircraft electrical system maintenance include: overloading, poor electrical contacts and wiring short circuits. Specialists shall follow TO guidance whenever troubleshooting aircraft electrical systems. **(T-1)** When the TO does not cover a specific troubleshooting procedure, reference the aircraft wiring schematics. The specialists shall exercise extreme caution and ensure each step of the TO is followed before proceeding to the next step. **(T-1)**

31.9.2. Electrical systems shall be de-energized whenever possible. **(T-1)** If the approved procedure requires work on an energized circuit, the sequence of steps shall be followed and other maintenance personnel must be informed of this action. **(T-1)** If the system has been de-energized, procedures shall include a provision to effectively lockout or tagout the power source while work is in progress. An AFTO Form 492, *Warning Tag*, authorized by AFI 21-101, *Aircraft and Equipment Maintenance Management*, shall be used IAW local procedures. **(T-1)** Refer to **Chapter 29** for additional guidance.

31.9.3. Aircraft Battery Shop Requirements. Batteries shall never be charged while in the aircraft, unless permitted by the aircraft TO. Batteries being charged, battery chargers and their control equipment shall not be positioned in Class I locations as classified in *National Electrical Code*, 511-3, *Class 1 Locations*, or defined in *National Electrical Code*, 513-3, *Wiring and Equipment in Class 1 Locations*. **(T-0)** These locations include pits or depressions below floor level, areas from floor level up to 18 inches above the floor and within 5 feet of aircraft fuel vents, tanks or engines. Chargers shall be located in a separate building or in an area (as described in *National Electrical Code*, 513-3) which is adequately ventilated and effectively separated from the hangar, shelter or nose dock by walls or partitions. **(T-0)** Battery chargers shall carry at least one permanently affixed warning sign which reads: *Warning—Keep 25 Feet Clear of Aircraft Engines and Fuel Tank Areas*. **(T-1)**

Chapter 32

MOTOR VEHICLE – OPERATIONS AND MAINTENANCE

32.1. Specific Hazards.

32.1.1. Vehicle maintenance hazards include hazardous noise, compressed gases, pressurized air, toxic materials, flammable or explosive mists, particulates and vapors. During servicing of single piece rim wheels, pressurized air in the tire may release suddenly either by bead break-in or by the bead slipping over the rim flange. Brake and clutch assemblies on military vehicles may contain asbestos, which poses an inhalation hazard. Inhalation of mists and vapors from nearly all fuels, paints, solvents, thinners, cleaning chemicals, strippers and epoxies can be hazardous depending upon the material's toxic characteristics and amount and method of exposure. Further, many chemicals/solvents can cause skin irritations, burns and/or defatting of the skin. These chemicals/solvents can also be absorbed through the skin and cause internal damage. In addition, paints containing epoxy or polyurethanes can cause employee sensitization, which causes an allergic reaction to a given substance. Sensitivity usually occurs after exposure of a few days to a few months. After sensitivity is established, exposure to even a small amount of the sensitizing material will likely produce a severe reaction. Refer to AFI 90-821, *Hazard Communication (HAZCOM) Program*, for additional guidance and information on chemical exposures.

32.1.2. Compressed Gas Hazards. Compressed gases can be hazardous. Depending on the particular gas, there is a potential for simultaneous exposure to both chemical and mechanical hazards. Gases may be combustible, explosive, corrosive, poisonous, inert or a combination of hazards. If the gas is flammable, flash points lower than room temperature compounded by high rates of diffusion (which allow for fast permeation throughout the laboratory) present a danger of fire or explosion. High concentrations of seemingly "harmless" gases such as nitrogen can pose an asphyxiation hazard. Since compressed gases are contained in heavy, highly pressurized metal containers, the large amount of potential energy makes the cylinder a potential rocket or fragmentation bomb. Gas cylinders shall be properly identified, handled and secured. **(T-0)** Vehicle maintenance personnel shall be aware of proper procedures for handling the various compressed gases, the cylinders containing the compressed gases, regulators or valves used to control gas flow, and associated piping systems. **(T-0)** TO 42B5-1-2, *Gas Cylinders (Storage Type) Use, Handling and Maintenance*, provides gas cylinder precaution guidance.

32.1.3. Tool misuse or abuse and failure to properly use protective equipment can cause eye injuries, lacerations, punctures, burns, pinching and bruises. These mishaps result from:

32.1.3.1. Catching fingers, hair, necktie and other loose clothing or jewelry in moving pulleys and belts in the fan area.

32.1.3.2. Removing radiator cap on an overheated engine. **Caution:** Removing the radiator cap from a vehicle that has been operating (hot engine) is equally dangerous, i.e., fluids are hot and under pressure.

32.1.3.3. Working under vehicles without safety glasses or goggles, thus allowing rust or other debris to fall into the eyes.

32.1.3.4. Elevating a vehicle using jacks or ramps that are not resting on a firm, level surface.

32.1.3.5. Crawling under a vehicle supported only by a jack and not using jack stands for additional support.

32.1.3.6. Placing hands or feet directly under the wheel while changing a flat tire.

32.1.3.7. Peering directly into the throat of a carburetor when engine is running, resulting in face and hair burns or eye damage (or both) if engine backfires through the carburetor.

32.1.3.8. Leaving creepers on the floor.

32.1.3.9. Failing to properly deflate tires on split rim wheels before dismantling for repairs.

32.2. General Safety.

32.2.1. Vehicle maintenance personnel shall not wear neckties, loose flowing clothing, loose sleeves or gloves which can become entangled when working on or around shop equipment or vehicles. Open footwear and canvas or cloth shoes without safety toes shall not be worn in maintenance shops. Long hair (including facial hair) or pony tails shall be secured to prevent becoming tangled when working around shop equipment or vehicles. **(T-0)**

32.2.2. Compressed air shall not be used to clean dirt and dust from clothing or the body. Compressed air shall be regulated to less than 30 psi when used for cleaning and only when effective chip guarding is used. **(T-0)** Appropriate eye protection shall be worn at all times while using compressed air. **(T-0)**

32.2.3. Mechanics shall never place any part of their body directly under the wheels or tires of a vehicle on jacks without jack stands being in place .

32.2.4. Housekeeping. Good housekeeping is essential to safe operations. Vehicle maintenance operations are prone to oil spillage, debris on work surfaces and cleaning materials and tools lying around. Housekeeping requirements include:

32.2.4.1. Clean up spills promptly.

32.2.4.2. Perform motor vehicle maintenance activities, such as painting, welding, battery work and wheel and tire maintenance in separate parts of the shop, where one type of operation will not become hazardous to another.

32.2.4.3. Paint rooms, booths, etc., shall be kept clean with equipment stored in a proper and orderly manner. **(T-0)**

32.2.4.4. Keep street clothing and protective clothing in separate lockers. **(T-0)** Work clothing shall be stored in metal lockers, vented at top and bottom. **(T-1)**

32.2.4.5. Approved self-closing metal waste containers shall be provided wherever rags or waste are impregnated with flammable or combustible materials and all such rags or waste deposited therein immediately after use. **(T-0)** IAW 29 CFR 1910.107(g)(3), the contents of waste containers shall be disposed of at least once daily or at the end of each shift. **(T-0)** Contact the installation Environmental Management office for waste disposal guidance. **(T-1)**

32.2.4.6. All flammable and combustible materials stored in vehicle maintenance shops shall be kept in tightly covered metal containers IAW **Chapter 22,** *Flammables and Combustibles*. **(T-0)** Refer to paragraph **2.4** for additional guidance on housekeeping.

32.2.4.7. Floor surfaces shall be cleaned as often as necessary to maintain a safe walking surface. **(T-0)** Personal protective equipment (PPE) shall be worn whenever toxic or hazardous cleaning materials are used. **(T-0)** As a minimum, eye protection, nonslip rubber boots and rubber gloves shall be worn. **(T-0)**

32.2.5. Where snow and ice conditions are present, personnel shall keep walkways, emergency exits and personnel and vehicle door openings free of snow and ice. **(T-0)** If these areas become slippery, they shall be treated with sand, ashes, calcium chloride or other similar materials. **(T-1)** Overhangs above personnel walkways or doorways and vehicle entrances and exits shall be kept free of ice or snow that could fall and injure personnel or damage equipment. **(T-0)** Install icefall protection in hard to access areas. Snow removal equipment and other vehicles with large amounts of snow and ice accumulation on the vehicle shall be brought into the shop and snow or ice allowed to melt before repairs are started. **(T-1)** If this is not practical, the vehicles shall be washed with water to remove snow and ice. **(T-1)** Melted snow and ice deposits from each vehicle shall be washed down the floor drains before work is started or another vehicle is moved into the area. **(T-1)** In areas where maintenance on vehicles during winter months causes constantly wet floors, the floor surface shall be covered with nonskid materials, if possible. **(T-1)**

32.2.6. PPE shall be kept clean and, if not individually issued, shall be prominently displayed and/or stored in the immediate vicinity where its use is required. **(T-0)**

32.2.7. The vehicle maintenance supervisor shall ensure all personnel are trained in the care and use of PPE and shall enforce its use. **(T-0)**

32.2.8. Respiratory protection is required if prolonged breathing of chemical vapors, mists or fumes is expected or if working in confined spaces when the atmosphere is 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 American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance,* and AFMAN 48-155, *Occupational and Environmental Health Exposure Controls,* for additional guidance.

32.2.9. Backing of government-owned motor vehicles.

32.2.9.1. Government-owned motor vehicles equipped with back-up warning alert systems will be maintained in an operational fashion as designed and not modified. **(T-0)**

32.2.9.2. Backing of government-owned motor vehicles and the usage of spotters will be IAW AFMAN 24-306, *Operation of Air Force Government Motor Vehicles*.

32.2.9.2.1. Government-owned motor vehicle operators will immediately stop if they lose visual contact with the spotter or notice the spotter is dangerously positioned between the vehicle and another object. **(T-1)** In such cases, vehicle operators will secure the vehicle, exit and make an on-the-spot correction before continuing operations. **(T-1)**

32.2.9.2.2. Spotters should position themselves away from the vehicle's path of travel where they maintain visual contact with the vehicle operator. **(T-1)**

32.3. Occupational Health.

32.3.1. Refer to paragraph **2.2.2** for additional guidance on hazardous noise or noise level surveys.

32.3.2. Stationary internal combustion engine-driven equipment shall not be operated inside buildings unless an exhaust system, approved by BE, is installed and used. When equipment is operated adjacent to buildings, the exhaust shall be directed away from the building. **(T-1)** Ventilation shall be adequate to provide fresh air and prevent accumulation of JP-4, gasoline, carbon monoxide and other hydrocarbon vapors. **(T-0)** Refer to paragraph **32.6** for additional guidance on ventilation.

32.3.3. JP-4, JP-5, JP-8 and other jet engine fuels containing toxic aromatics shall be handled with the same precaution(s) as gasoline. **(T-1)**

32.3.4. Personal Hygiene. IAW 29 CFR 1910.134(g)(1)(i)(A), personnel required to wear tight- fitting respiratory protection must be clean shaven so facial hair does not interfere with the face- piece seal of the respirator. **(T-0)** Personnel shall keep hands and faces clean, change clothes when contaminated and keep hands and soiled objects out of mouth. **(T-0)** Do not bring or consume food or drink in paint and dope shops. Personnel shall wash their hands prior to smoking or consuming food. **(T-0)**

32.3.5. First Aid.

32.3.5.1. First aid kits shall be approved by base medical services. **(T-1)** This item is required if work is over 3-4 minutes from the nearest medical facility. **(T-0) Note:** OSHA's letter of interpretation for paragraph 1910.151(b) explains that a first aid kit is required if medical services are more than three to four minutes away.

32.3.5.2. If hydrocarbon fuels, such as gasoline, E85, B20, JP-4, JP-5 and JP-8, are splashed or spilled onto personnel, the following steps shall be taken:

32.3.5.2.1. Remove contaminated clothing as soon as possible and wash affected skin areas with soap and water. Launder contaminated clothing before wearing again. Do not place contaminated clothing in lockers or other confined spaces. Hang in a safe area away from fire and heat and allow to air dry.

32.3.5.2.2. If fuel is splashed into the eyes, immediately flush eyes with water continuously for at least 15 minutes, then seek immediate medical attention.

32.3.5.2.3. If fuels are swallowed, do not induce vomiting. Seek immediate medical attention.

32.3.6. Exposure to high concentrations of tetraethyl lead (TEL) shall be avoided. **(T-0)** While use of leaded gasoline is no longer permitted in over the road vehicles, it may still be used in off- road vehicles, support equipment and in aircraft. If process not already evaluated, contact BE for an occupational and environmental health risk assessment.

32.4. Facility and Equipment Requirements for Vehicle Maintenance Operations.

32.4.1. Proper layout, spacing and arrangement of equipment and machinery are essential. The installation Occupational Safety office, FES Flight, BE and CE shall coordinate on all layout plans. **(T-1)** Refer to **Chapter 7,** *Walking – Working Surfaces,* for additional guidance.

32.4.2. Only authorized shop personnel shall be allowed on shop floor. **(T-1)** All other persons shall remain in designated areas so they do not interfere with shop operations. **(T-1)** Vehicle operators shall not approach mechanics on the floor to report discrepancies. When necessary, shop supervision shall authorize the operator's presence on the floor. **(T-1)** Normal operator debriefings shall be a function of the Customer Service Center. **(T-1)**

32.4.3. Vehicle operators and mechanics shall sound vehicle horns before backing and intermittently during the entire backing operation unless vehicles are equipped with backup alarms. **(T-1)** Vehicle operators shall stop and sound horn prior to entering and leaving the maintenance shop. **(T-1)** A spotter shall be posted when moving large equipment and vehicles backwards or in close quarters. **(T-1)** Refer to paragraph **32.2.9** for additional backing/spotter guidance. Roll-down or side sliding doors shall be completely opened whenever a vehicle enters or exits the vehicle maintenance shop. **(T-1)**

32.4.4. Shop entrances and exits shall be clearly marked and lighted to prevent mishaps. **(T-0)** Appropriate traffic signs shall be posted at entrances and exits. **(T-1)** To minimize mishaps, a maximum speed limit of five (5) miles per hour shall be enforced in and around shops. **(T-1)** The operator shall sound the vehicle horn prior to entering or exiting facilities to alert nearby personnel. **(T-1)**

32.4.5. Door frames and edges of doorways used for vehicle entry and exit, and any obstruction (building support columns, etc.) within the vehicle maintenance area that could pose a hazard to vehicular traffic shall be highlighted. **(T-1)** Highlighted or reflective areas shall be painted or marked, when possible, in contrasting colors with three inch stripes, three inches apart and at least four feet up from the ground. **(T-1)** Reflectivity may be enhanced using paint with reflective beads or reflective tape.

32.4.6. Floor slopes, drains and oil/water separators in shops shall be constructed and maintained using guidance from the installation Environmental Management office. **(T-1)** Oil separators shall be cleaned at a frequency determined by the installation Environmental Management office. **(T-1)** The shop supervisor shall maintain the letter identifying the cleaning frequency and document compliance with the cleaning frequency. **(T-1)** Drains shall not be connected to sanitary sewers, except the effluent from oil separators shall be connected to sanitary sewers. **(T-1)**

32.4.7. Emergency Eyewash. Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes or body shall be provided within the work area for immediate emergency use. **(T-0)** A water hose may not be used to meet the requirements in this reference. Eyes and skin shall be flushed/washed with water for 15 minutes prior to transport to medical care. **(T-0)** Medical attention shall be obtained immediately after adequate flushing and drenching of the eyes or body has been accomplished. **(T-0)** Supervisors may contact the installation Occupational Safety office for assistance in determining how to meet the requirements of this reference. Refer to **Chapter 9,** *Emergency Shower and Eyewash Units,* for additional guidance.

32.4.8. Catching, snagging and pulling of rings and jewelry may occur in and around vehicle maintenance operations. Because of this, controls shall be exercised over the wear of these and other items of jewelry with all such items removed before working on or around shop equipment or vehicles. **(T-1)** Refer to paragraph **2.3** for additional guidance.

32.4.9. Only one wheel per axle or one dual wheel assembly shall be jacked at one time. **(T-1)**

32.4.10. No person outside the range of prompt and easy communication with other employees shall perform work with a risk of serious injury unless a second person is available to assist in an emergency.

32.4.11. No employee shall enter a confined space until the atmosphere has been evaluated and found safe to enter, or proper precautions, IAW **Chapter 23,** *Confined Spaces*, are taken. **(T-0)**

32.4.12. Employees shall never use ramps on soft earth. They shall ensure the ramps rest on a firm, level surface. **(T-1)**

32.4.13. Illumination. At least 50 foot-candles of illumination shall be maintained at an employee's position. **(T-1)** Where necessary, additional lighting shall be supplied. **(T-1)** The installation CE shall be consulted for further guidance on illumination levels. **(T-1)** Additionally, the installation CE will conduct lighting surveys, if requested. **(T-1)**

32.4.14. Machinery, Machine Guarding, Power Transmission Guarding and Shop Equipment. **Chapter 11,** *Hands Tools, Portable Tools & Machinery*, 29 CFR 1910 Subpart O, *Machinery and Machine Guarding*, and OSHA 3067, *Concepts and Techniques of Machine Safeguarding*, shall be followed when designing and maintaining machine and equipment guards. **(T-0)**

32.4.14.1. Supervisors shall maintain technical data, to include applicable 48--series AFOSH standards, for all machinery and shop equipment in their area of responsibility. **(T-1)**

32.4.14.2. Machinery and shop equipment shall be maintained and operated by qualified personnel. **(T-0)**

32.4.14.3. Machine guarding and power transmission guarding not covered in AFOSH Standards shall be IAW 29 CFR 1910 Subpart O. **(T-0)** All machinery guard and danger zones shall be conspicuously identified. **(T-0)** Refer to OSHA 3067 for additional information and guidance.

32.4.14.4. No attempt shall be made to clean any part of a machine until all moving parts have come to a complete stop. **(T-0)** Chips or other particles shall be removed by brushes or compressed air. **(T-1)** If compressed air is used, the pressure at the discharge end of the air nozzle shall be less than 30 psi and effective chip guarding shall be used. **(T-0)** Eye and/or face protection shall be worn while using compressed air to clean machines. **(T-0)** Effective methods of preventing flying chips and particles are screens, barriers and protective cones attached to air nozzles. Compressed air shall not be used to blow chips or other debris from an employee's body or clothing. **(T-0)** Some dusts such as lead, beryllium, cadmium, asbestos, etc., are extremely hazardous if inhaled, and cleaning these dust with compressed air shall not be done under any circumstances. **(T-0)** If process not

already evaluated, contact BE for an occupational and environmental health risk assessment.

32.4.14.5. Air compressors shall be installed with easy access to all drains, valves and drives. **(T-1)** A drain cock shall be provided at the lowest point of the tank to allow removal of water and metal particle accumulations. **(T-1)** Air compressors shall be located outside the work area whenever possible to minimize noise exposure. **(T-1)**

32.4.15. Hand Tools: Portable Powered and Non-powered.

32.4.15.1. The first factor of hand tool safety is that the tools are of good quality and designed for the job at hand. All tools shall be kept in good repair and maintained by qualified personnel or removed from service. **(T-0)**

32.4.15.2. Specific criteria unique to a certain tool shall be contained in the technical data requiring use of the tool. **(T-1)** To determine required tools and equipment, consult TO 32-1-2, *Use of Hand Tools*. Allowance Standards 403, *General Purpose Tools*, and Allowance Standards 457, *Vehicle Maintenance, Locomotive Maintenance, and Vehicle Operations*, and General Services Administration catalogs shall be used to determine additional requirements necessary for a particular maintenance mission. **(T-0)**

32.4.15.3. Portable powered tools shall conform to Mil Specs, if available. **(T-0)** If Mil Specs applicable to a portable powered tool have not been published, the procuring document shall include a requirement for the tool to meet or exceed requirements of 29 CFR 1910.243, *Guarding of Portable Powered Tools*, and 29 CFR 1910.304, *Electrical, Wiring Design and Protection*. **(T-0)** Whenever possible, low noise power tools or tools with noise reduction attachments shall be utilized. **(T-1)** Vibration dampening material/PPE shall be used to minimize fatigue when applicable. **(T-1)** Consult AFI 48-127 and if process not already evaluated, contact BE for an occupational and environmental health risk assessment.

32.4.15.4. Tools, when not in use, shall be kept in suitable containers and not in clothing pockets. **(T-1)** Power tools shall not be left running unattended on a stand, the floor or a vehicle. **(T-1)**

32.4.16. Roll-up Doors. Refer to paragraph **2.7** for roll up door requirements.

32.5. Fire Prevention. The installation FES Flight shall be consulted for specific shop requirements. **(T-1)**

32.5.1. Open Flames.

32.5.1.1. Flame-producing equipment shall not be used in refueler maintenance shops. **(T-1)** Other vehicle maintenance shops may use flame-producing equipment if all safety procedures are followed and requirements in **Chapter 27,** *Welding, Cutting, and Brazing,* are complied with.

32.5.1.2. The welding shop shall be properly identified as such and approved by the installation FES Flight and Occupational Safety office for open flame activities. **(T-1)**

32.5.2. Low Flashpoint Solvents. Supervisors in charge of operations where solvents, lubricants or other flammable liquids are used shall avoid the use of low flashpoint solvents and try to use non-flammable solvents when practical. Other items to avoid in the presence of

flammable or combustible liquids are open flames, open-element heaters, equipment not properly grounded and use of non-explosion proof electrical equipment.

32.5.3. Fuel ethanol fires, like all fires, shall be taken seriously. An E85 fuel fire shall be handled like a gasoline fire. **(T-1)** Use a CO_2 or dry chemical extinguisher that is marked B, C, BC or ABC. An alcohol-type or alcohol-resistant foam may also be used to combat fuel ethanol fires. Never use water to control a fire involving high-concentration fuel ethanol such as E85.

32.6. Ventilation.

32.6.1. Control of Vehicle Exhaust.

32.6.1.1. Local Engine Exhaust Ventilation.

32.6.1.1.1. The vehicle maintenance work area shall have a suitable exhaust ventilation system either under the floor with readily available adapter hoses or an overhead system arranged so connecting hoses can be raised when not in use. **(T-0)** In shop areas with under floor systems, adapters shall be used on equipment having vertical exhaust stacks to conduce the exhaust to the floor connections. **(T-1)** Carbon monoxide (CO) concentration shall be monitored by BE and levels kept under occupational and environmental exposure limits listed in AFMAN 48-155. **(T-1)** The facility owner/operator shall ensure a proper calibration schedule for the airborne gas analyzer. **(T-1)**

32.6.1.1.2. Exhaust ducts shall be protected against mechanical damage. **(T-1)** In-floor ducts shall be flush with the floor, level when closed and capable of withstanding vehicle and equipment traffic or the maintenance operation being performed. **(T-1)** In-floor ducts shall be equipped with a fluid collection system that prevents drainage into the installation sanitary sewage system. **(T-1)** This can be accomplished by sump pumps, a fuel and/or oil separator, a combination thereof, or by routing collected fluids to the shop's main drainage system. Overhead ducting shall be properly supported and located to avoid damage from moving vehicles and equipment. **(T-1)**

32.6.1.1.3. When not in use, ducting shall be stowed in a way that prevents damage to the equipment and does not cause a hazard to personnel. **(T-1)**

32.6.1.2. General Engine Exhaust Ventilation. Minimum general ventilation rates are specified in American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance*. This ventilation, either natural or mechanical, is in addition to local exhaust ventilation and is required to remove vehicle exhaust gases and fuel vapors.

32.6.2. The following operations or processes may produce airborne contaminants that exceed occupational and environmental exposure limits. The vehicle maintenance supervisor shall have these and similar operations evaluated by BE and shall document the results, along with any corrective actions taken. **(T-1)**

32.6.2.1. Spray painting, spray cleaning, solvent cleaning or stripping operations.

32.6.2.2. Open surface tanks (dip tanks, etc.).

32.6.2.3. Welding, soldering, torch cutting and metalizing.

32.6.2.4. Abrasive blasting operations.

32.6.2.5. Metal cutting, grinding, buffing and polishing operations.

32.6.2.6. Machine shop operations (lathes, etc.).

32.6.2.7. Battery shops. Refer to **Chapter 31,** *Batteries – Maintenance, Handling and Storage Requirements,* for additional guidance.

32.6.2.8. Open tanks on refueler vehicle.

32.6.2.9. Brake lining discs.

32.6.2.10. Clutch linings.

32.6.3. IAW AFMAN 48-155, BE's risk assessment identifies controls.

32.6.4. If ventilation system deficiencies exists, the vehicle maintenance supervisor shall use current BE occupational and environmental health risk assessment to determine interim control measures needed. **(T-1)**

32.6.5. Periodic Testing. IAW AFMAN 48-155, BE shall perform periodic evaluations. **(T-1)** BE shall provide evaluation results to the vehicle maintenance supervisor. **(T-1)** If a shop has a manometer or similar piece of equipment that measures the ventilation system's air flow, then only the monitoring data needs to be reviewed annually by BE and the shop supervisor.

32.7. Hazardous Materials Storage and Handling.

32.7.1. Spills.

32.7.1.1. Fuel Spills. All maintenance operations shall immediately cease if a fuel spill or severe petroleum product leak occurs in the vehicle maintenance area with drainage into a fuel separator. **(T-1)** All affected personnel shall immediately evacuate the area and the installation FES Flight shall be notified. **(T-1)** Report and handle all fuel spills IAW local contingency spill plans. **(T-1)** No one except emergency and cleanup personnel shall be permitted to return to the area until the spill is cleaned up, diluted, evaporated or absorbed. **(T-1)** Employees shall avoid any action that could provide an ignition source for fuel vapors. **(T-1)** Fuel-saturated clothing shall be removed away from the spill area. **(T-1)** Skin shall be thoroughly washed with soap and water if fuel is splashed or spilled onto it. **(T-1)** Clothing shall be flushed with water in a well-ventilated area where the fuel and vapors will not pose a hazard. **(T-1)** Clothing contaminated with fuel shall not be placed in lockers or other confined areas, since fuel vapors can be trapped in clothing. **(T-1)** If vapors in clothing are ignited, the resulting fire is difficult to extinguish and could cause severe burns to the person involved.

32.7.1.2. Oil and Hydraulic Fluid Spills. The organization responsible for the spill shall contain/clean the spill using the applicable approved method, such as compound, oil and water absorbent (NSN 7920-00-269-1272 or equivalent). **(T-1)** Contact the installation Environmental Management office for additional guidance.

32.7.1.3. Sanitary Sewers. Every effort shall be taken to preclude spilling petroleum products into sanitary sewers because this can adversely affect sewage treatment facilities. **(T-1)** The installation FES Flight, Environmental Management office and BE shall be notified if spillage enters a sewer. **(T-1)** If fuel spills are washed down floor drains,

sufficient water shall be used to ensure all fuel has been flushed from the drainage system. **(T-1)** Before using large amounts of water to flush the fuel, supervisors shall ensure proper containment measures are available to prevent an environmental pollution incident in a receiving stream. **(T-1)**

32.7.1.4. Hazardous materials shall be removed and disposed of in compliance with published environmental regulations. **(T-1)** Installation Environmental Management personnel shall be contacted for assistance. Refer to AFI 32-7001, *Environmental Management*, for additional guidance. **(T-1)**

32.7.2. Flammable Liquid Storage.

32.7.2.1. The storage, use and handling of flammable and combustible liquids shall be IAW **Chapter 22** and installation FES Flight guidance. **(T-1)** Refer to US DOE, *Handbook for Handling, Storing, and Dispensing E85*, for additional guidance on alternative fuels. The facility manager shall retain a copy of the FES Flight guidance. **(T-1)**

32.7.2.2. The type of cabinet, location, type of materials and quantities stored shall be coordinated with the installation FES Flight. **(T-1)**

32.7.2.3. Cabinets storing flammables shall be conspicuously labeled "*FLAMMABLE - KEEP FIRE AWAY*." **(T-0)** For additional guidance, refer to paragraph **22.7.3** and 29 CFR 1910.106, *Flammable and Combustible Liquids*. Fuels shall not be used to clean floors, clothing hands, or parts. **(T-1)** Refer to paragraph **32.9.1.4** for additional guidance on cleaning parts with JP-8. Fuels or solvents shall not be used as cigarette lighter fluid. **(T-1)**

32.8. Electrical. All electrical work, installation and wire capacities in vehicle maintenance facilities shall be IAW National Fire Protection Association 70, *National Electrical Code*. **(T-0)**

32.8.1. Only trained and qualified electricians shall install and maintain electrical equipment. **(T-0)**

32.8.2. All personnel shall know the location and on-off operation of power control switches and stations in their work area. **(T-1)** In addition, emphasis shall be placed on the need to maintain clear, unrestricted access to these controls at all times. **(T-1)** This knowledge is essential to disengage electrical power to equipment if a fire or accidental electrical contact occurs. All panels and control switches shall identify what they control, as required by the *National Electrical Code*. **(T-0)** Refer to paragraph **8.10.2** for additional information.

32.9. Cleaning With Solvents.

32.9.1. General Requirements.

32.9.1.1. A metal tank or container approved for flammable or combustible liquid shall be used to immerse articles or materials for cleaning, finishing, treating or similar processes whenever flammable or combustible cleaning materials are used. **(T-1)** The metal tank or container shall be labeled with the contents. **(T-1)** Care shall be taken to avoid solvent spillage. **(T-1)**

32.9.1.2. Due to the exceptionally low flashpoint of some solvents used in cleaning operations, care shall be exercised in the correct selection of solvents. **(T-1)** The lower the flashpoint, the higher the risk of ignition at low temperatures. The flashpoints of various

solvents differ widely due to their chemical properties; these properties determine the flammability, thus the need to understand the difference between solvents. For example: There are four types of MIL-PRF 680B solvents. Although each group is closely related and somewhat similar, they are not identical and shall not be confused.

32.9.1.2.1. MIL-PRF-680B, Type I, has a flashpoint between 100° f and 140° F.

32.9.1.2.2. MIL-PRF-680B, Type II and IV, has a flashpoint between 141° F and 198° F, due to the higher flashpoint, is the recommended solvent for cleaning operations.

32.9.1.2.3. MIL-PRF-680B, Type III, is a recommended interim substitute for MIL-PRF-680 Types II and IV. There shall be no change in cleaning solvent from MIL-PRF-680B Type II/Type III/Type IV or compound emulsion cleaning solvent (Mil Spec C – 25179) without prior approval of the installation FES Flight, Occupational Safety office, BE and the Aircraft Program Office for aircraft-related cleaning. **(T-1)**

32.9.1.3. The following items shall not be used as cleaning solvents: acetone, benzene, carbon tetrachloride, gasoline, isopropyl alcohol, methanol, methyl ethyl ketone, naphtha (solvent), perchlorethylene, toluene, trichloroethylene or turpentine. Commercial cleaning solvents, such as "Safety Klean" or other non-flammable emulsion type cleaning liquids shall be considered for use whenever possible. **(T-1)**

32.9.1.4. Flammable cleaning solvents, jet fuel or aviation gas shall not be used to clean floors or clothing. JP-8 may be used for parts cleaning provided the requirements of paragraph **32.9.1.1** and any TO or manufacturer's restrictions are met.

32.9.1.5. Cleaning rooms shall be equipped with an adequate mechanical ventilation system and blowers and exhaust systems shall conform to National Fire Protection Association 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids.* Refer to ACGIH's *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance,* and AFMAN 48-155 for additional guidance. **(T-0)**

32.9.1.6. There shall be no open flames, spark-producing devices or heated surfaces having a temperature sufficient to ignite vapors in any vapor area. **(T-0)**

32.9.1.7. There shall be no electrical equipment in the immediate vicinity of cleaning tanks subject to splashing or dripping of cleaning tank liquids, unless approved for use in that environment. **(T-1)**

32.9.1.8. There shall be no open flames or spark-producing devices in any floor space outside a vapor area or within 20 feet thereof (not separated by tight partitions), except as specifically permitted in National Fire Protection Association 86, *Standard for Ovens and Furnaces*. Areas in the vicinity of dip tanks shall be kept as clear of combustible stock as practical and shall be kept entirely free of combustible debris. **(T-0)**

32.9.1.9. When waste or rags are used in connection with dipping operations, approved metal waste cans with self-closing lids, or as required by the installation Environmental Management office, shall be provided and all impregnated rags or waste shall be placed there immediately after use. **(T-0)** The contents of waste cans shall be properly disposed of at least once daily and at the end of each shift in a manner consistent with local hazardous

waste disposal procedures and applicable environmental regulations. **(T-0)** Contact the installation Environmental Management office for disposal guidance.

32.9.1.10. Periodic inspection or tests of all dip tank facilities shall be made, including associated ventilation and fire protection equipment. **(T-1)** Any defects shall he promptly corrected. **(T-1)**

32.9.1.11. *DANGER - NO SMOKING* signs shall be conspicuously posted in the vicinity of dip tanks. **(T-0)**

32.9.1.12. Areas in the vicinity of dip tanks shall have manual fire extinguishers suitable for combustible liquids. **(T-0)** Protection systems shall be provided for tanks of 150 gallon capacity or more, or 10 square feet or more of liquid surface area. **(T-0)** Refer to National Fire Protection Association 34, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids*, for additional guidance.

32.9.2. Specific Requirements.

32.9.2.1. Personal Protective Equipment.

32.9.2.1.1. When handling parts cleaned in PD 680 solvent, all personnel shall wear rubber gloves and keep the inside of gloves clean and dry. **(T-0)** Rubber gloves and an apron shall be worn when acids are poured or dumped. **(T-0)** American National Standards Institute/International Safety Equipment Association Z87.1-compliant eye protection with side shields shall also be worn. **(T-0)** Consult BE regarding the occupational and environmental health risk assessment. Refer to **Chapter 14** for additional guidance.

32.9.2.1.2. Contact lens wearers shall wear appropriate eye and face protection. **(T-1)** Contact lenses may trap toxic or dangerous substances that are harmful to the eye. Contact lenses decrease the effectiveness of emergency eyewash fountains and sometimes compound the severity of an injury. Soft contact lenses may absorb and be contaminated by chemicals, their vapors and/or fumes. **Note:** Employees shall advise supervisors if they wear contact lenses. **(T-1)**

32.9.2.2. Vehicle Engine Cleaning. Starters, generators, alternators, distributors or magnetos shall be protected (covered with waterproof paper or plastic), so internal mechanisms are not exposed to water spray or cleaning agents. Remove the air cleaner and cover the carburetor throat or air intake with waterproof paper or plastic. **(T-1)** Follow TO 36-1- 191, *Technical and Managerial Reference for Motor Vehicle Maintenance*, when cleaning installed engines.

32.9.2.2.1. Employees shall wear PPE listed in paragraph **32.9.2.1** when cleaning engines. **(T-1)**

32.9.2.2.2. When cleaning tanks are located in an isolated room or facility, users shall obtain permission from the appropriate supervisor to use the tank. **(T-1)** A buddy system shall be used, when required by management or safety, to ensure assistance is available if a mishap or emergency occurs. **(T-1)**

32.9.2.2.3. Solvent Storage and Handling. Bulk solvents shall be stored in well-ventilated rooms, physically separated from other storage and operations. **(T-0)** Caution and warning labels shall not be removed. Leaking drums shall be removed

outdoors immediately so vapors or liquid will not collect and become a hazard. **(T-0)** Contact the installation Environmental Management office for proper disposal guidelines for leaking drums. Drip pans shall not be used to catch spilled liquids unless these pans drain into a closed container. Approved containers with the solvent name clearly marked on the container shall be used. **(T-1)** The BE shall help determine the adequacy of ventilation in areas where solvents will be used, prior to their use. **(T-1)** Through BE's occupational and environmental health risk assessment, appropriate ventilation, if any, is recommended.

32.10. Paint Shop.

32.10.1. General Requirements. To ensure safe and efficient operation, all painting activities shall be performed IAW accepted safety standards and **Chapter 28,** *Interior Spray Finishing*.

32.10.2. Specific Requirements.

32.10.2.1. Personal Protective Equipment. BE's occupational and environmental health risk assessment outlines PPE, if required. Refer to **Chapter 14** for additional guidance.

32.10.2.2. Housekeeping. Good housekeeping is essential to safe paint shop operations. Paint rooms shall be kept clean and their equipment stored in an orderly manner.

32.10.2.3. Spray Booths. All high volume low pressure spraying shall be accomplished in a paint booth to minimize health, fire and explosion hazards. **(T-1)** The walls of these booths shall be made of fire-resistant material that can be easily and frequently cleaned. **(T-0)** Refer to **Chapter 28** and American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance*, for construction and installation of ventilating systems for paint-spraying operations.

32.10.2.3.1. Walls. Walls and floors of spray booths may be covered with thin paper bags or a cellophane bag having a thickness of .003 inches or less to protect them from paint deposits. Coverings shall be replaced frequently to prevent the accumulation of deposits. **(T-1)** This paper shall be removed and disposed of IAW state and federal hazardous waste regulations. **(T-0)** Contact the installation Environmental Management office for disposal guidelines. Soap-like, water-soluble materials or coatings which can be stripped, or other similar materials that can be easily washed down, may be used to protect the walls and floors of spray booths from paint accumulation, provided they do not pose an environmental pollution problem. Protective paper wall coatings shall not be used for dry or dusty paint substances that can be removed from the booths by adequate ventilation. Refer to National Fire Protection Association 33, *Spray Application Using Flammable and Combustible Materials*, for additional guidance. **Note:** Paint facilities with overhead sprinklers shall have sprinkler heads covered with a paper bag to prevent paint overspray from clogging the heads. **(T-0)**

32.10.2.3.2. Direction of Spray. Personnel shall always spray paint toward the exhaust portal to minimize accumulation of harmful mists and vapors in the booth and to minimize any potential health hazards from airborne contaminants. **(T-1)** Spray guns shall never be pointed toward other personnel.

32.10.2.3.3. Hand Work. Adequate exhaust ventilation shall be provided in booths when hand-spray painting. **(T-1)** BE's occupational and environmental health risk assessment identifies controls. Refer to **Chapter 14** for additional guidance. Care shall be taken to ensure hoses do not present a tripping hazard for personnel or are cut by passing vehicles. **(T-0) Caution**: Some paints and additives contain toxic isocyanates. Ensure all recommendations and warnings listed on the container label are followed. Adequate National Institute for Occupational Safety and Health-approved respiratory protection shall be worn during the entire paint process. **(T-0)** Refer to 29 CFR 1910.134(d)(1)(ii).

32.10.2.4. Ventilation. Mechanical ventilation shall be provided in all paint spray booths to prevent accumulation of flammable and injurious vapors. **(T-0)** Refer to American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance,* and 29 CFR 1910.107, *Spray Finishing Using Flammable and Combustible Materials,* for additional guidance.

32.10.2.5. Interlocks. Electrical equipment for electrostatic hand spraying shall be interlocked with spray booth ventilation controls so spraying cannot be done unless the ventilation fans are operating. **(T-0)** Refer to 29 CFR 1910.107 for additional guidance.

32.11. Air Compressors.

32.11.1. General Requirements.

32.11.1.1. Only qualified personnel shall repair or adjust pressure-regulating equipment. **(T-0)**

32.11.1.2. All personnel operating air compressors shall be familiar with air compressor operating instructions. **(T-0)**

32.11.2. Specific Requirements.

32.11.2.1. All new air tanks and safety valves shall be constructed, installed and maintained IAW American Society of Mechanical Engineers' *Boiler and Pressure Vessel Code, Section VIII*. **(T-0)** The American Society of Mechanical Engineers code seal is permanently stamped on tanks meeting this criteria.

32.11.2.2. Air receivers shall be installed so all drains are easily accessible. **(T-0)** Air receivers shall be installed with sufficient clearance to permit a complete external inspection and to avoid corrosion of external surfaces. **(T-1)**

32.11.2.3. A drain pipe and valve shall be installed at the lowest point of the air receiver to remove accumulated oil and water. **(T-0)** The drain valve shall be opened and the receiver completely drained daily to prevent accumulation of excessive amounts of liquid in the receiver. **(T-1)** Air receivers shall be stenciled to reflect this requirement (exclude air receivers with automatic drains). **(T-1)**

32.11.2.4. Every air receiver shall be equipped with a readily visible pressure indicating gauge and with one or more spring-loaded safety valves. **(T-0)** The total relieving capacity of such valves shall prevent receiver pressure exceeding the maximum allowable working pressure by more than 10 percent. **(T-0)**

32.11.2.5. No valve of any type shall be placed between the air receiver and its safety valve or valves.

32.11.2.6. All safety valves shall be tested at regular intervals by installation CE or designated representative to ensure the valves are operational, and will repair and replace the safety valves, if faulty/non-operational. **(T-1)**

32.11.2.7. Installed compressed air line outlets shall have the delivered air pressure tagged or marked showing maximum working pressure. **(T-1)**

32.11.2.8. Air hoses shall not be placed where they may create tripping hazards. All hoses shall be inspected to ensure they are properly connected to pipe outlets before use. **(T-1)** Hoses shall not be kinked to stop air flow. The control valve shall be used to turn off the air. **(T-1)** Water hose type clamps or wire connections shall not be used to replace or repair broken fittings.

32.11.2.9. When used for approved cleaning, compressed air shall be regulated to less than 30 psi and only when effective chip guarding and eye protection is used. **(T-0)** Compressed air shall not be routinely used to blow dry parts since this process can increase the inhalation hazards to employees.

32.11.2.10. Vehicles shall not be parked or left running near air intakes of compressors used to supply breathing air to painters.

32.11.3. Compressed Air. Compressed air is used in many shop operations: spray painting, tire inflation, fuel line cleaning and others. Compressed air can be used safely when handled with care and according to accepted safety standards. Eye protection shall be used at all times when cleaning with compressed air. **(T-0)**

32.11.3.1. Personnel with cuts/lacerations on their hands or fingers shall not hold parts that have been washed in cleaning solvent if using compressed air to blow dry the parts. Personnel shall wear neoprene or rubber gloves to avoid problems from contact with solvents. **(T-1)**

32.11.3.2. A vacuum system or water hose shall be used to remove dust, etc., from large surfaces. **(T-1)**

32.11.3.3. Compressed air shall not be used to clean clothing or body parts.

32.11.3.4. Compressed air shall not be used to “spin-dry” or “air-dry” bearings, unless permitted by the applicable TO.

32.11.3.5. Never point compressed air toward other personnel.

32.11.3.6. Assume all brakes contain asbestos, unless proven otherwise. Personnel shall utilize the OSHA Wet Method, IAW 29 CFR 1910.1001, Appendix F, *Work Practices and Engineering Controls for Automotive Brake and Clutch Inspection, Disassembly, Repair and Assembly*. **(T-0)** Cleaning materials shall be disposed of IAW local guidance. **(T-1)** Consult the installation Environmental Management office for further disposal guidelines. Never use compressed air to clean clutch and brake assemblies.

32.12. Compressed Gas Cylinders.

32.12.1. General Requirements. Vehicle maintenance shops use acetylene and oxygen in welding, R-12 and Freon as refrigerants, and liquid petroleum gas (butane-propane) as a motor vehicle fuel. These cylinders may contain pressures up to 3,600 psi. Cylinders are designed and constructed IAW Department of Transportation (DOT) regulations and bear the DOT identification. This stamping is generally found near the neck of the cylinder. Subsequent re-inspections shall be stamped in the same area. **(T-0)** The cylinder contents shall be legibly marked on each cylinder in large letters. **(T-0)** Refer to MIL-STD 101B, *DoD Color Code for Pipelines and Compressed Gas Cylinders*, 29 CFR 1910.101, *Compressed Gases*, 1910.102, *Acetylene*, 1910.103, *Hydrogen*, 1910.104, *Oxygen*, 1910.105, *Nitrous Oxide*, and applicable TOs for additional guidance. Non-government owned cylinders shall be tagged or otherwise marked to indicate cylinder contents. **(T-0)**

32.12.2. Specific Requirements.

32.12.2.1. Inspection. Cylinders shall be inspected upon receipt at the installation or organization by a qualified supply inspector IAW Air Force 23- series (Supply) instructions. **(T-1)** The user shall perform a similar inspection when receiving the cylinder from supply. **(T-1)**

32.12.2.2. Manual Handling:

32.12.2.2.1. Due to their shape and weight, most cylinders are difficult to handle manually. However, if such handling is necessary, they shall be tipped slightly and rolled on the bottom edge, not dragged or slid across the floor, whenever feasible. **(T-1)** Mechanical handling generally requires carts in which cylinders are secured on specially constructed skids. The use of electromagnets or slings is not acceptable for mechanical handling. The insertion of bars through the protective caps may damage the valve assembly; for this reason, bars shall not be used. Cylinders shall not be handled without protective caps in place.

32.12.2.2.2. Cylinders shall not be dropped or permitted to strike each other. Cylinders shall not be used as rollers or for any purpose other than gas containers. Cuts or abrasions and corrosion on cylinders may seriously reduce their design strength and shall be identified to the supply inspector. **(T-1)**

32.12.2.2.3. Acetylene cylinders shall never be placed on their sides or laid down for any reason.

32.12.2.3. Use:

32.12.2.3.1. Before connecting compressed gas cylinders to a regulator or system outlet, cylinders shall be cleared of dust and particles (except cylinders containing hydrogen or toxic gases). **(T-1)** The valve shall be pointed away from the body and other personnel, then opened slightly to blow out foreign material. **(T-1)**

32.12.2.3.2. A compressed gas cylinder shall not be used without a pressure reducing regulator attached to the valve. If cylinders are in a manifold, the regulator shall be attached to the manifold header. **(T-0)** Only regulators and pressure gauges designed for the specific gases shall be used. **(T-0)** Employees shall not attempt to force connections that do not fit easily. If a leak develops between the cylinder and regulator, shut off the cylinder gas valve before attempting to tighten the regulator connection.

32.12.2.3.3. All compressed gas valves shall be opened slowly to prevent sudden pressure surges that may damage regulators. **(T-0)** Oxygen valves shall be opened fully to gain the benefit of the sealing qualities of the double-seated valve. **(T-0)** Valves on acetylene cylinders shall never be opened more than one-quarter turn. **(T-0)** Regulator output pressure shall not exceed 10 psi gauge. **(T-0)** The special tool recommended by the supplier shall be the only tool used for these valves. **(T-0)** The tool shall be left on the valve. **(T-1)** Compressed gas cylinder valves shall be closed when not in use. **(T-0)**

32.12.2.3.4. When high and low pressure gases are used on the same cylinder cart, the hoses shall be different colors and the fittings on the ends of these hoses different types and sizes. **(T-1)**

32.12.2.3.5. Oil or grease shall not be used to lubricate oxygen cylinder outlets or attachments. Oxygen cylinders and attachments shall be handled with oil-free hands, gloves and clothing. **(T-1)**

32.12.2.4. Manifolds for Compressed Gas Cylinders. They shall be a type approved by the gas supplier or other reputable manufacturer for the gas being used. **(T-1)** Connections shall be tested for tightness using an approved leak testing product or soap and water. **(T-1) Caution:** Never use an open flame to test for leaks.

32.12.2.5. Storage.

32.12.2.5.1. Inside cylinder storage areas shall be free from excessive heat and kept clean. **(T-1)** Flammable gases shall be stored separately from other gases and oxygen. **(T-0)** Storage areas shall have good natural ventilation or mechanical ventilation shall be provided. **(T-0)** Inside storage areas shall be identified with product identification. **(T-0)**

32.12.2.5.2. Cylinders of one type shall not be mixed with cylinders of other types. **(T-0)** Where a safe distance between flammable gases and oxygen is unattainable, partitions of fire resistant material shall be provided. **(T-0)** Floors shall be level and of noncombustible construction. **(T-0)**

32.12.2.5.3. Outside storage requires all the protection afforded by inside storage, plus a noncombustible canopy to protect cylinders from adverse weather and the sun.

32.12.2.5.4. All cylinders shall be stored upright, with the valve up. **(T-0)** Empty cylinders shall be stored apart from full cylinders and the word *EMPTY* or *MT* chalked in large letters on them. **(T-0)** The valves shall be closed and protective caps put in place. **(T-0)** Storage areas shall be free of sources of ignition and smoking prohibited. **(T-0)**

32.12.2.5.5. The storage area shall be provided with chains (or similar devices) to keep the cylinders from being knocked over. **(T-0)** Cylinders shall not be secured around valves or caps. Areas near elevators, stairs or ramps shall be avoided for storage, because cylinders could easily be knocked down or damaged. **(T-0)** Cylinders shall be stored so they are used in the order in which they are received. **(T-0)**

32.12.2.5.6. In main areas of type *C* (combustible) constructed buildings other than storage buildings and in main areas of noncombustible constructed buildings, the amount of flammable gas stored shall be IAW Air Force 23-series (Supply)

instructions. **(T-1)** In cutoff rooms and enclosures within buildings of combustible construction or occupancy, the amount of gas shall be limited to that allowed by the installation FES Flight. **(T-1)**

32.13. Lifting Devices.

32.13.1. Inspection. Many lifting device problems can be detected prior to use if properly inspected. Periodic inspections shall be performed by qualified inspection or maintenance personnel. **(T-1)** Test and certification of cranes and hoists shall be performed by experienced, qualified inspectors. Certification, inspection and test reports shall be available on the premises where the crane or hoist is located, in the supervisor's office or in a central maintenance shop. **(T-1)** Refer to **Chapter 12,** *Material Handling Equipment*, for additional inspection guidance.

32.13.2. Responsibilities. Responsibilities for periodic inspection, records, maintenance and test of lifting devices and separate lifting aids shall be as follows:

32.13.2.1. Permanently Installed Equipment (Real Property Installed Equipment). The installation CE shall be responsible for Real Property Installed Equipment inspection requirements. **(T-1)** Real property installed-equipment includes installed equipment attached to and made part of buildings and structures, e.g., air conditioning/heating systems, but not movable equipment such as plant equipment.

32.13.2.2. Mobile Equipment. The vehicle maintenance officer and/or superintendent shall be responsible for mobile equipment inspection requirements. **(T-1)**

32.13.2.3. Fixed Shop and Portable Equipment (Equipment Authorized Inventory Data). The responsible activity shall be responsible for fixed shop and portable equipment inspection requirements. **(T-1)**

32.13.2.4. Hoists and Cranes. Refer to specific technical data. If none is available, consult the installation CE or safety representatives. Refer to **Chapter 12** for additional guidance.

32.13.3. Specific Requirements.

32.13.3.1. Hydraulic Vehicle Lifts.

32.13.3.1.1. Employees shall stand to one side of the vehicle as it is driven on or off the lift. **(T-1)** The load shall rest squarely on the lift. The operator shall close the vehicle doors, hood and trunk and make sure there is no one inside the vehicle prior to raising it, except to facilitate repairs. **(T-1)** This applies to vehicle lifts equipped with automatic locking devices that shall not allow the vehicle to descend with loss of power. The operator shall know the load limits of the lift and adapter and ensure it is not overloaded. **(T-1)** The operator shall not lock the hoist controls in the open or shut position, but operate them manually. All vehicle lifts shall be equipped with a safety device to prevent accidental lowering. **(T-1)** The device can be a simple mechanism such as a safety leg, which locks in a vertical position as the lift is raised, or a restricted orifice device, which permits controlled lowering during hydraulic failure. As an added safety feature, air-oil operated hydraulic lifts shall be equipped with a lock which prevents raising by air if the oil supply is low." **(T-1)** This is a removable device which prevents compressed air entering the lift cylinder assembly. The arrangement prevents the plungers being raised above the oil supply in the air-oil reservoir.

32.13.3.1.2. Roll-on lifts shall be equipped with stop chocks to prevent the vehicle moving while the lift is hoisting, lowering or in the elevated position. **(T-0)** Stop chocks shall be automatic (springing into position when the vehicle is on the lift). **(T-0)**

32.13.3.1.3. All vehicle lifts shall be marked with the manufacturer name, lift capacity and date of installation. **(T-1)** These markings shall be stamped or etched on a metal plate permanently attached to the lift in a position where it can be inspected. **(T-1)**

32.13.3.1.4. All vehicle lifts shall be equipped with "dead man" controls, which automatically return to *NEUTRAL* or *OFF* when released by an operator. **(T-0)** Controls shall be conveniently located near a lift, if feasible. **(T-1)**

32.13.3.1.5. A lift shall not be used and an appropriate hazard warning tag shall be attached if it:

32.13.3.1.5.1. Jerks or jumps when raised. **(T-1)**

32.13.3.1.5.2. Slowly settles downward after being raised. **(T-1)**

32.13.3.1.5.3. Slowly rises, either when in use or when not in use. **(T-1)**

32.13.3.1.5.4. Comes down very slowly. **(T-1)**

32.13.3.1.5.5. Blows oil out of the exhaust line. **(T-1)**

32.13.3.1.5.6. Leaks oil at the packing gland. **(T-1)**

32.13.3.2. Electric Vehicle Lifts.

32.13.3.2.1. Inspect the lift daily. Never operate it if it has damaged parts which render it unsafe. Make repairs with original equipment parts, if possible.

32.13.3.2.2. Operating controls are designed to close when released. Do not block open or override them.

32.13.3.2.3. Never overload the lift. The manufacturer's rated capacity is shown on the lift nameplate.

32.13.3.2.4. Do not operate the lift if any safety devices are inoperative.

32.13.3.2.5. Allow only trained and authorized personnel to position the vehicle and operate the lift.

32.13.3.2.6. Never raise the vehicle with anyone inside, except to facilitate repairs. (This applies to vehicle lifts with automatic locking devices that do not allow the vehicle to descend with loss of power.) Do not allow anyone under the vehicle when raising or lowering the lift. When operating the lift, stand outside of it and keep hands clear of moving parts.

32.13.3.2.7. Always keep the lift area free of obstructions, grease, oil, trash and other debris.

32.13.3.2.8. Before driving the vehicle over the lift, position arms and supports to provide unobstructed clearance. Do not hit or run over lift arms, adapters or axle supports. This could damage the lift or vehicle.

32.13.3.2.9. Position the vehicle on the lift carefully. Position lift supports to contact at the vehicle manufacturer's recommended lifting points. Raise lift until supports contact the vehicle. Check supports for secure contact with vehicle. Raise the lift to desired working height. **Caution**: Raise the lift high enough for the locking device to engage whenever someone is working under the vehicle.

32.13.3.2.10. Do not attempt to move the vehicle when the lift is off the ground.

32.13.3.2.11. With some vehicles, removal or installation of components may cause a critical shift in the center of gravity and result in raised vehicle instability. Refer to the vehicle manufacturer's service manual for recommended procedures when vehicle components are removed.

32.13.3.2.12. When performing maintenance on electrical lifts, ensure electrical power is disconnected unless required for checking unit operation.

32.13.3.2.13. Before lowering lift, ensure tool trays, stands, etc., are removed from under the vehicle and vicinity of the lift. **(T-1)** Release locking devices before attempting to lower the lift.

32.13.3.2.14. Lower lift slowly.

32.13.3.2.15. Before removing vehicle from the lift area, position lift arms and supports to provide an unobstructed exit.

32.13.3.3. Jacks. Vehicle maintenance personnel shall not use hydraulic floor jacks, post jacks or mechanical jacks to support vehicles while repair is accomplished. The vehicle shall be blocked and placed on approved axle or frame stands before a repair operation is started. **(T-1)**

32.13.3.3.1. The rated load of the jack shall be legibly and permanently marked in a prominent location by casting, stamping or other suitable means. **(T-0)**

32.13.3.3.2. Shop personnel shall not use a leaking or faulty jack. Defective jacks shall be taken out of service immediately, tagged and not used until repaired. **(T-1)**

32.13.3.3.3. Shop personnel shall exercise care in positioning jacks under vehicles, making sure the cap is properly located to preclude the jack slipping after the load is applied. **(T-1)** A flat piece of wood, thick enough to withstand the load, may be placed between the jack cap and vehicle lift point to help prevent the jack cap from slipping.

32.13.3.3.4. All jacks shall be properly lubricated at regular intervals and only lubricants recommended by the manufacturer shall be used. **(T-0)**

32.13.3.3.5. Improper jacking can cause serious injury or property damage. The following jacking procedures shall be used:

32.13.3.3.5.1. Equipment shall be properly chocked prior to jacking. **(T-0)**

32.13.3.3.5.2. Jack stands shall be used any time equipment is jacked for maintenance. **(T-1)**

32.13.3.3.5.3. Equipment shall be removed from jacks as soon as possible. **(T-1)**

32.13.3.3.5.4. Equipment shall be jacked to the minimum height required for the

particular task. **(T-1)**

32.13.3.3.5.5. Personnel shall only remain under a jacked unit for the time required to place axle or frame stands for support. **(T-1)**

32.13.3.3.5.6. Personnel shall not position any portion of themselves under the tire or wheel of jacked equipment. **(T-1)**

32.13.3.3.5.7. Supervisors are responsible for ensuring jacks and jack stands of sufficient capacity are available and utilized.

32.13.3.3.5.8. Employees shall ensure placement of jack does not cause damage to the equipment. **(T-1)**

32.13.3.3.5.9. Jacks and jack stands shall be inspected and maintained IAW equipment TOs. **(T-1)** If no technical data exists, manufacturer's manuals may be used as long is it meets criteria in 29 CFR 1910, Subpart P, *Hand and Portable Powered Tools and Other Hand-Held Equipment*.

32.13.3.3.5.10. Defective jack stands shall be taken out of service immediately and tagged for disposition. **(T-1)**

32.14. Wheel and Tire Maintenance.

32.14.1. Employee Training.

32.14.1.1. Extensive damage to equipment and serious injury to personnel may result from careless or improper demounting, mounting and inflation of tires on both single piece and multi-piece rim wheels. To ensure safety of equipment and personnel, all personnel involved in wheel dismantling or buildup operations shall be thoroughly familiar with applicable TOs, rim manuals, OSHA 3086 entitled "*Servicing Single-Piece and Multi-Piece Rim Wheels*," and this standard for the particular wheel involved. **(T-0)** Precautions outlined in these publications shall be strictly adhered to when working on wheels and rims. **(T-1)** As an added safety measure, procedures shall be reviewed prior to starting tire maintenance operations. **(T-1)**

32.14.1.2. The supervisor shall ensure all employees who service multi-piece or single piece rim wheels are trained in the proper servicing techniques and practices applicable to the type of wheels being serviced. **(T-1)** A mechanic's level of proficiency shall be established by demonstrating his or her familiarity with and ability to use the information contained in the charts, rim manuals, TOs and this standard.

32.14.1.3. The supervisor shall ensure each employee demonstrates and maintains the ability to service rim wheels safely, including the following tasks:

32.14.1.3.1. Inspection of rim wheel components. **(T-1)**

32.14.1.3.2. Mounting of tires, including inflation within a restraining device or other safeguard required by this chapter. **(T-1)**

32.14.1.3.3. Use of the restraining device, barrier and other equipment required by this chapter. **(T-1)**

32.14.1.3.4. Handling of rim wheels. **(T-1)**

32.14.1.3.5. Inflation of tire when a rim wheel is mounted on the vehicle. **(T-1)**

32.14.1.4. The supervisor shall evaluate each employee's ability to perform these tasks and to service rim wheels safely and shall provide additional training as necessary to ensure each employee maintains proficiency. **(T-1)**

32.14.2. Tire Servicing Equipment.

32.14.2.1. The supervisor shall ensure a restraining device for servicing multi-piece rim wheels is available and used. **(T-1)**

32.14.2.2. When servicing single piece rim wheels, the employee shall use a restraining device or barrier, except where the rim wheel is bolted to the vehicle during inflation. **(T-1)**

32.14.2.3. Supervisors shall ensure restraining devices and barriers meet the following requirements:

32.14.2.3.1. Each restraining device or barrier shall withstand the maximum force transferred to it during an explosive rim wheel separation occurring at 150 percent of maximum tire specification pressure for the type wheel being serviced. **(T-1)**

32.14.2.3.2. Restraining devices and barriers shall prevent rim wheel components being thrown outside or beyond the device or barrier for any rim wheel positioned within the device. **(T-1)**

32.14.2.3.3. A restraining device or barrier shall not contain a solid flat surface against which the rim wheel can lie or lean during inflation, such as the bed or table of a tire changing machine. **(T-1)**

32.14.2.3.4. Restraining devices and barriers shall be visually inspected prior to each day's use and after any explosion or explosive separation of the rim wheel components. **(T-1)** Any restraining device or barrier exhibiting damage such as the following defects shall be immediately removed from service:

32.14.2.3.4.1. Cracks at welds. **(T-1)**

32.14.2.3.4.2. Cracked or broken components. **(T-1)**

32.14.2.3.4.3. Bent or sprung components caused by mishandling, abuse, tire explosion or rim wheel separation. **(T-1)**

32.14.2.3.4.4. Pitting of components due to excessive corrosion. **(T-1)**

32.14.2.3.4.5. Rust or other structural damage. **(T-1)**

32.14.2.3.4.6. Inoperative air pressure warning light or gauge. **(T-1)**

32.14.2.3.4.7. Leaking, cracked or deteriorating hoses. **(T-1)**

32.14.2.3.5. NDI techniques may be used to verify existence of cracks or other damage to welds whenever a tire/wheel failure occurs inside a restraining device, a weld is found to be severely rusted or whenever a weld's integrity is in doubt. **Note:** Accomplish a one-time NDI of all welds on locally manufactured restraining devices or commercially procured devices when weld integrity has not been documented.

32.14.2.3.6. Restraining devices or barriers removed from service and requiring structural repair, such as component replacement or re-welding, shall not be returned to service until certified, by the manufacturer or a Registered Professional Engineer. This certification shall ensure the restraining device or barrier will withstand the maximum force transferred during a rim wheel separation at 150 percent of the maximum tire specification pressure for the rim wheel being serviced or as required by the applicable TO, whichever is greater. **(T-1)**

32.14.2.4. The supervisor shall ensure a hose assembly consisting of the following components is used for inflating rim wheels:

32.14.2.4.1. A clip-on chuck. **(T-1)**

32.14.2.4.2. A sufficient length of hose to allow the employee to stand outside the trajectory. **(T-1)**

32.14.2.4.3. An in-line valve with a pressure gauge or an adjustable regulator. **(T-1)**

32.14.2.5. An approved tire inflator cage appropriately sized for tires being serviced shall be used for inflating multi-piece wheels. **(T-1)** A regulator gauge, shutoff valve, service hose and lock-on type chuck shall be used with the cage to control the air when inflating. **(T-1)** In addition, a bleed valve shall be used to relieve pressure in the hose when the tire is filled. **(T-1)** Refer to TO 36-1-191 for additional guidance.

32.14.2.6. A current OSHA 3086, *Servicing Single-Piece and Multi-Piece Rim Wheels*, along with OSHA charts entitled "*Demounting and Mounting Procedures for Truck/Bus Tires,*" and "*Multi-piece Rim Matching Chart*," shall be available and posted in the service area. **(T-0)**

32.14.2.7. A current rim manual and TO 36-1-191, containing instructions for the types of wheels being serviced, shall be available in the service area. **(T-1)**

32.14.2.8. The supervisor shall ensure only tools recommended in the rim manual for the type of wheel being serviced are used to service rim wheels. **(T-1) Warning**: Failure to observe precautions outlined in this standard may result in faulty positioning of the tire and/or rim parts, causing the assembly to burst with explosive force sufficient to cause serious physical injury or death.

32.14.3. Wheel Component Acceptability.

32.14.3.1. Multi-piece wheel components shall not be interchanged except as provided in the charts or applicable rim manual.

32.14.3.2. Multi-piece wheel components and single piece wheels shall be inspected prior to assembly. **(T-1)** Any wheel part bent out of shape, pitted from corrosion, broken or cracked shall not be used and shall be rendered unserviceable and discarded. **(T-1)** Damaged or leaky valves shall be replaced. **(T-1)**

32.14.3.3. Rim flanges, rim gutters, rings, bead seating surfaces and bead areas of tires shall be free of any dirt, surface rust, scale or loose or flaked rubber build-up prior to mounting and inflation. **(T-1)**

32.14.3.4. The size and type of the tire and wheel shall be checked for compatibility prior to assembly of the rim wheel. **(T-1)**

32.14.4. Safe Operating Procedure – Multi-piece Rim Wheels. The supervisor shall establish a safe operating procedure for servicing multi-piece rim wheels and shall ensure employees are instructed in and follow that procedure. **(T-1)** The procedure shall include, as a minimum, the following elements:

32.14.4.1. Tires shall be completely deflated by removing the valve core before a rim wheel is removed from the axle. **(T-1)** If the axle and rim are secured by wedges and lug nuts, loosen the lug nuts out to the end of the stud, but do not remove. Lightly tap on wedges to break them free. When all wedges are broken free, lug nuts can be removed. Wedges can become dangerous projectiles if these procedures are not followed. Employees shall use mechanical devices, such as dollies, to help them remove or mount large, heavy tires. **(T-1)**

32.14.4.2. A nonflammable rubber lubricant shall be applied to bead and rim mating surfaces during assembly of the rim wheel and inflation of the tire, unless the wheel or tire manufacturer advises against its use. **(T-1)** The rubber lubricants used shall not be flammable. **(T-1)**

32.14.4.3. Tires mounted on multi-piece rims shall only be inflated when constrained by a restraining device or placed in a tire cage. **(T-1)** Tires on multi-piece rims mounted on vehicles that are more than 20 percent under-inflated shall not be re- inflated until inspected by a qualified person and the tire certified safe to re-inflate. **(T-1)** Safeguards, such as chains or remote control inflation systems, shall be used to encase the wheel and tire during the re-inflation process. **(T-1)** Supervisors shall ensure no personnel are in the trajectory area during tire re-inflation. **(T-1)** Heat shall not be applied to a multi-piece rim with a tire mounted on it. **(T-1) Exception**: After the tire is completely deflated, the lug nuts may be heated briefly to facilitate their removal.

32.14.5. Safe Operating Procedure — Single Piece Rim Wheels. The supervisor shall establish a safe operating procedure for servicing single piece rim wheels and shall ensure employees are instructed in and follow that procedure. **(T-1)** The procedure shall include as a minimum the following elements:

32.14.5.1. Tires shall be completely deflated by removing the valve core before demounting. **(T-1)** Mechanical devices, such as dollies, shall be used to mount or remove large, heavy tires. **(T-1)**

32.14.5.2. Mounting and demounting of tire shall be performed only from the narrow ledge side of wheel. **(T-1)** Care shall be taken to avoid damage to tire beads while mounting tires on wheels. **(T-1)** Tires shall be mounted only on compatible wheels of matching bead diameter. **(T-1)**

32.14.5.3. A nonflammable rubber lubricant shall be applied to bead and wheel mating surfaces before assembly of the rim wheel and inflation of tire. **(T-1)**

32.14.5.4. If a bead expander is used to seat the beads, it shall be removed before the valve core is installed and before the tire is inflated to more than 10 psi. **(T-1)**

32.14.5.5. Tires may be inflated above 10 psi only when contained within a restraining device, positioned behind a barrier or bolted on the vehicle with lug nuts fully tightened.

Tires shall never be serviced above the pressure stamped on the tire sidewall, unless the manufacturer recommends a higher pressure.

32.14.5.6. When inflating a tire, employees shall not place a rim wheel where it will rest against or within one foot of any flat solid surface, as measured from the sidewall. **Exception:** Hold-down components of a restraining device may be placed within one foot of the sidewall.

32.14.5.7. Tires shall not be inflated to more than their recommended operating pressure. The proper tire inflation pressure, tire size and load range can be found on the vehicle information/data plates or stenciled on the door jamb/glove box or as specified in the Dash-1 TO or owner's manual. If this information is not available, TO 36-1-191 or the *Tire and Rim Association Handbook*, shall be used to obtain the recommended tire pressure. **(T-1)** Refer to paragraph **32.14.5.5** for additional guidance.

32.14.5.8. Employees shall stay out of the trajectory when inflating a tire. **(T-1)**

32.14.5.9. If the tire beads are not fully seated by the time the tire is inflated to its recommended pressure, the tire shall be deflated and rim wheel disassembled. **(T-1)** The wheel and tire shall be rechecked for compatibility, re-lubricated, repositioned and then re-inflated IAW paragraphs **32.14.5.2** thru **32.14.5.7** **(T-1)**

32.14.5.10. No heat shall be applied to a single piece wheel when a tire is mounted on it. **Exception**: After the tire is completely deflated, the lug nuts may be briefly heated to facilitate their removal.

32.14.5.11. Cracked, broken, bent or otherwise damaged wheels shall not be reworked, welded, brazed or otherwise heated, except as provided in paragraph **32.14.5.10**

32.14.5.12. High pressure air shall not be used to inflate tires.

32.14.5.13. Rims shall be inspected and maintained IAW the individual equipment manufacturer's rim manuals or TO 36-1-191. **(T-1)**

32.14.6. Demounting, Mounting and Inflating All Types of Tires.

32.14.6.1. Personnel shall:

32.14.6.1.1. Respect the potential power and explosive force of air under pressure. **(T-1)** Serious mishaps have resulted from lack of awareness of the explosive potential of compressed air. Respect it as you would an explosive!

32.14.6.1.2. Make sure all tools are in good condition – not damaged, dented or deformed. **(T-1)**

32.14.6.1.3. Remove valve core and exhaust all air from the tire (or tires, in the case of a dual assembly), before demounting. **(T-1)** Probe the valve stem with a wire as a final check to ensure the valve is not obstructed by a foreign material. **(T-1)** **Caution**: Do not stand in front of valve opening, as dirt particles may be blown into eyes.

32.14.6.1.4. Block vehicle so it cannot roll forward or backward after it is lifted. **(T-1)**

32.14.6.1.5. Place large hardwood blocks under the jack, regardless of how hard or firm the ground appears. **(T-1)**

32.14.6.1.6. Place safety jack stands – or crib up with blocks – at an appropriate spot under the vehicle, in case the jack slips. **(T-1)**

32.14.6.1.7. Check rim diameter to ensure it exactly matches rim diameter molded on tire. **(T-1)**

32.14.6.1.8. Clean and inspect used rim parts thoroughly. **(T-1)**

32.14.6.1.9. Use new tubes and new flaps in new tires. **(T-1)**

32.14.6.1.10. Inspect inside of tire for loose cords, cuts, penetrating objects or other carcass damage. Tires that are damaged beyond simple repair shall be removed from service. **(T-1)** Remove dirt, debris and liquids from inside of tire before tube is installed.

32.14.6.1.11. Lubricate with approved rubber lubricant, such as thin vegetable oil or soap solution. **(T-1)**

32.14.6.1.12. Use a clip-on chuck and extension hose with remote control valve and pressure gauge, long enough to allow you to stand to one side – not in front of the assembly – during inflation. **(T-1)**

32.14.6.1.13. Center tire properly on rim before inflating. **(T-1)**

32.14.6.1.14. Securely lock wheel down or place assembly in safety cage or portable safety device before attempting to inflate tire to seat beads. **(T-1)**

32.14.6.1.15. Position the vehicle crane boom in the center of the hub prior to inflation of off-the-road tires in field service work. **(T-1)**

32.14.6.1.16. Check for proper flange and lock ring seating. **(T-1)**

32.14.6.1.17. Adjust air pressure to manufacturer's recommended cold operating pressure after beads have been seated. **(T-1)**

32.14.6.1.18. Inspect valve cores for proper air retention. Replace damaged or leaky cores. **(T-1)**

32.14.6.2. Personnel shall not:

32.14.6.2.1. Work on tire and rim assemblies until they review applicable safety practices and procedures.

32.14.6.2.2. Loosen lug nuts on dual equipment with split or multi-piece rims until all air is exhausted from both tires. A broken or cracked rim part under pressure may blow apart and seriously injure or kill if lugs are removed before air is exhausted.

32.14.6.2.3. Apply heat or do repair work on an inflated tire, rim or wheel assembly. Heat can increase tire air pressure sufficient to burst the tire or rim.

32.14.6.2.4. Re-inflate a tire that has been run flat or seriously under-inflated without demounting that tire and checking tire and tube for damage.

32.14.6.2.5. Mix rim parts of different manufacturers unless approved by those manufacturers.

32.14.6.2.6. Rework, weld, heat or braze rim parts. Always replace damaged parts with same size, type and make.

32.14.6.2.7. Reuse tubes or flaps that have buckled or creased.

32.14.6.2.8. Use a tube in a tire larger or smaller than that for which the tube was designed. Inflate beyond recommended bead seating pressure.

32.14.6.2.9. Stand over tire when inflating.

32.15. Maintenance Operations.

32.15.1. Body Shops.

32.15.1.1. Jagged edges of mangled fenders, decks and quarter panels can be razor sharp. Protective gloves shall be worn when handling them. **(T-0)**

32.15.1.2. A full protective plastic face shield plus safety glasses or goggles shall be worn while cutting or grinding glass. **(T-0)** If handling large sheets of glass, gloves shall be used for a better grip and to keep hands from being cut. **(T-0)**

32.15.2. Welding in Vehicle Maintenance Shops.

32.15.2.1. General Precautions.

32.15.2.1.1. Inspect all equipment regularly. **(T-0)** Equipment with worn, leaky or burned hoses or damaged cables and connections shall not be used.

32.15.2.1.2. Never weld or cut gas tanks, oil barrels or drums without first purging and inerting them. **(T-0)**

32.15.2.1.3. Weld behind flame resistant screens or in booths to protect other employees from flying sparks and flash burns. **(T-1)** Refer to **Chapter 27** for additional guidance.

32.15.2.1.4. Always provide adequate ventilation. **(T-0)** Arrange work so air movement pulls fumes away from the breathing zone. **(T-0)**

32.15.2.1.5. Wear clean, oil free, flame resistant clothing while welding. **(T-0)** Wear protective gloves and apron (hearing protection may be required for some welding operations). **(T-0)**

32.15.2.1.6. Wear special welder's goggles as specified in **Chapter 27** (a welding helmet may also be required). **(T-0)**

32.15.2.1.7. Provide a suitable fire extinguisher and pails of sand in the vicinity of the welding area. **(T-0)** Mount fire extinguishers (if space permits) on portable welding carts used in locations where adequate fire extinguishers are not available. **(T-1)**

32.15.2.1.8. Always mark hot work either with a sign or with chalk on the work itself. **(T-1)**

32.15.2.1.9. Store welding equipment securely when not in use. **(T-1)**

32.15.2.1.10. Have welding tasks evaluated by BE to determine the need for (and type of) respiratory protection. **(T-1)**

32.15.2.2. Gas Welding.

32.15.2.2.1. Store cylinders in areas that are isolated, protected, ventilated, dry and removed from any heat source. **(T-0)**

32.15.2.2.2. Store oxygen cylinders and welding gas cylinders at least 20 feet apart or separate them with a flame resistant barrier at least 5 feet high when not connected for use. **(T-0)**

32.15.2.2.3. Keep oxygen cylinders at least 35 feet away from oil, oil pits and grease. **(T-0)**

32.15.2.2.4. Keep cylinder valve caps in place when cylinders are not connected for use. **(T-0)**

32.15.2.2.5. Shut cylinder valves off tightly when not in use. **(T-0)**

32.15.2.2.6. Do not use acetylene with the tank pressure less than 15 psi.

32.15.2.2.7. Always leave the shutoff wrench on the valve stem. **(T-0)**

32.15.2.2.8. Secure all tanks with a chain or fire resistant strap. **(T-1)**

32.15.2.2.9. Ensure cylinder contents are identified before use. **(T-0)**

32.15.2.3. Electric Arc Welding.

32.15.2.3.1. Carefully spread out cables while performing work. **(T-1)** Avoid placing cables in walkway areas to prevent tripping hazards. **(T-1)**

32.15.2.3.2. Join ground and electrode cables with connectors designed for that purpose. **(T-1)**

32.15.2.3.3. Do not allow splices in the cable within 10 feet of the electrode holder. **(T-1)**

32.15.2.3.4. To avoid electrical shock, check all connections, ground the work piece, do not weld in wet locations and do not use wet machines until they are dry and tested. **(T-1)**

32.15.2.3.5. Store electrode holders in a safe location away from objects which conduct electricity. **(T-1)**

32.15.3. Mobile Maintenance. Vehicles used routinely for mobile maintenance shall include as part of their equipment: baking soda for neutralizing acid spills, adequate fire extinguishers, container of water and eye and/or face protection for use by individual performing vehicle jump start procedures. **(T-1) Note:** In cold climate regions, effort shall be made to prevent container of water from freezing. **(T-1)**

32.15.4. Air Conditioning Maintenance. Gas and liquid coolants used in automotive air conditioners shall be handled with care, especially those stored under pressure. **(T-1)** Eye and face protection and gloves shall be worn while servicing or purging these systems. **(T-1)**

32.15.5. Radiator Maintenance.

32.15.5.1. Never open a pressurized radiator while the engine is hot. Use eye protection and caution when boiling out radiators. **(T-1)** The cleaning solutions contain caustic chemicals that will burn if splashed on the skin or face. Flush the skin with water if splashed.

32.15.5.2. Wear protective gloves when handling a damaged radiator because it may have jagged metal edges. **(T-1)**

32.15.6. Fuel Tank Repairs.

32.15.6.1. Vehicles with leaking fuel tanks shall be removed from the shop immediately. **(T-1)** Ground the siphon tank and pump out remaining fuel into a safety can. **(T-1)**

32.15.6.2. If the tank requires welding, cutting or soldering, clean out all fuel and fuel vapors. **(T-1)** The best way to do this is by steam cleaning. Steam the tank, both inside and outside, for at least 10 minutes. Flush out the tank with hot water for five (5) minutes. Then dry the inside and outside thoroughly, using warm air. After cleaning, check for fuel odor and, if needed, repeat the cleaning process. Test the tank for vapors prior to any welding.

32.15.7. Refueler Vehicle Maintenance Areas.

32.15.7.1. Open flames and spark-producing devices are prohibited within 50 feet of the refueling maintenance shop when a refueling vehicle is undergoing maintenance and fuel vapors are likely to be present. There shall be no smoking within 50 feet of a refueler maintenance building. **(T-1)** Danger signs shall be posted in the immediate area and worded as follows: *NO OPEN FLAME OR IGNITION SOURCE BEYOND THIS POINT* or the nearest commercially available equivalent. **(T-1)** Refer to **Chapter 18**, *Hydrocarbon Fuels*, for additional guidance.

32.15.7.2. Static Grounding. Aircraft refuelers shall have a static ground system in serviceable condition. **(T-1)** Refueling equipment in a refueler maintenance facility or undergoing maintenance shall be connected to a serviceable ground at all times, except when the vehicle is in motion. **(T-1)** Refueling maintenance support equipment shall be grounded. **(T-1)** Storage bins shall be grounded if located inside the maintenance bay. **(T-1)** Ramp ground rods shall have resistance values of 10,000 ohms or less. **(T-1)** These static grounds do not require retesting unless damaged or if the system has a deficiency. Any static ground which measures greater than 10,000 ohms shall be removed or replaced. **(T-1)** Static ground test data shall be maintained by the installation CE. **(T-1)** Fuel nozzle static grounding shall be IAW TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding*. Only approved 75 amp ground clips, for example, National Stock Number (NSN) 5999-00-134-5844, shall be used IAW TO 00-25-172. **(T-1)** Alligator clips shall not be used to ground or bond aircraft and support equipment. Only specified ground wire shall be used in the shop or on refueling equipment. **(T-1)** Ground cables shall be inspected weekly for broken strands. **(T-1)** Repaired or newly constructed grounding cable assemblies shall be checked for continuity. **(T-1)** User shall check bonding devices on all aircraft refueling units and associated equipment to ensure proper bonding prior to use. **(T-1)**

32.15.7.3. The supporting Air Force weather organization, IAW the weather support document, shall advise the Fuels Management Flight of adverse or mission-limiting weather, such as thunderstorms, lightning, strong winds, heavy rain, snow or freezing precipitation. **(T-1)** All maintenance on fuel systems of fuel servicing vehicles shall cease work conducted outside. The supporting Air Force weather organization shall advise the Fuels Service Center when the adverse weather advisory is terminated. **(T-1)** Refer to **Chapter 3**, *Weather Safety*, for additional information on weather.

32.15.7.4. As an extra precaution, personnel shall ground themselves prior to entering a refueler maintenance shop. **(T-1)** Several methods can be used to discharge static electricity from the body. If the facility or building is metal, it shall be grounded and bonded. **(T-1)** Personnel can ground themselves by touching their hand to the bare metal. By touching their bare hand to the door knob they are grounded (if the door is metal and sufficiently bonded to the metal structure).

32.15.7.5. The *National Electrical Code* and National Fire Protection Association codes provide guidance and/or requirements for electrical equipment and wiring in locations where fire or explosion hazards may exist due to flammable gases or vapors and flammable liquids. The classification used for flammable gases, vapors and liquids is Class I, Division 1 or 2, Group D and is used to design facilities and buildings. The Division 1 location is in areas below floor level (a pit or depression) and the Division 2 location is in areas up to 18 inches above the floor as defined in *National Electrical Code,* Articles 511 and 513. This classification does not mean the building is a hazardous location or the working environment is a hazardous area at all times. Certain areas in the building may become hazardous when working on fuel systems, fuel leaks occur or excessive vapors exist due to venting. If the working environment has flammable vapors greater than 20 percent of the lower explosive limit, the operation shall be shut down until the vapors are removed to maintain a safe working environment. **(T-0)**

32.15.7.6. Whenever major maintenance is required to the main tank, all fuel and fuel vapors shall be cleaned out from the tank pumping system and filter separator and the tank purged prior to any maintenance. **(T-1)** Cleaning procedures shall comply with TO 36Y31-1-1, *Removal of Rust and Sediment from Fuel and Oil Servicing Truck and Trailer Tanks and Application of Coating, Interior, Fuel and Water Resistant*. **(T-1)** Precautions outlined in the applicable TO of the equipment being serviced shall be followed. **(T-1)**

32.15.7.7. When fuel filter elements are changed, old filters shall be disposed of IAW installation Environmental Management office regulations. **(T-1)**

32.15.7.8. A minimum of two (2) persons, one qualified in the task to be performed and the other a safety observer to provide assistance, shall be available in the refueling maintenance site whenever repairs are done on a vehicle fuel system. **(T-1)** For minor maintenance after duty hours, the Vehicle Flight Commander may waive, in writing, the two-person policy if all safety precautions are taken and a qualified 5-skill level mechanic does the work. **Note:** A vehicle operator for the type of equipment being repaired may be the second person. Refer to AFI 24-302, *Vehicle Management*, for additional guidance.

32.15.7.9. Personnel performing maintenance on fuel trucks shall not wear shoes with exposed nails or metal plates.

32.15.7.10. Clothing containing more than 65 percent nylon, rayon, wool or polyester shall not be worn as outer garments when working with/around low flash point fuels. Flak vests shall not be worn during aircraft fuel servicing operations or during fuel operations where low flashpoint vapors may be present. In all cases (e.g., servicing with any fuel), an employee wearing a flak vest will always ground or bond him or herself when approaching an aircraft and prior to beginning work. **(T-1)** If no spark occurs during bonding or grounding, normal work may begin. However, if a spark does occur during bonding or grounding, the employee will ground or bond him or herself frequently during all work

phases. **(T-1) Note:** Commanders may authorize wear of body armor/flak vests and Gortex-type clothing in combat areas. Outer garments shall not be removed or put on in the work area. Matches or lighters shall not be handled or removed from pockets.

32.15.7.11. All tools used in the refueling maintenance shop shall be approved for such use. **(T-1)**

32.15.7.12. Axle stands, rated at least 10 tons, shall be used for axle support on refuelers. **(T-1)**

32.15.7.13. Hydraulic jacks, rated at least 10 tons, shall be used when lifting refueling vehicles. **(T-1)**

32.15.8. Refueler Maintenance Buildings.

32.15.8.1. An empty refueling vehicle containing fuel vapors is a potential bomb and shall be treated as such. **(T-1)** Except under conditions listed below, no other vehicular equipment will be serviced or repaired in refueler maintenance shops when fuel servicing vehicles are present. **(T-1)**

32.15.8.1.1. Vehicle(s) containing only JP-5, JP-8, JP-10 or other high flashpoint fuels may be serviced or repaired in refueler maintenance shops with fuel servicing vehicles present.

32.15.8.1.2. Vehicle(s) containing only JP-4, AV-gas, Mo-gas or other low flashpoint fuels may be serviced or repaired in refueler maintenance shops only if no other fuel servicing vehicles are present. **Note 1:** For remote/austere locations or where vehicle maintenance services are distant to the location where refueling vehicles are assigned, commanders may authorize minor maintenance (e.g., lubrication, oil and filter changes, headlight and tire changes, etc.) in facilities not designed for refueler maintenance if the refueler vehicle is used to transport and operates on only high flashpoint fuels (e.g., the refueler transports and operates only on JP-8). **Note 2:** While the exceptions provide commanders additional flexibility, organizations shall still perform and document an appropriate risk assessment prior to introducing other vehicles into a refueler maintenance facility or performing maintenance on refuelers in other than a refueler maintenance facility. **(T-1)** Risk assessments shall be coordinated with the installation FES Flight and Occupational Safety office. **(T-1)**

32.15.8.1.3. Because of the large number of fueling vehicles and carts normally assigned, an AF installation shall have a separately sited maintenance and repair facility. It shall be physically separated from other inhabited structures and any other source of ignition by at least 50 feet. **(T-1)** Due to space restrictions and the low number of fueling vehicles and carts normally assigned to an Air National Guard unit, a separately sited maintenance and repair facility, separated from other inhabited structures and any other source of ignition by at least 50 feet, is recommended. Refer to AFI 24-302, *Vehicle Management*, and AFI 32-1024, *Standard Facility Requirements*, for additional guidance.

32.15.8.2. The refueling maintenance shop should be located near the refueling vehicle parking area to minimize travel distance and help keep refuelers off installation streets.

32.15.8.3. The shop should be located so the installation FES Flight will have immediate and direct access on paved roads. **(T-1)** One or two minutes saved in response time may mean the difference between saving or losing the facility.

32.15.8.4. Both external and internal earth grounds shall be provided for the refuelers and a lightning protection system provided for the structure. **(T-1)**

32.15.8.5. Separate locker areas, washing areas and eating areas shall be provided for employees. **(T-1)** Adequate PPE for exposure to liquid fuels and vapors shall be provided. **(T-1)** Refer to AFI 24-302 and AFI 32-1024 for additional information.

32.15.8.6. The amount of space required for refueler maintenance areas is determined by the number of refueling vehicles assigned. Refer to AFI 32-1024 for specific requirements.

32.15.8.7. Contamination from floor drains is a potential fire, safety and health hazard. Floor drains shall be kept clean at all times. **(T-1)** Solvent or fuel shall not be used to clean floor drains. **(T-1)** Protective clothing such as goggles, rubber boots and gloves shall be worn during drain cleaning. **(T-1)**

32.15.9. Vehicle Maintenance Repair Pits.

32.15.9.1. Vehicle repair pits shall be guarded. **(T-1)** The type of guard used is dependent on the location, reason for the opening and frequency of use. Where railings are used, they shall be permanently attached leaving only one exposed side. **(T-1)** The exposed side shall have a removable railing kept in place when not in use. **(T-1)** It shall be painted yellow to designate caution. **(T-1)**

32.15.9.2. A vertical barrier shall be placed at the floor level, along open edges of the pit, to prevent materials, tools, etc., from dropping and striking employees. **(T-1)**

32.15.9.3. All pits equipped with steps shall have handrails and approved (*National Electrical Code*/National Fire Protection Association) lighting. **(T-0)** Steps shall be painted, coated or made with an approved nonskid material to prevent slippage. **(T-1)**

32.15.9.4. Adequate explosion-proof lighting shall be installed in pits or portable explosion-proof extension lights furnished. **(T-1)**

32.15.9.5. Pits shall be built with drains equipped with oil or grease traps, shall not be connected to sanitary sewers. **(T-1)** In addition, local exhaust should be provided to remove vapors. Refer to BE's occupational and environmental health risk assessment for additional guidance. Exhaust fans used in pit ventilation systems shall be suitable for use with fuel vapors, i.e., have explosion-proof motors and non-sparking blades IAW *National Electrical Code*/National Fire Protection Association. **(T-0)**

32.15.9.6. Pit contamination is a potential fire, safety and health hazard. Pits shall be cleaned regularly with soap and water or an approved caustic solution, but not flammable or combustible solvents. **(T-1)** PPE, including goggles, rubber boots and gloves, shall be worn during pit cleaning. **(T-1)**

32.15.9.7. To prevent accumulation of hazardous gases, the vehicle engine shall not be operated while a vehicle is positioned over a repair pit, unless required by manufacturer's instructions or TO.

Chapter 33

COMPOSITE MATERIALS

33.1. Scope. Composite materials (e.g., fiberglass, carbon fiber, Kevlar, etc.) are widely used in Air Force operations. These materials can present potentially serious health and safety hazards to personnel unless specific precautions are taken. Environmental, Safety and Occupational Health (ESOH) personnel must evaluate operations involving fabrication, repair and handling of composite materials to assure adequate precautions are taken to prevent injury or illness to personnel and/or damage to equipment. **(T-1)** Guidance contained in this document refers to applicable TOs for using composite materials. Paragraph **1.5,** Job Hazard Analysis, AFI 90-802, *Risk Management*, and AFPAM 90-803, *Risk Management (RM) Guidelines and Tools*, shall be observed and adhered to when working with composite materials. (T-1) For additional information, the OSHA Technical Manual, Section III, Polymer Matrix Materials: Advanced Composites, is available at **http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_1.html.** Managers, supervisors and workers shall be aware of human factors that can lead to worker error, injury or adverse effects on their operations. Composite operations involving confined spaces shall follow guidance in **Chapter 23,** *Confined Spaces.*

33.2. Specific Responsibilities. Functional managers and supervisors shall:

33.2.1. Ensure all personnel who work with or handle composite materials receive the appropriate level of training associated with required tasks. **(T-0)**

33.2.2. Ensure workers performing composite repair and fabrication tasks, or handling or using hazardous materials, receive the appropriate level of hazard communication training IAW AFI 90-821, *Hazard Communication (HAZCOM) Program*. **(T-1)**

33.2.3. Ensure SDSs are available for all hazardous materials used in composite work tasks. **(T-0)**

33.2.4. Ensure workers handling and storing flammable or combustible chemicals are trained in fire prevention and protection. **(T-0)** Refer to **Chapter 6,** *Fire Protection and Prevention,* for additional guidance.

33.2.5. Ensure appropriate spill and containment control procedures, and materials are readily available in areas where composite materials are stored, dispensed or used. **(T-0)**

33.2.6. Ensure appropriate PPE is available and worn when handling composite materials and chemicals. **(T-0)**

33.2.7. Ensure hazardous composite materials and chemicals are authorized through the installation Hazardous Material process IAW AFI 32-7086, *Hazardous Material Management.* **(T-1)**

33.2.8. Coordinate with the installation Environmental Management office to establish procedures for hazardous waste disposal. **(T-1)**

33.3. General Requirements.

33.3.1. Composite materials require careful handling at all times. Many of the chemicals and materials used in composite fabrication and repairs pose serious health or fire hazards and must be used and handled with care. Air Force personnel must be made aware of the potential

hazards associated with composite materials through appropriate training. **(T-0)** Workers shall refer to the SDS prior to starting any work when hazardous materials or chemicals are involved or needed for the process. **(T-1)** As a minimum, job safety training shall include: need for and use of approved PPE; maintenance and care of PPE; safe chemical handling procedures; and emergency treatment practices in case of exposure, ingestion or inhalation of liquids, vapors or dusts from composite operations. **(T-1)** Refer to **Chapter 14,** *Personal Protective Equipment (PPE),* and AFI 90-821, for additional guidance.

33.3.2. Training. All personnel who work with composite materials shall be trained on the hazardous properties of chemicals and materials used. **(T-0)** This training shall be documented on the individual's AF Form 55, *Employee Safety and Health Record*, IAW AFI 91-202. **(T-1)**

33.3.3. Hazard Communication. Workers performing composite repair and fabrication tasks shall receive the appropriate level of hazard communication training and shall ensure SDS are available for all hazardous materials prior to performing work. **(T-0)** Refer to AFI 90-821 for additional guidance.

33.3.4. Eyewash and Emergency Showers. Due to the potential for eye and skin contact with resins, catalysts and fibrous materials, eyewash and emergency shower facilities for composite repair shops shall be installed as required by **Chapter 9**, *Emergency Shower and Eyewash Units*. **(T-1)** Coordinate with the installation Occupational Safety office to determine the appropriate type and location.

33.3.5. Exposure Monitoring. Supervisors shall consult with BE to ensure workers who may be potentially exposed to airborne composite materials are monitored, and appropriate respiratory protection requirements are established IAW AFI 48-137, *Respiratory Protection Program*. **(T-1)** Additional protective equipment for workers handling composite materials shall be provided IAW **Chapter 14** to minimize employee exposure to chemicals, unless otherwise directed, catalyze only enough resin for immediate use. **(T-1) Note:** Do not exceed manufacturer's maximum batch size or a violent exothermic reaction may result.

33.3.6. Fire protection. All facilities and operating areas shall have fire protection appropriate for their fire hazard classification. **(T-0)** Fire protection includes portable fire extinguishers, alarm systems, and evacuation and emergency plans. For additional details regarding applicable Air Force and National Fire Protection Association fire protection requirements, consult with the installation FES Flight. All fire protection equipment shall be inspected annually IAW **Chapter 6**. **(T-1)**

33.3.7. Ventilation Requirements. Ventilation for all composite repair and fabrication shops, as well as locations where composites are installed and repaired (e.g., on-aircraft repairs) must be based upon the recommendations of BE's occupational and environmental health risk assessment and installed IAW the manufacturer's instructions. **(T-1)**

33.3.8. Handling Flammable and Combustible Liquids and Materials. Refer to **Chapter 22,** *Flammables and Combustibles,* regarding appropriate procedures for handling flammable and combustible materials.

33.3.9. Storage Of Composite Materials. Composite materials, including resins and catalysts, shall be stored IAW technical order requirements or, if not available, the manufacturer's instructions. **(T-1)** If neither are available, storage shall be IAW locally developed guidance

prepared in coordination with the installation FES Flight, Occupational Safety office, BE and Environmental Management office. **(T-1) Note:** Composite materials may be destroyed or damaged by improper storage conditions.

33.3.9.1. Storage Inside Buildings. When inside storage of composite materials is required, and the storage is incidental and not the primary purpose of the area, storage shall comply with **Chapter 22,** National Fire Protection Association 30, *Flammable and Combustible Liquids Code*, or the manufacturer's suggested guidelines. **(T-1)**

33.3.9.2. Outside Storage. Some chemicals used in composite operations are toxic or pose other environmental hazards. To minimize the potential for environmental contamination, the installation Environmental Management office shall coordinate on the siting of all outside storage areas. **(T-1)** Refer to **Chapter 22** and National Fire Protection Association 30 for additional guidance and information.

33.3.10. Electrical Requirements for Flammable Vapor Areas. Facility wiring shall be installed and maintained IAW National Fire Protection Association 70, *National Electrical Code*, Air Force Civil Engineer Fire Protection guidance and any specialized criteria necessary to maintain the safety of the operation. **(T-0)** Design and installation shall be IAW UFC 3-600-01, *Fire Protection Engineering for Facilities*.

33.3.11. Powered and Non-powered Equipment and Tools Used Near Flammable and Combustible Materials. Tools and equipment used in composite operations shall be procured, installed and maintained such that they pose no ignition source to chemicals, chemical byproducts and finished products of the operation. **(T-1)**

33.4. Specific Applications.

33.4.1. Laboratories. All laboratories shall have fire protection appropriate for their fire hazard classification. **(T-0)** For additional details regarding required fire protection requirements, refer to National Fire Protection Association 45, *Standard on Fire Protection for Laboratories Using Chemicals*, and AFI 48-158, *Occupational Exposure to Hazardous Chemicals in Laboratories*. Guidelines for storage and handling of flammable and combustible materials are contained in paragraph **22.6.1**.

33.4.2. Military Exchanges, Commissaries and Associate Retail Stores. Facilities offering un-reacted composite materials (e.g., auto body fillers, fiberglass repair kits, etc.) shall ensure the materials are kept in their original containers and that all manufacturer's precautions and use information is provided to purchaser at time of sale. **(T-1)** Damaged or leaking packages shall be removed from sale and disposed of properly. **(T-0)** Contact the installation Environmental Management office for disposal guidelines. In rooms or areas accessible to the public, storage shall be limited to quantities needed for display and normal merchandising purposes. **(T-1)** For storage of flammable and combustible materials, refer to **Chapter 22** and National Fire Protection Association 30.

33.5. Hazardous Waste Disposal. Supervisors shall coordinate with the installation Environmental Management office to establish a hazardous waste material list for their unit and establish procedures for hazardous waste disposal. **(T-1)** Refer to AFI 32-7042, *Waste Management*, for additional guidance.

33.6. Special Mishap Considerations. Mishaps involving composite materials require special handling. Although burning composites may be extinguished, these materials may continue to smolder and outgas toxic vapors. The installation FES Flight, BE and Environmental Management office shall establish appropriate measures to handle mishaps involving composite materials. **(T-1)** Special firefighting and debris handling requirements are identified in TO 00-105E-9, *Aerospace Emergency Rescue and Mishap Response Information (Emergency Services)*.

33.7. Use of Composite Materials in New System Acquisition, and System and Process Modifications. Introduction of composite materials by new system acquisition or modification of existing systems and processes shall be carefully reviewed for fire protection, occupational safety, health (bioenvironmental concerns), and environmental impact prior to use by the appropriate Air Force Systems Program Office, Item Manager or Design/Process Engineer, and the technical data developing organization. **(T-1)** These organizations shall ensure necessary safeguards are identified and in place before Air Force personnel are exposed to the equipment, system or process. **(T-1)** When composite handling/repair/fabrication processes are turned over to a contractor, the contracting officer shall ensure associated Air Force fire, safety, health and environmental data is provided to the contractor. **(T-1)**

Chapter 34

PRECISION MEASUREMENT EQUIPMENT LABORATORY

34.1. General Information.

34.1.1. Housekeeping. A high standard of housekeeping is essential to safe operations in laboratories. Dry floors are essential to physical safety. Liquid spills on floors shall be immediately cleaned and dried to minimize the possibility of slipping and falling. **(T-0)** In addition, wet floors provide a conductive surface which may cause electrical shock, injury or death. All work and storage areas shall be kept clean and free of unnecessary obstructions. **(T-0)** Equipment and materials shall be stored in a safe and orderly manner. **(T-1)**

34.1.2. Due to the inherent differences between C-E system maintenance and PMEL operations, guidance in **Chapter 30,** *Communication Cable, Antenna & Communication Systems*, shall not be used in PMEL operations. **(T-1)**

34.1.3. PPE Requirements. Consult applicable technical data and SDSs for specific safety guidance for equipment and chemical use. Occupational safety office and BE should be consulted for additional guidance.

34.1.3.1. Noise Suppression Devices. In noise hazard areas (85 dBA or greater), as determined by BE's occupational and environmental health risk assessment, require all personnel to wear appropriate hearing protection. Refer to paragraph **2.2.2** for additional guidance.

34.1.3.2. Laser Eye Protection. Appropriate laser eye protection shall be worn when working with laser equipment. The installation Laser Safety Officer and BE's occupational and environmental health risk assessment shall be consulted for the type of laser eye protection required. **(T-1)** Lasers shall be used in a controlled area and guarded by the required warning devices. **(T-0)** Refer to AFI 48-139, *Laser Radiation Protection Program,* for additional information.

34.1.3.3. Respiratory Protection. Inhalation of toxic levels of hazardous materials may cause adverse health effects. These exposures may be short-term or long-term (chronic), low-level or high level (acute), or both. Health effects from these exposures may vary from minor irritation and temporary illness to permanent organ damage, cancer and death. The proper use of approved respirators shall protect the wearer from toxic levels of airborne chemicals. **(T-0)** AFI 48-137, *Respiratory Protection Program*, provides guidance on the proper use and application of respiratory protection. BE's occupational and environmental health risk assessment will identify respiratory protection, if necessary. **(T-1)** Refer to paragraph **2.2.4** and **Chapter 14,** *Personal Protective Equipment (PPE),* for additional guidance.

34.2. Specific Hazards. Personnel engaged in PMEL operations are exposed to several potential hazards. They include, but are not limited to, exposure to electrical and electromagnetic energy, hazardous chemicals/materials and flammable and combustible liquids and gases. PMEL personnel are also subject to physical injuries associated with on-site job environments. Particular attention must be given to protection against exposure to toxic chemicals and ionizing radiation, because the effects of any exposures are not always immediately apparent. Potential health hazards

can be managed by following guidance in this standard, adhering to proper work procedures, engineering controls and facility design, and by using proper PPE and clothing.

34.2.1. Electrical Hazards. All sources of electrical energy are potentially hazardous if proper safety precautions are not routinely followed. Personal injury from electric shock, arcing and resulting physical reactions may cause severe or fatal injuries. Safe electrical work practices, safe equipment and approved grounding procedures are essential to prevent electrical mishaps.

34.2.1.1. Electric Shock. Personal contact with any voltage source, alternating current or direct current, capable of producing a current flow of 50 milliamperes or more through the body, can cause cardiac arrest. The severity of electric shock injury is determined by the amount of current flowing through the body, the path of current flow, the time of exposure and the body's physical condition. Additionally, tissue damage may occur to any part of the body exposed to high electrical energy.

34.2.1.2. Electric Arcing. When a metallic object, such as a tool, comes in contact or near contact with a high current source and ground, it becomes a conductor. An instantaneous surge of current will flow from the terminal through the tool to ground, resulting in a high intensity, high temperature arc. This arc can cause serious burns to the body and temporary or permanent blindness.

34.2.1.3. Physical Reaction to Electric Exposure. A natural reaction after making contact with an electric current or exposure to an arc is to repel oneself away from the source. This can result in falls or abrupt contact with fixed objects causing serious or fatal injuries.

34.2.1.4. Personnel working on, with or near energized electrical circuits or equipment shall not wear rings, watches or other conductive objects. **(T-0)** These items could increase shock risk, be the source of potentially severe burns or cause a short circuit if dropped into equipment. Metal-rimmed eyeglasses shall be secured by a non-metallic band or cord to prevent them from falling into energized circuits. **(T-1)**

34.2.2. Radiation Hazards. Radiation is electromagnetic energy in the form of waves or particles that radiate into space from an emitting source. Hazardous radiation in PMEL operations may be classified as either ionizing radiation or non-ionizing radiation.

34.2.2.1. Ionizing Radiation. Ionization of matter occurs when an electron orbiting a stable atom is expelled. Because ions are charged particles, they are chemically more active than their electrically neutral forms. Atoms of all elements can become ionized, but only gamma rays, x-rays, alpha particles and beta particles have enough energy to create ions. Ionizing radiation can cause chemical changes in biological systems that may be cumulative and can be detrimental, and even fatal. Radioactive materials found in calibration sources, detection instrument check sources and electron tubes produce ionizing radiation. Calibration sources pose the greatest hazard because of the intensities involved and can become hazardous when broken or touched directly. Damage to the body can occur through exposure to gamma rays from open calibration sources and from unsealed radioactive materials if they are inhaled, ingested, passed through openings in the body or open wounds. Radioactive electron tubes may pose a hazard when broken or stored in large quantities. Refer to AFI 48-148, *Ionizing Radiation Protection*, for guidance on ionizing radiation hazards and AFMAN 48-125, *Personnel Ionizing Radiation Dosimetry*, for guidance on use of ionizing radiation detection devices.

34.2.2.2. Non-ionizing Radiation. Non-ionizing radiation is electromagnetic radiation that includes radio waves, microwaves, infrared light and visible light. Unlike ionizing radiation, non-ionizing radiation does not have enough photon energy to remove an electron from an atom. However, it can still be hazardous. High levels of radio frequency and microwave radiation can heat tissue, and if the temperature increase is high enough, can adversely affect health. Refer to 29 CFR 1910.97, *Nonionizing Radiation,* for additional guidance on the management of non-ionizing radiation hazards.

34.2.2.3. Laser Radiation. Laser energy presents a significant hazard to the eyes and skin under direct or reflected viewing conditions. The use of optical viewing aids, e.g., binoculars, telescopes, etc., can significantly increase the eye hazard from laser radiation, particularly when used to view a point source of radiation. The radiant energy entering the eye is increased by the magnifying power of the optical device. Refer to AFI 48-139 for additional guidance and information on managing laser radiation hazards.

34.2.2.4. Radio Frequency Radiation. Radio frequency radiation produces heat in body tissues. Absorption by specific body organs depends upon the frequency and intensity of the radio frequency radiation. It is possible for a person to absorb damaging amounts of radio frequency radiation in deep tissue and organs with little or no sensation of skin heating. Refer to AFI 48-109 *Electromagnetic Field Radiation (EMFR) Occupational and Environmental Health Program*, for additional guidance and information on managing radio frequency radiation hazards.

34.2.3. Chemical Hazards. PMEL operations use and may expose personnel to hazardous chemicals. OSHA defines a hazardous chemical as any chemical which is a physical or health hazard. This definition clearly applies to most of the chemicals typically used in PMEL operations. Refer to AFMAN 48-155, *Occupational and Environmental Health Exposure Controls,* for additional guidance and information on the management of hazards associated with chemical exposure.

34.2.3.1. Hydrazine. Hydrazine, a clear, oily liquid having an ammonia-like odor, is one of several common and potentially harmful chemicals used in PMEL operations. It can be absorbed through the skin, swallowed or inhaled. Because individual sensitivity to the odor may vary and prolonged exposure can overcome sensory recognition, the odor cannot be relied upon as a warning indicator. If exposed to high concentrations of hydrazine for short periods, individuals may experience dizziness, nausea or irritation of the eyes, nose, throat or lungs. A yellow discoloration of the skin and eyes may also be apparent. Liquid contact may cause skin burns. Very high concentrations may cause unconsciousness. Liver and kidney damage may occur if a worker is exposed to concentrations above the permissible exposure limits over a long period of time. All incidents of hydrazine overexposure as indicated by BE hydrazine sampling results and/or any symptoms mentioned above shall be reported IAW AFI 91-204, *Safety Investigations and Reports*. **(T-1)** Emergency Power Unit test sets and/or pressure gauges exposed to hydrazine during normal use or exercises shall be marked/identified to prevent accidental exposure or ventilation of gases. **(T-1)**

34.2.3.2. Mercury. Liquid mercury is used in pressure and temperature measuring instruments. This liquid can be absorbed through the skin, swallowed or inhaled, but breathing the vapor is the most common cause of mercury poisoning. Mercury vaporizes at temperatures as low as 10°F. Since mercury vapors are colorless and odorless, they may

be present anywhere mercury is used. When spilled, liquid mercury breaks up into tiny beads that lodge in cracks, mix with dust, and penetrate such porous materials as wood or tile. Exposures to high levels of mercury can cause acute poisoning characterized by a metallic taste, tightness and pain in the chest, difficulty breathing, fever, diarrhea and headaches. However, acute poisoning is rare. A more common condition is chronic poisoning, which is caused by long-term exposure to lower levels of mercury. Symptoms of chronic poisoning include tremors, emotional changes (e.g., mood swings, irritability, nervousness, excessive shyness), insomnia, decreased mental function, inflammation of the mouth and gums, increase in saliva, weakness, loss of appetite and weight, and impaired digestive and kidney functions. Workers shall be very cautious when working with or near mercury. **(T-0)** Mercury can accumulate on working surfaces and cause a serious health hazard by clinging to clothing, especially knitted fabrics, and the soles of shoes, which can cause serious health hazards if inadvertently taken home.

34.2.3.2.1. All equipment containing mercury shall be properly maintained to prevent escape of mercury liquid or vapor. **(T-0)**

34.2.3.2.1.1. Containers of mercury shall be kept tightly capped to prevent vapors from escaping. **(T-1)**

34.2.3.2.1.2. Waste mercury or materials contaminated by mercury shall be placed in vapor-tight containers until disposal. **(T-1)**

34.2.3.2.1.3. Areas where mercury is used shall be kept separate from other work areas and shall be restricted to those workers directly involved in the mercury operations. **(T-1)**

34.2.3.2.1.4. Carpets shall not be placed in areas where mercury is used. **(T-1)**

34.2.3.2.1.5. Exposure to mercury may be controlled through use of enclosed systems that isolate mercury processes, regular monitoring of the work environment, good housekeeping and good personal hygiene to prevent contamination of clothing, food and tobacco products.

34.2.3.2.2. Consult BE and Environmental Management office for local procedures for clean-up procedures and disposal of mercury-contaminated materials. A copy of these procedures shall be maintained by the PMEL shop supervisor. **(T-1)**

34.2.3.3. Flux/Solder. The health hazard potential of any soldering operation depends on the types of filler metals, fluxes, coatings, cleaning agents, gases, and base metals used, and the method of exposure. It is important to know what types of chemicals and materials are in use. Electrical solder, such as resin core and lead alloy, is commonly used in PMEL operations. Exposure to lead fumes or ingestion of lead residue can present a severe hazard. Repeated exposures can result in a gradual accumulation of lead absorbed into the bloodstream and stored in bones and tissues. Liquid Solder Flux is commonly used in PMEL operations. It may be flammable and is toxic to skin, eyes and respiratory tract. Avoid skin and eye contact and all sources of ignition. Adequate ventilation shall be provided when using flux and solder to prevent inhalation of fumes and vapors. **(T-0)** Refer to **Chapter 27,** *Welding, Cutting, and Brazing*, and TO 00-25-234, *General Shop Practice Requirements for the Repair, Maintenance, and Test of Electronic Equipment*, for additional guidance on proper soldering measures.

34.2.3.4. Solvents/Test Chemicals. Trichloroethylene, trichloroethane, trichlorotrifluoroethane and methylene chloride solvents are commonly used for cleaning PMEL equipment. Chemical hazards include skin irritations, burns, defatting of skin and irritating or harmful vapors. These solvents can be absorbed through the skin and may cause liver damage. Sodium hydroxide, ammonium hydroxide and ammonium chloride are commonly used oxygen test chemicals. Chemical hazards include skin irritations, burns and irritating or harmful vapors.

34.2.4. Compressed Gas Hazards. Many laboratory operations require compressed gases for analytical operations. Depending on the particular gas, there is a potential for simultaneous exposure to both chemical and mechanical hazards. Gases may be combustible, explosive, corrosive, poisonous, inert or a combination of hazards. If the gas is flammable, flash points lower than room temperature present a fire/explosion hazard, especially when compounded by high rates of diffusion, which allow for fast permeation throughout the laboratory. Additional hazards of reactivity and toxicity of the gas, as well as asphyxiation, can be caused by high concentrations of even seemingly "harmless" gases, such as nitrogen. Since the gases are contained in heavy, highly pressurized metal containers, the large amount of potential energy resulting from compression of the gas makes the cylinder a potential rocket or fragmentation bomb. Compressed gas cylinders shall be properly identified, handled, secured and stored. **(T-0)** Laboratory personnel shall be aware of the proper procedures for handling the various compressed gases, the cylinders containing the compressed gases, regulators or valves used to control gas flow, and the piping used to confine gases during flow. **(T-0)** Compressed gases commonly found in PMEL operations are air, methane, nitrogen and oxygen. Refer to TO 42B5-1-2, *Gas Cylinders (Storage Type) Use, Handling and Maintenance*, for gas cylinder precautions. Some common and potentially harmful gases used in PMEL operations are:

34.2.4.1. Methane. Methane is one of several common and potentially harmful gases used in PMEL operations. It is a colorless, odorless, tasteless, highly flammable gas that may also be an asphyxiant if it displaces available oxygen. This can create an oxygen-deficient atmosphere, causing a worker to become dizzy, unconscious or to possibly die.

34.2.4.2. Nitrogen (N2). A colorless, odorless and tasteless gas which liquefies at -195°C or 320.44°F. By displacing available oxygen, it can create an oxygen-deficient atmosphere, causing a worker to become dizzy, unconscious or to possibly die. Due to its extremely low temperature, liquid nitrogen (LN_2) can cause cryogenic burns to body tissues similar to frostbite. Refer to **Chapter 26,** *Liquid Nitrogen (LN_2) and Oxygen (LOX) and Cryogens*, for additional guidance and information on the safe use and handling of these cryogens.

34.2.4.3. Oxygen (O2). Oxygen mixed with hydrocarbon contamination can cause fires and violent explosions. Because of its extremely low temperature, LOX can cause cryogenic burns to body tissues similar to frostbite. The expansion ratio of LOX can also result in oxygen enrichment, producing fire and explosion hazards. Refer to **Chapter 26** for additional hazards and guidance concerning LOX.

34.2.5. Compressed Oil Hazards. Some testing and calibrating operations require use of compressed oil at pressures of 30,000 psi. An oil leak above 4000 psi produces a high velocity stream of oil that may penetrate the skin and inject oil into body tissue. These high-pressure injections can cause severe localized circulatory system damage and loss of the injured extremity. Even low pressure, high volume systems pose a danger to personnel because of the

amount of energy stored in the system. **Warning:** Injected oil may be life threatening and requires immediate medical treatment.

34.2.6. Fire Hazards. Flammable and combustible liquids must be properly handled, stored and used. **(T-0)** Refer to **Chapter 22,** *Flammables & Combustibles*, for additional guidance. Also, consult the installation FES Flight for guidance on the selection and placement of fire extinguishers within the workplace.

34.3. Supervisor Responsibilities. Supervisors shall ensure:

34.3.1. Personnel are trained on the location, selection and use of fire extinguishers, alarm systems, main power switches and evacuation procedures. **(T-0)**

34.3.2. CPR training is provided for workers required to perform work on energized high voltage electric circuits. **(T-0)** Workers requiring CPR training shall receive refresher training before current CPR certification expires. **(T-0)**

34.3.3. Personnel performing maintenance on ionizing radiation equipment receive the proper ionizing and non-ionizing radiation safety training from the installation Radiation Safety Officer. **(T-1)**

34.3.4. Applicable technical data and SDSs are consulted for specific safety guidance prior to equipment or chemical use. **(T-0)**

34.3.5. Fire extinguishers are properly mounted, readily accessible, in a serviceable condition and clearly visible. **(T-0)**

34.3.6. All exits are clearly identified, posted with signs, doors unlocked, easily accessible and clear paths of egress are provided. **(T-0)** Consult the installation FES Flight for guidance on emergency lighting and exit requirements.

34.3.7. Smoking is not permitted in the immediate area where flammable materials are being dispensed, stored or used. **(T-0)**

34.3.8. Soiled rags, paper towels, Kraft paper and other trash contaminated with oil or grease are placed in self-closing metal safety cans marked and color-coded to indicate contents. **(T-0)** At the end of each shift, these containers shall be emptied or placed in an approved location outside the work center for pickup or disposal. **(T-1)** Clean rags shall be clearly identified and kept in appropriate containers. **(T-1)**

34.3.9. All new chemicals, machines and processes are evaluated by the installation Occupational Safety office, FES Flight, Environmental Management office and BE, as appropriate, prior to introduction into the work area. **(T-0)** All new chemicals and/or processes in which these chemicals are planned to be used must be evaluated and authorized IAW AFI 32-7086, *Hazardous Material Management.* **(T-1)** Once approved, supervisors shall ensure all personnel are trained prior to using the new chemicals, machines or processes. **(T-0)** Training shall be documented as required for personnel and the supervisor shall keep a list of trained personnel on each chemical, machine or process. **(T-1)**

34.4. Ventilation Systems. As a minimum, PMEL cleaning areas and laboratory work areas must have appropriate ventilation. Ventilation shall continue for a sufficient time after job completion to minimize residual vapors and provide adequate makeup air. **(T-0)** Refer to American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of*

Recommended Practice for Operations and Maintenance, AFMAN 48- 155, *Occupational and environmental health Exposure Controls*, FC 4-218-01F, and *Criteria for Air Force Precision Measurement Equipment Laboratory Design and Construction*, for additional information on workspace ventilation including information on permissible exposure levels, flow rate requirements and design criteria. BE will determine what, if any, periodic testing of ventilation systems is required. **(T-1)**

34.5. Electrical Safety for PMEL Operations. Refer to **Chapter 8,** *Electrical Safety*, for additional guidance and information pertaining to the following:

34.5.1. Laboratory Floors. The floor covering of calibration/repair areas shall be as specified in UFC 4-218-01F, *Criteria for Air Force Precision Measurement Equipment Laboratory Design and Construction*. **(T-0)** Floor coverings that are damaged or do not meet specified requirements, shall be repaired or replaced. **(T-0)** Insulated mats, NSN 7220-00-255-0765 (Black – 24 inches wide), 7220-00-267-4630 (Blue – 36 inches wide), 7220-00-913-8751 (Green – 36 inches wide), or suitable substitutes, are required when personnel are exposed to and working on energized high voltage circuits.

34.5.2. Equipment Grounding. Unless the equipment is made with double insulated construction (which does not require grounding), most equipment can and shall be grounded using a three wire cord/plug/wall receptacle system. **(T-0)** All wall receptacles shall be checked for ground continuity and for ground resistance of 10 ohms or less. **(T-0)** Equipment requiring 220 volt or higher input voltage shall be grounded IAW National Fire Protection Association 70, *National Electric Code*, or manufacturer's recommendations. **(T-0)** Fixed electrical equipment shall be electrically bonded to a grounding connector. **(T-0)** Special protection shall be provided to safeguard grounding wires from mechanical damage. **(T-0)** Most electrical equipment is assembled with the outer case electrically isolated from internal components and the case shall be separately grounded. **(T-0)** However, some equipment shall not operate with their cases grounded. Other equipment may require an ungrounded case for calibration. Local in-house procedures shall be developed and defined to cover these situations. **(T-1)** Refer to the manufacturer's manual or 29 CFRs 1910.303, *General Requirements*, 1910.304, *Wiring Design and Protection*, 1910.305, *Wiring Methods, Components, and Equipment for General Use*, and 1910.308, *Special Systems*, for additional guidance and information.

34.5.3. Workbenches. Metal topped workbenches shall be grounded to the facility ground. **(T-0)** Workbenches with insulated, nonconductive tops are considered isolated from ground. All isolated workbenches shall have a grounding point provided and used when a grounded workbench is required, such as electrostatic discharge sensitive operations. **(T-1)** Refer to TO 00-25-234 for electrostatic discharge control procedures and workstation grounding.

34.5.4. Mobile Equipment Grounding. System grounding of mobile equipment shall be done by a separate insulated equipment grounding conductor. **(T-1)**

34.5.5. Buss Bars. Buss bars shall be clean, free of corrosion and connections periodically checked for tightness. **(T-1)**

34.5.6. Facility Ground. The facility ground shall be marked at its connection to the ground buss bar. **(T-1)** If the connection is outdoors, it shall be coated with an anti-oxidant grease and marked IAW TO 31-10-24-WA-1, *Communication Systems Grounding, Bonding and Shielding*, and any requirements established by the installation CE. **(T-1)** The facility custodian

shall visually inspect the electrical and grounding systems on a monthly basis for security and damage. **(T-1)** After repairs, they shall be tested for continuity and polarity by a qualified electrician. **(T-1)**

34.5.7. Equipment Electrical Safety Devices.

34.5.7.1. The doors to equipment racks and enclosures shall be closed at all times except to facilitate necessary and authorized repairs. **(T-1)**

34.5.7.2. Interlocks shall not be disabled during maintenance or adjustments unless prescribed by the manufacturer's manual or applicable TOs. During these periods, a sign stating "*Danger Interlocks Disabled*" or other suitable commercially available substitute shall be placed on the equipment. **(T-1)** Interlocks shall not be permanently disabled or bypassed. Refer to **Chapter 21,** *Hazardous Energy Control,* **Chapter 29,** *Mishap Prevention Signs and Tags,* and 29 CFR 1910.306, *Specific Purpose Equipment and Installations,* for additional information on lockout and tagout procedures and requirements.

34.5.7.3. Only authorized maintenance personnel shall perform repair work on equipment with defective interlocks. **(T-1)** Refer to 29 CFR 1910.303, 1910.305 and 1910.306, for additional guidance regarding interlocks.

34.5.7.4. When personnel are exposed to and working on energized high voltage circuits, i.e., greater than 600 volts, nominal, safety observers trained in CPR shall be present, unless the area supervisor determines the risk of the operation does not warrant a safety observer. **(T-0)** Personnel shall follow guidance in UFC 3-560-01, *Operation and Maintenance: Electrical Safety,* when an arc- flash exists. **(T-0)**

34.5.8. Fuses and Circuit Breakers.

34.5.8.1. Circuit breakers or fuses shall be installed in all electrical circuits to interrupt the current flow when it exceeds the current carrying capacity of the conductor and/or circuit. **(T-0)** Circuit breakers and fuses shall not be bypassed. **(T-0)** Refer to 29 CFR 1910.306 for additional guidance and information.

34.5.8.2. Equipment fuses shall always be replaced by fuses of the size and type required by the TO or manufacturer's manual. **(T-1)** Insulated fuse pullers shall be used to remove and replace cartridge fuses. **(T-1)** Wire, foil, solder or other conductive materials shall not be used as substitutes for fuses. A lower amperage fuse of the same type may be used as a temporary measure until the proper fuse is available. An AFTO Form 350, *Repairable Item Tag,* must be attached stating the unit is under fused. **(T-0)** Refer to 29 CFR 1910.306 for additional guidance and information.

34.5.9. Grounding Sticks. A grounding stick shall be available for use at electronic workstations where residual voltages may be encountered during maintenance on de-energized equipment. **(T-1)**

34.5.10. Adjustments and Testing of Equipment.

34.5.10.1. Electrical power shall be disconnected before technicians perform mechanical adjustments or repairs not involving alignment of mechanical/electrical components. **(T-0)** Mechanical/electrical adjustments with power on shall only be accomplished when required by applicable TOs or manufacturer's manual. **(T-1)** Technicians performing the

adjustment/alignment shall use insulated tools to minimize the possibility of shock or damage to equipment components. **(T-1)** Refer to **Chapter 21** for proper lockout and tagout procedures.

34.5.10.2. Technicians shall not use lead pencils, screwdrivers or other hand tools to make radio-frequency energy tests on any piece of electronic equipment. **(T-1)**

34.5.11. Power Distribution Panels/Controls. Main power switches shall be conspicuously marked. **(T-0)** All personnel shall know the location and on-off operation of the main power distribution panels in their work areas. **(T-0)** This knowledge is essential to de-energize electrical circuits in the event of a fire or accidental electrical contact. Except for 110 volt 60 hertz outlets, all electrical fuse, switch and circuit-breaker boxes shall be plainly marked with the voltage, phase and frequency of the circuit, and exactly what they control. **(T-0)** Refer to 29 CFR 1910.304 and 1910.306 for additional information.

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

34.6. Radioactive Material Safety.

34.6.1. Radioactive material shall be handled in a manner that results in as low as reasonably achievable exposures to personnel. **(T-1)** The installation Radiation Safety Officer and BE shall prescribe special procedures and precautionary measures as necessary. **(T-1)** In overseas areas, follow disposal procedures as dictated by host nation agreements. Refer to AFI 40-201, *Radioactive Materials (RAM) Management*, for additional guidance.

34.6.2. Personnel shall not handle or expose a radioactive source except as required in the performance of duty. **(T-1)** Personnel involved in the actual use of radioisotopes shall receive formal training in their use and any precautionary measures, followed by continuing on-the-job training (OJT). **(T-1)** No one shall be authorized to use, handle or access any area with an exposed or open ionizing radiation source without the worker and task being evaluated by the installation Radiation Safety Officer for possible entry into the US Air Force Dosimetry Program and placed on the dosimetry program, if deemed necessary. Refer to AFMAN 48-125, *Personnel Ionizing Radiation Dosimetry*, for additional guidance and information.

34.6.3. In restricted areas where radioactive material is used or stored, appropriate placards shall be conspicuously posted at each entrance and around the exterior perimeter of each area so at least one placard is clearly visible from any direction of approach. **(T-0)** Obstacles, such as rope, barricades, etc., shall be used to discourage unauthorized entry into controlled areas. **(T-1)** Individual containers of radioactive material within the area shall be appropriately identified. **(T-1)**

34.6.4. Pregnant military personnel must report to Public Health (PH), and civilian workers are encouraged to report to PH, who will, in coordination with BE and the Primary Care Manager, document health risks and preventive actions. **(T-1)** For military personnel, an AF Form 469, *Duty Limiting Condition Report*, will be completed. A copy of this report will be sent to the supervisor. **(T-1)**

34.6.5. Smoking, eating or drinking in any area in which a radiation ingestion hazard may exist is strictly forbidden. Personnel working with radioactive materials shall wash their hands and face before eating, drinking or smoking and upon leaving a contaminated area. **(T-1)**

34.6.6. Regardless of radiation intensity, radioactive items used in PMEL operations shall not be carried in pockets or clothing of personnel. **(T-1)**

34.6.7. In addition to placards, positive measures, such as locked or guarded gates or doors, shall be established to prevent unauthorized entry into high radiation areas, as defined in AFI 48-148, *Ionizing Radiation Protection*. **(T-1)** Entry of personnel into a high radiation area will energize a conspicuously visible or audible alarm signal designed to alert personnel present or cause the exposure to terminate.

34.6.8. If containers of radioactive materials are broken or damaged, the area shall be cleared of all personnel not required in evaluation of the condition, recovery of the radioisotope or decontamination of the area or material. **(T-1)** Once the area is cleared, it shall be secured. **(T-1)** If radioactive material becomes airborne, doors and windows shall be closed and ventilation equipment turned off. **(T-1)** The PMEL supervisor and installation Radiation Safety Officer shall be notified immediately. **(T-1)** A survey of the area shall be conducted to determine the extent of the radiological hazard. **(T-1)** Personnel who have been, or may have been, exposed shall be monitored to determine the extent of medical action required. **(T-1)** The Radiation Safety Officer shall direct the decontamination or recovery operation, as necessary. **(T-1)** Broken or damaged items shall be safely packaged and disposed of. **(T-1)** Refer to AFI 40-201, for additional disposal and handling instructions.

34.7. Cathode Ray Tubes. The following precautions shall be taken to minimize the danger of breaking the glass envelope of cathode ray tubes.

34.7.1. Prior to handling a tube, momentarily ground all pin connections, including the high voltage connection, to preclude electrical shock. **(T-1)**

34.7.2. Avoid scratching the glass of a tube since scratches weaken the tube and can cause the tube to implode. **(T-1)**

34.7.3. Remove tube from its carton "face up" by grasping the larger (bell) end. **(T-1)** Avoid handling large tubes by the neck since this narrow portion of the tube is particularly susceptible to breakage from bumping or striking other objects. **(T-1)** This procedure also minimizes strain due to mechanical misalignment.

34.7.4. Follow manufacturer's special handling instructions for tubes with an external insulation coating applied to areas of the bell end. Avoid touching the coated areas. **(T-1)**

34.7.5. Do not place a tube on its side on a flat surface. Instead, place the tube face down on a protective nonabrasive pad. **(T-1)** If possible, do not remove the cathode ray tube from the carton until ready for use.

34.7.6. Dispose of tubes using the same handling precautions as for new ones. **(T-1)** Destroy cathode ray tubes prior to disposal by placing them face down in an empty cathode ray tubes carton and breaking the center guide (keying) pin. **(T-1)** Remove the tube's high vacuum by breaking off the tip of the glass vacuum seal. **(T-1)** Seal the container and make an access hole so a crowbar or other heavy rod can be driven through to break the glass envelope. **(T-1)** Contact the installation Environmental Management office for additional cathode ray tube disposal guidance.

34.7.7. If broken glass from a tube cuts the skin, immediately wash cuts with soap to remove dirt, phosphorus or other contaminants, then obtain medical attention. **(T-1)**

34.7.8. Use dry chemical extinguishers to control fires involving equipment with cathode ray tubes. **(T-1)** The thermal shock from cold CO2 may cause cathode ray tube implosion.

34.8. Equipment/Component Cleaning.

34.8.1. Vacuuming using a nonmetallic wand and suction nozzle is the preferred method for cleaning electronic equipment. If compressed air is used, the air pressure shall be limited to the lowest possible level. **(T-1)** Generally, 5 psi is adequate for equipment cleaning; however, pressures shall not exceed 30 psi. A diffuser nozzle shall be provided. **(T-1)** Refer to TO 00-25-234 for additional information.

34.8.2. Only approved and authorized solvents shall be used. **(T-1)** Adequate ventilation shall be provided. **(T-1)** BE's occupational and environmental health risk assessment shall be consulted if the characteristics of a solvent are in question. **(T-1)** Refer to American Conference of Governmental Industrial Hygienists' *Industrial Ventilation: A Manual of Recommended Practice for Operations and Maintenance*, for additional guidance and information on ventilation requirements. Appropriate PPE, as required in maintenance data and SDS, shall be worn. **(T-0)** Additionally, refer to **Chapter 14** for additional PPE requirements when working around solvents.

34.8.3. Ultrasonic Cleaning. When using ultrasound-cleaning equipment, workers shall always follow the manufacturer's instructions for parts and equipment cleaning. TO 00-25-234 and Mil Spec C-24196, *Cleaning System Ultrasonic Console*, provide guidance on equipment cleaning and proper use of ultrasonic-cleaning equipment.

34.9. Tools and Equipment.

34.9.1. Insulated tools shall be used when performing work on energized equipment. **(T-1)** Placing rubber grips or tape on un-insulated tools does not make them acceptable insulated tools. Wooden handle tools shall not be used on energized equipment. **(T-1)**

34.9.2. Only wood or fiberglass ladders are acceptable for work on or near electrical equipment. Refer to **Chapter 7,** *Walking – Working Surfaces*, for additional guidance on portable ladders.

34.9.3. Ground wrist straps shall be disconnected when personnel are exposed to or working on energized electrical circuits. **(T-1)**

34.9.4. Industrial equipment such as floor hoists, cranes, drill presses, grinders and polishers may pose hazards to technicians. Consult applicable maintenance, commercial data, **Chapter 11,** *Hand Tools, Portable Tools and Machinery*, and TO 34-1-3, *Inspection and Maintenance – Machinery and Shop Equipment*, for proper operation and maintenance of such equipment.

34.9.5. Radar and Microwave Equipment. Radar and microwave equipment are sources of radio frequency radiation. Personnel shall be instructed on radio frequency radiation hazards prior to working on this equipment and shall not be exposed to radio frequency radiation levels above permissible exposure limits. **(T-0)** Caution shall be observed with any open waveguide connected to an energized source of microwave radiation, as high power densities can be found at the waveguide opening. **(T-1)** An radio frequency radiation warning sign shall be posted in areas where access to power density levels exceed the permissible exposure limit. **(T-1)**

34.9.6. Hydraulic and Pneumatic Pressure Systems. TO 00-25-223, *Integrated Pressure Systems and Components (Portable and Installed)*, explains safe operating procedures for this equipment and shall be followed when using this equipment. **(T-1)**

34.9.7. Calibration/Repair of Fluid Analysis Equipment. Exposure to acids, electric current and petroleum distillates may occur when performing oil analysis operations and maintenance. Workers shall wear appropriate PPE when using this equipment and associated chemicals. **(T-1)**

34.9.8. Calibration/Repair of Radiation Measuring Equipment. Personnel shall follow AFI 48-109, AFI 48-139, *Laser and Optical Radiation Protection Program*, and AFI 40-201, when calibrating or repairing radiation test, measuring and diagnostic equipment. **(T-1)** Problems not covered in this standard or referenced AFOSH guidance, manuals and TOs shall be referred to the installation Radiation Safety Officer and BE. **(T-1)**

JOHN T. RAUCH
Major General, USAF
Chief of Safety

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

AFFARS Clause 5352.223-9001, *Health and Safety on Government Installations,* 15 June 2006

AFI 11-218, *Aircraft Operations and Movement on the Ground,* 28 October 2011

AFI 13-213, *Airfield Driving,* 1 June 2011

AFI 21-101, *Aircraft and Equipment Maintenance Management,* 21 May 2015

AFI 23-201, Fuels Management, 20 June 2014

AFI 24-301, *Vehicle Operations,* 5 May 2016

AFI 24-302, *Vehicle Management,* 29 October 2007

AFI 31-218, *Motor Vehicle Traffic Supervision,* 22 May 2006

AFI 32-1023, *Designing and Constructing Military Construction Projects,* 19 November 2015

AFI 32-1024, *Standard Facility Requirements,* 14 July 2011

AFI 32-1042, *Standards for Marking Airfields,* 19 October 2016

AFI 32-1043, *Managing, Operating, and Maintaining Aircraft Arresting Systems,* 4 March 2015

AFI 32-1052, *Facility Asbestos Management,* 24 December 2014

AFI 32-1064, *Electrical Safe Practices,* 29 December 2016

AFI 32-1065, *Grounding Systems,* 14 June 2017

AFI 32-1067, *Water Systems,* 4 February 2015

AFI 32-1068, *Heating Systems and Unfired Pressure Vessels,* 8 February 2017

AFI 32-2001, *Fire Emergency Services Program,* 27 February 2014

AFI 32-7001, *Environmental Management,* 16 April 2015

AFI 32-7040, *Air Quality Compliance and Resource Management,* 4 November 2014

AFI 32-7042, *Waste Management,* 7 November 2014

AFI 32-7086, *Hazardous Materials Management,* 4 February 2015

AFI 32-9005, *Real Property Accountability and Reporting,* 4 March 2015

AFI 32-10141, *Planning and Programming Fire Safety Deficiency Correction Projects,* 5 February 2015

AFI 33-360, *Publications and Forms Management,* 1 December 2015

AFI 36-2251, *Management of Air Force Training Systems,* 5 June 2009

AFI 40-201, *Managing Radioactive Materials in the US Air Force,* 17 September 2014

AFI 41-201, *Managing Clinical Engineering Programs,* 10 October 2017

AFI 44-108, *Infection Prevention and Control Program,* 6 November 2014

AFI 44-177, *Public Access Defibrillator Program,* 5 June 2014

AFI 47-101, *Managing Air Force Dental Services,* 20 February 2014

AFI 48-109, *Electromagnetic Field Radiation (EMFR) Occupational and Environmental Health Program,* 1 August 2014

AFI 48-127, *Occupational Noise and Hearing Conservation Program,* 26 February 2016

AFI 48-137, *Respiratory Protection Program,* 15 July 2014

AFI 48-139, *Laser and Optical Radiation Protection Program,* 10 December 1999

AFI 48-145, *Occupational and Environmental Health Program,* 15 September 2011

AFI 48-148, *Ionizing Radiation Protection,* 21 September 2011

AFI 90-821, *Hazard Communication,* 27 January 2014

AFI 90-802, *Risk Management,* 11 February 2013

AFI 91-202, *The US Air Force Mishap Prevention Program,* 24 June 2015

AFI 91-204, *Safety Investigations and Reports,* 12 February 2014

AFI 91-207, *The US Air Force Traffic Safety Program,* 16 February 2017

AFJI 48-110, *Immunizations and Chemoprophylaxis for the Prevention of Infectious Diseases,* 7 October 2013

AFJMAN 23-210, *Joint Service Manual (JSM) for Storage and Materials Handling,* 12 April 1994

AFMAN 15-129V1, *Air and Space Weather Operations – Characterization,* 6 December 2011

AFMAN 24-204, *Preparing Hazardous Materials for Military Air Shipments,* 13 July 2017

AFMAN 24-306, *Operation of Air Force Government Motor Vehicles,* 9 December 2016

AFMAN 33-363, *Management of Records,* 1 March 2008

AFMAN 48-125, *Personnel Ionizing Radiation Dosimetry,* 4 October 2011

AFMAN 48-155, *Occupational and Environmental Health Exposure Controls,* 1 October 2008

AFMAN 91-118, *Safety Design and Evaluation Criteria for Nuclear Weapon Systems,* 28 July 2015

AFMAN 91-201, *Explosives Safety Standard,* 21 March 2017

AFPAM 90-803, *Risk Management (RM) Guidelines and Tools,* 11 February 2013

AFPD 91-2, *Safety Programs,* 1 May 2017

AFTO Form 95, *Significant Historical Data,* 17 June 2002

AFTO Form 244, *Industrial/Support Equipment Record,* 13 January 2011

AFVA 91-303, *DANGER—DO NOT ENERGIZE—PERSON WORKING ON ANTENNA*

AFVA 91-304, *DANGER—DO NOT ENERGIZE—WORK IN PROGRESS ON EQUIPMENT*

AFVA 91-305, *DANGER—INTERLOCKS DISABLED*

AFVA 91-306, *DANGER—HIGH VOLTAGE*

DD Form 1574, *Serviceable Tag – Material,* 1 October 1988

DD Form 1577-2, *Unserviceable (Reparable) Tag Materiel*

DoD 4160.21-M, *Defense Materiel Disposition Manual,* 22 October 2015

DoD 6055.09-STD, *DoD Ammunition and Explosives Safety Standards,* 29 February 2008

DoDI 6055.1, *DoD Safety and Occupational Health (SCH) Program,* 14 October 2014

DoDI 6055.12, *Hearing Conservation Program,* 3 December 2010

Engineering Technical Letter 01-18, *Fire Protection Engineering Criteria – Electronic Equipment Installations,* 24 October 2001

Engineering Technical Letter 07-3, *Jet Engine Thrust Standoff Requirements for Airfield Asphalt Edge Pavements,* 14 February 2007

MIL-DTL-15562G, *Matting or Sheet, Floor Covering Insulating for High Voltage Application,* 31 May 1996

MIL-HDBK-1190, *Facility Planning and Design Guide,* 1 September 1987

MIL-PRF-680, *Degreasing Solvent,* 13 December 1999

MIL-PRF-680B, *Degreasing Solvent,* 26 October 2006

MIL-PRF-32058, *Chock, Wheel-Track-Aviation, Adjustable Rope Type,* 18 June 2008

MIL-STD-101C, *Color Code for Pipeline for Compressed Gas Cylinders,* 26 August 2014

MIL-STD-161H, *Identification Methods for Bulk Petroleum Products Systems Including Hydrocarbon Missile Fuels,* 4 September 2015

MIL-STD-882E, *Department of Defense Standard Practice – System Safety,* 11 May 2012

MIL-STD-1411B, *Inspection and Maintenance of Compressed Gas Cylinders,* 8 June 2010

MIL-STD-1472G, *Design Criteria Standard: Human Engineering,* 11 January 2012

TO 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures,* 11 July 2016

TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding,* 9 August 2013

TO 00-25-223, *Integrated Pressure Systems and Components (Portable and Installed),* 11 January 2017

TO 00-25-232 *Control and Use of Insulating Matting for High-Voltage Application,* 28 February 1997

TO 00-25-234 *General Shop Practice Requirements for the Repair, Maintenance and Test of Electrical Equipment,* 22 September 2013

TO 00-25-245 *Operations Instruction – Testing and Inspection Procedures for Personnel Safety and Rescue Equipment,* 14 October 2016

TO 00-25-252, *Intermediate Maintenance and Depot Level Maintenance Instructions – Aeronautical Equipment Welding*, 1 September 2009

TO 00-85-20, *Engine Shipping Instructions*, 15 September 2017

TO 00-105E-9, *Aerospace Emergency Rescue and Mishap Response Information (Emergency Services)*, 1 February 2006

TO 1-1-3, *Inspection and Repair of Aircraft Integral Tanks and Fuel Cells*, 21 June 2013

TO 1-1-8, *Application and Removal of Organic Coatings, Aerospace and Non-Aerospace Equipment*, 21 January 2010

TO 4T-1-3, *Inspection, Maintenance Instruction – Storage and Disposition of Aircraft Tires and Inner Tubes*, 30 January 2018

TO 11A-1-33, *Handling and Maintenance of Explosives Loaded Aircraft*, 27 May 2009

TO 31-10-24-WA-1, *Communication Systems Grounding, Bonding and Shielding*, 15 November 2011

TO 31W3-10-12, *Outside Plant Cable Placement*, 30 October 2004

TO 31W3-10-16, *Outside Plant Cable Pressurization*, 15 July 2009

TO 32-1-101, *Use and Care of Hand Tools and Measuring Tools*, 1 December 2004

TO 33-1-37-1, *Joint Oil Analysis Program Manual*, 15 September 2014

TO 33B-1-1, *Nondestructive Inspection Methods, Basic Theory*, 1 January 2013

TO 34-1-3, *Inspection and Maintenance – Machinery and Shop Equipment*, 17 December 2016

TO 35-1-3, *Corrosion Prevention and Control, Cleaning, Painting, and Marking of USAF Support Equipment (SE)*, 26 April 2014

TO 35A2-1-1, *General Inspection Procedures and Overhaul Instructions – For Hydraulic Jacks*, 19 November 2015

TO 35E8-2-4-1, *Operation and Maintenance Instruction Arresting Gear, ACFT Mod Bak-9/F48A*, 5 September 2008

TO 35E8-2-5-1, *Operation and Maintenance Aircraft Arresting System Mod BAK-12/E32A*, 21 January 2015

TO 36-1-191, *Technical and Managerial Reference for Motor Vehicle Maintenanc*e, 20 July 2007

TO 36M-1-141, *Operator and Operation Instruction—Material Handling Equipment System Components of 463L*, 9 June 2000

TO 36M2-3-35-11, *Operation and Operator Maintenance Instructions, Truck, Aircraft Cargo Loading/Unloading 60,000 Pound Capacity*, 31 January 2014

TO 36M2-3-45-1, *Halvorsen 25K Aircraft Cargo Loaders*, 14 March 2015

TO 36Y31-1-1, *Removal of Rust and Sediment from Fuel and Oil Servicing Truck and Trailer Tanks and Application of Coating, Interior, Fuel and Water Resistant*, 14 May 1985

TO 37A-1-101, *General Instructions – USAF Fuel, Water, and Lubricant Dispensing Equipment,* 1 July 2011

TO 42B-1-1, *Quality Control Fuels and Lubricants,* 15 November 2016

TO 42B1-1-14, *Fuels for USAF Aircraft,* 23 July 2012

TO 42B-1-22, *Quality Control of Compressed and Liquid Breathing Air,* 1 July 2017

TO 42B5-1-2, *Gas Cylinders (Storage Type) Use, Handling, and Maintenance,* 16 August 2010

TO 42B6-1-1, *Quality Control of Aviators Breathing Oxygen and Aviators Gaseous Breathing Oxygen,* 6 March 2012

TO 42B7-3-1-1, *Quality Control of Nitrogen,* 25 April 2011

TO 42C-1-2, *Anti-icing, Deicing and Defrosting of Parked Aircraft,* 15 April 2016

UFC 3-120-01, *Design: Sign Standards,* 1 March 2014

UFC 3-460-01, *Design: Petroleum Fuel Facilities,* 16 August 2010

UFC 3-460-03, *O&M: Maintenance of Petroleum Systems,* 10 November 2017

UFC 3-520-01, *Interior Electrical Systems,* 6 October 2015

UFC 3-560-01, *Operation and Maintenance:Electrical Safety,* 24 July 2017

UFC 3-600-01, *Fire Protection Engineering for Facilities,* 8 August 2016

UFC 3-601-02, *Operations and Maintenance: Inspection, Testing, and Maintenance of Fire Protection Systems,* 8 September 2010

UFC 4-024-01, *Security Engineering: Procedures for Designing Airborne Chemical, Biological, and Radiological Protection for Buildings,* 10 June 2008

UFC 4-510-01, *Design: Military Medical Facilities,* 1 May 2016

UFC 4-740-14, *Design: Child Development Centers,* 1 August 2002

Department of Transportation, *Manual on Uniform Traffic Control Devices (MUTCD),* (**http://mutcd.fhwa.dot.gov/kno_2009.htm**), December 2009

American Conference of Governmental Industrial Hygienists' *Industrial Ventilation; A Manual of Recommended Practice,* 21 April 2015

American National Standards Institute/American Society of Heating, Refrigerating and Air Conditioning Engineers 62.1, *Ventilation for Acceptable Indoor Air Quality,* 1 January 2016

American National Standards Institute A92.2, *Vehicle-Mounted Elevating and Rotating Aerial Devices,* 7 July 2015

American National Standards Institute/American Society of Safety Engineers A1264.2, *Standard for the Provision of Slip Resistance on Walking/Working Surface,* 11 January 2013

American National Standards Institute B71.1, *Consumer Turf Care Equipment – Pedestrian-Controlled Mowers Ride-On Mowers – Safety Specifications,* 24 January 2017

American National Standards Institute Z359.1, *The Fall Protection Code,* 1 January 2016

American National Standards Institute Z359.4, *Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components*, 1 January 2013

American National Standards Institute/International Safety Equipment Association Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices,* 1 January 2015

American National Standards Institute/International Safety Equipment Association Z89.1, *Personal Protection – Protective Headwear for Industrial Workers,* 1 January 2014

American National Standards Institute/International Safety Equipment Association Z358.1, *Emergency Eyewash and Shower Equipment,* 1 January 2014

American Society of Mechanical Engineers A17.1, *Safety Code for Elevators and Escalators,* 30 November 2016

American Society of Mechanical Engineers A17.2, *Guide for Inspection of Elevators, Escalators and Moving-Walkways,* 26 January 2018

American Society of Mechanical Engineers' *Boiler and Pressure Vessel Code,* 1 July 2017

American Society of Mechanical Engineers B20.1, *Safety Standards for Conveyors and Related Equipment,* 30 November 2015

American Society of Mechanical Engineers B30.2, *Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist),* 30 May 2017

American Society of Mechanical Engineers B30.5, *Mobile and Locomotive Cranes,* 31 December 2014

American Society of Mechanical Engineers B30.7, *Winches,* 16 September 2016

American Society of Mechanical Engineers B30.9, *Slings,* 6 February 2015

American Society of Mechanical Engineers B30.10, *Hooks,* 8 January 2009

American Society of Mechanical Engineers B30.11, *Monorails and Underhung Cranes,* 16 April 2010

American Society of Testing Materials D120, *Standard Specification for Rubber Insulating Gloves,* 1 November 2014

American Society of Testing Materials D178, *Specification for Rubber Insulating Matting,* 10 March 2001

American Society of Testing Materials - D1051, *Specification for Rubber Insulating Sleeves,* 1 November 2014

American Society for Testing Materials E84, *Standard Test Method for Surface Burning Characteristics of Building Materials,* 1 November 2017

American Society for Testing Materials E119, *Standard Test Methods for Fire Tests of Burning Construction and Materials,* 1 July 2016

American Society for Testing Materials F887, *Standard Specifications for Personal Climbing Equipment,* 15 November 2016

American Society of Testing Materials F2412, *Standard Test Methods for Foot Protection,* 1 July 2011

American Society of Testing Materials F2413, *Standard Specification for Performance Requirements for Protective (Safety) Toe Cap Footwear,* 1 November 2017

Compressed Gas Association G-4, Oxygen, 1 January 2015

Compressed Gas Association P-1, Safe Handling of Compressed Gases in Containers, 1 January 2015

Compressed Gas Association P-2, Characteristics and Safe Handling of Medical Gases, 1 January 2013

Crane Manufacturers Association of America 70, *Specification for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes,* 2015

Crane Manufacturers Association of America 74, *Specification for Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist,* 2015

National Fire Protection Association 10, *Standard for Portable Fire Extinguishers,* 17 August 2017

National Fire Protection Association 12, *Standard on Carbon Dioxide Extinguishing Systems,* 30 November 2017

National Fire Protection Association 13, *Standard for the Installation of Sprinkler Systems,* 18 August 2015

National Fire Protection Association 17, *Standard for Dry Chemical Extinguishing Systems,* 1 December 2016

National Fire Protection Association 30, *Flammable and Combustible Liquids Code,* 6 September 2017

National Fire Protection Association 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages,* 21 August 2017

National Fire Protection Association 33, *Standard for Spray Application Using Flammable or Combustible Materials,* 30 November 2017

National Fire Protection Association 34, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids,* 30 November 2017

National Fire Protection Association 42, *Code for the Storage of Organic Peroxide Formulations,* 19 July 2002

National Fire Protection Association 45, *Standard for Fire Protection for Laboratories Using Chemicals,* 1 December 2014

National Fire Protection Association 50, *Bulk Oxygen Systems at Consumer Sites,* 9 February 2001

National Fire Protection Association 51B, *Standard for Fire Prevention During Welding, Cutting and Other Hot Work,* 17 June 2013

National Fire Protection Association 55, *Compressed Gases and Cryogenic Fluids Code,* 15 June 2015

National Fire Protection Association 70, *National Electrical Code,* including applicable Articles, 24 August 2016

National Fire Protection Association 70E, *Standard for Electrical Safety in the Workplace,* including applicable Articles, 21 August 2017

National Fire Protection Association 72, *National Fire Alarm and Signaling Code,* 7 September 2015

National Fire Protection Association 80 , *Standard for Fire Doors and Other Opening Protectives,* 15 June 2015

National Fire Protection Association 86, *Standard for Ovens and Furnaces,* 19 May 2014

National Fire Protection Association 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids,* 1 December 2014

National Fire Protection Association 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations,* 1 December 2016

National Fire Protection Association 99, *Health Care Facilities Code,* 17 August 2017

National Fire Protection Association 101, *Life Safety Code,* 6 September 2017

National Fire Protection Association 241, *Standard For Safeguarding Construction, Alteration and Demolition Operations,* 17 December 2012

National Fire Protection Association 326, *Safeguarding of Tanks and Containers for Entry, Cleaning or Repair,* 1 January 2015

National Fire Protection Association 407, *Standard for Aircraft Fuel Servicing,* 2 June 2016

National Fire Protection Association 409, *Standard on Aircraft Hangars,* 15 June 2015

National Fire Protection Association 410, *Standard on Aircraft Maintenance,* 1 December 2014

National Fire Protection Association 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas,* 2 June 2016

National Fire Protection Association 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations,* 18 August 2017

National Fire Protection Association 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films,* 1 December 2014

National Fire Protection Association 1901, *Standard for Automotive Fire Apparatus,* 7 September 2015

National Fire Protection Association 1914, *Standard for Testing Fire Department Aerial Devices,* 8 August 2002

National Fire Protection Association 1931, *Standard for Manufacturer's Design of Fire Department Ground Ladders,* 29 July 2014

National Fire Protection Association 1932, *Standard on Use, Maintenance and Service Testing of In-Service Fire Department Ground Ladders,* 29 July 2014

National Institute for Occupational Safety and Health (National Institute for Occupational Safety and Health) *Registry of Toxic Effects of Chemical Substances (RTECS)*

National Safety Council, *Accident Prevention Manual,* 2015

National Sanitation Foundation Standard 49, *Class II (Laminar Flow) Biological Cabinetry, Design, Construction, Performance and Field Certification,* 24 June 2016

OSHA, **http://www.osha.gov/**

29 CFR 1910 (General Industry)

29 CFR 1926 (Construction)

OSHA 3067, *Concepts and Techniques of Machine Safeguarding,* 1992

OSHA 3086, *Servicing Single-Piece and Multi-Piece Rim Wheels,* 1998

Underwriters Laboratories 94, *Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances,* 8 July 2015

US Army Corps of Engineers Manual [EM] 385-1, *Explosives Safety and Health Requirements Manual,* 12 April 2013

US DOE, *Handbook for Handling, Storing and Dispensing E85,* 1 February 2016

Prescribed Forms

AF Form 592, *USAF Hot Work Permit,* 19 November 2015

AF Form 979, *Danger Tag,* 1 July 1990

AF Form 980, *Caution Tag,* 1 July 1990

AF Form 981, *Out of Order Tag,* 1 February 1981

AF Form 982, *Danger Tag: Do Not Start,* 1 July 1990

AF Form 983, *Danger – Equipment Lockout,* 4 September 2012

AF Form 1024, *Confined Spaces Entry Permit,* 22 March 2016

Adopted Forms

AF Form 55, *Employee Safety and Health Record,* 10 July 2013

AF Form 103, *Base Civil Engineering Work Clearance Request,* 11 March 2003

AF Form 171, *Request for Driver's Training and Addition to U.S. Government Driver's License,* 15 February 2011

AF Form 332, *Base Civil Engineer Work Request,* 1 January 1991

AF Form 469, *Duty Limiting Condition Report,* 25 October 2007

AF Form 483, *Certificate of Competency,* 1 February 1985

AF Form 623, *Individual Training Record Folder,* 1 October 1996

AF Form 1098, *Special Task Certification and Recurring Training,* 1 April 1985

AF Form 1118, *Notice of Hazard*, 15 June 2015

AF Form 1800, *Operator's Inspection Guide and Trouble Report*, 1 April 2010

AF Form 1807, *Operator's Inspection Guide and Trouble Report (Fuel Servicing Vehicles),* 22 March 2011

AFTO Form 492, *Warning Tag*, 18 May 2018

Abbreviations and Acronyms

AFCEC—Air Force Civil Engineer Center

AFI—Air Force Instruction

AFJI—Air Force Joint Instruction

AFMAN—Air Force Manual

AFMC—Air Force Materiel Command

AFOSH—Air Force Occupational Safety and Health

AFPAM—Air Force Pamphlet

AFPD—Air Force Policy Directive

AFRC—Air Force Reserve Command

AFSEC—Air Force Safety Center

AFTO—Air Force Technical Order

AFVA—Air Force Visual Aid

AGE—Aerospace Ground Equipment

ANG—Air National Guard

BAK—Barrier Arresting System

BE—Bioenvironmental Engineering

C—Celsius

CBT—Computer-based Training

CE—Civil Engineering

C-E—Communications Electronics

CFR—Code of Federal Regulations

cm—Centimeter

CO2—Carbon Dioxide

CPR—Cardiopulmonary Resuscitation

dB—Decibels

DoD—Department of Defense

DOT—Department of Transportation

DRU—Direct Reporting Unit

E-I—Engineering and/or Installation

EM—Engineers Manual

F—Fahrenheit

FES—Fire Emergency Services

FMU—Fuels Management Unit

FOA—Field Operating Agency

FOD—Foreign Object Damage

GFCI—Ground Facult Circuit Interrupter

HAZMAT—Hazardous Material

HMMWV—High Mobility Multipurpose Wheeled Vehicle

HQ—Headquarters

HVAC—Heating, Ventilation and Air Conditioning

IAW—In Accordance With

IDLH—Immediately Dangerous to Life and Health

JHA—Job Hazard Analysis

JP—Jet Petroleum

JSM—Joint Service Manual

kV—Kilovolt

kW—Kilowatt

LEL—Lower Explosive Limit

LFL—Lower Flammable Limit

LN2—Liquid Nitrogen

LOTO—Lockout/Tagout

LOX—Liquid Oxygen

MAJCOM—Major Command

MDS—Mission Design Series

MHE—Material Handling Equipment

MIL-DTL—Military Detail Specifications

MIL-HDBK—Military Handbook

MIL-SPEC—Military Specification

MIL-STD—Military Standard

MNCL—Master Nuclear Certification List

MPH—Miles Per Hour

MTF—Medical Treatment Facility

MUTCD—Manual on Uniform Traffic Control Devices

NAF—Numbered Air Force

NATO—North Atlantic Treaty Organization

NDI—Non-Destructive Inspection

NSN—National Stock Number

OI—Operating Instruction

OJT—On-The-Job Training

OPR—Office of Primary Responsibility

OSH—Occupational Safety and Health

OSHA—Occupational Safety and Health Administration

PH—Public Health

PMEL—Precision Measurement Equipment Laboratory

PPE—Personal Protective Equipment

PSI—Pounds per Square Inch

RFR—Radio Frequency Radiation

RM—Risk Management

ROPS—Rollover Protection Structure

SABC—Self-Aid Buddy Care

SDS—Safety Data Sheet

SE—Support Equipment

SEG—Occupational Safety

TO—Technical Order

UFC—Unified Facilities Criteria

USAF—United States Air Force

US—United States

Terms

463L Equipment—Specialized material handling equipment designed for on- and off-loading cargo from aircraft. It includes specially constructed pallet conveyor platforms.

Abrasive Wheel—A cutting tool made of abrasive grains held together by organic or inorganic bonding materials.

Air Force Occupational Safety and Health (AFOSH)—An overarching term for the Air Force Occupational Safety and Health Program.

Automated External Defibrillator—A device that analyzes the heart's rhythm and, if necessary, tells the user to deliver a shock to a victim of sudden cardiac arrest. This shock, called defibrillation, may help the heart to re-establish an effective rhythm of its own.

Actuator—A manually operated device used to initiate controls or operator action. An actuator includes, but is not limited to, a push button, toggle switch, foot pedal, hand lever or a hand set timer.

Aerial Device—Any vehicle-mounted device, telescoping or articulating or both, that is used to elevate personnel to job sites above ground. These devices include extendable boom platforms, vertical towers or a combination of the above.

Aerial Ladder—An aerial device consisting of a single or multiple-section extendable ladder.

Affected worker—A worker whose duties require him/her to work in the vicinity of or operate a machine or equipment on which servicing or maintenance is being performed.

Aisleway—An established path for powered material handling equipment (or foot traffic) used inside a facility, such as aisleways in a warehouse.

Anchorage—See Fixed Anchorage.

Approved—Listed and approved by Underwriters Laboratories Inc., Factory and Mutual Engineering Corporation, The Bureau of Mines, National Institute for Occupational Safety and Health, American National Standards Institute, National Fire Protection Association or other nationally recognized agencies that list, approve, test or develop specifications for equipment to meet fire protection, health or safety requirements.

Approved Portable Fire Extinguishers—Extinguishers procured to a military specification for specific Air Force needs, or approved by a nationally recognized agency such as Underwriters Laboratories Inc., Factory Mutual Laboratory, Bureau of Mines, Department of Interior, Department of Transportation (DOT) or US Coast Guard.

Articulating Boom Platform—An aerial device with two (2) or more hinged boom sections.

Atmospheric Monitoring—The quantitative analysis of a confined space environment to identify a potentially hazardous atmosphere.

Attendant—A trained individual stationed outside one or more confined spaces who monitors authorized entrants and performs attendant's duties assigned in the permit space program.

Authorized Worker—A worker who locks or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment.

Automatic Fire Detection System—A system that employs heat, smoke and flame detectors, or a combination of these, to detect, announce and report the presence of fire. The system includes features to manually actuate the system and transmit the alarm to the FES Flight.

Backrest Extension (Forklift)—A device extending vertically from the fork carriage to keep cargo from falling rearward.

Bearer—A horizontal part of a scaffold on which the platform rests and which may be held in place by ledgers.

Belt Conveyor—An endless fabric, rubber, plastic, leather or metal belt operating over suitable drive, tail end and bend terminals and over belt idlers or slider bed for handling bulk materials, packages or objects placed directly upon the belt.

Belt Idler—A roller or series of rollers that support the belt of a belt conveyor.

Blanking or Blinding—The absolute closure of a pipe, line or duct, by fastening across it a solid plate or cap capable of withstanding the maximum upstream pressure with no leakage beyond the plate or cap.

Bloodborne Pathogens—Bloodborne pathogens are pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, Hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

Body and/or Hand protection—Any glove, finger guard, arm protector, apron, bib or garment designed to protect the body, arms, hands or fingers from contamination or injury due to absorption or physical contact.

Body Harness—A harness secured about the wearer so fall arrest forces are distributed over the thighs, buttocks, chest and shoulders, or any combination thereof. Includes provisions for attaching a lanyard centered in the back near shoulder level or above the head.

Bonding—The interconnecting of metal raceways, equipment cabinets, shields, etc., to the facility equipment system to eliminate electrical potential of individual pieces of equipment relative to each other.

Boom Angle—The angle between the longitudinal centerline of the boom and the horizontal. The boom longitudinal centerline is a straight line between the boom foot pin (heel pin) centerline and the boom point sheave pin centerline.

Boom (Crane)—A member, fixed or telescoping, hinged to the rotating superstructure and used to support the hoisting tackle.

Boom Hoist—A hydraulic or mechanical hoist drum and rope reeving system used to raise and lower the boom. The rope system may be all live reeving or a combination of live reeving and pendants.

Boom Stop—A device used to limit the angle of the boom at the highest position.

Brace—A tie that holds one scaffold part in a fixed place with respect to another part.

Brake—A friction device for slowing down a conveyor component, bringing conveyor equipment to a controlled stop, holding traveling or traversing equipment in a selected location, preventing reverse travel and controlling over-speed due to the action of gravity.

– *Brake, Drag.* A brake that provides retarding force without external control.
– *Brake, Holding.* A brake that automatically prevents motion when power is off.
– *Brake, Travel.* A brake that retards or stops motion in a horizontal direction.

Bridge—That part of a crane consisting of girders, trucks, end ties, footwalks and drive mechanism that carries the trolley or trolleys.

Bridge Plate—A plate, usually of metal and having a rated load capacity, used to span the space between freight cars or trucks and the loading platform. Also known as a dockboard.

Breakthrough Time—The time required for a specific chemical to permeate through a particular brand of protective clothing or equipment.

Buddy System—Two people, each responsible for each other's safety, are present in a hazardous situation. There are two (2) types of buddy systems. One involves both persons subjected to the sane hazard at the same time, and each assures the other's well-being and assists if a mishap occurs. The other system is where one person is exposed to the hazard while the other is not and acts as an observer.

Bumper (Buffer)—An energy absorbing device for reducing impact when a moving crane or trolley reaches the end of its permitted travel or when two (2) moving cranes or trolleys come in contact.

Cab—The operator's compartment attached to the crane or monorail carrier in which the operator may ride and from which the motions of the crane or monorail equipment may be controlled. A housing that covers the rotating superstructure machinery or operator's station.

Cab-Operated—Crane or monorail equipment, the motions of which are controlled from an operator's cab.

Calibration or Recalibration—A laboratory or bench-top resetting of alarm points, spans and zeros according to manufacturer's specifications.

Capable of being locked out—An energy isolating device is capable of being locked out if it has a hasp or other means of attachment to which, or through which, a lock can be affixed, has a locking mechanism built into it or if lockout can be achieved without the need to dismantle, rebuild or replace the energy isolating device or permanently alter its energy control capability.

Carbon Dioxide Fire Suppression System—An automatic or manually activated fire suppression system that uses carbon dioxide (a colorless, odorless, electrically nonconductive gas) as its extinguishing agent.

Cardiopulmonary Resuscitation (CPR)—A procedure to support and maintain breathing and circulation for a person who has stopped breathing (respiratory arrest) and/or whose heart has stopped (cardiac arrest).

Cathode Ray Tube (CRT)—A sealed evacuated glass tube containing an electron source and a phosphorous face often used to provide a visual image display. A television tube is a common example.

Catwalk—A passageway for persons, elevated above the floor or ground level, such as a foot walk along shafting or a walkway between buildings.

Chain—A series of links pivotally joined together for conveying or transmitting motion or power. General classes of chain are detachable, pintle, combination, roller, rivetless, coil, inverted tooth and bar link chains.

– *Chain, Roller Link.* A chain consisting of a series of stamped steel plates fastened with pins, bushings and rollers giving articulation in only one plane.
– *Chain, Welded Link.* A chain consisting of a series of interwoven links formed and welded from round bar stock.

Chemical Protective Clothing—Chemical protective clothing is intended to protect the worker from contact with chemicals. It may include items such as: hoods, face shields, chemical goggles, jackets, coats, aprons, bib overalls, coveralls, splash suits, boots, shoe covers and full-body encapsulating suits.

Chuck—A clamp that holds a tool or material being worked in or on a machine.

Climbing Ladder—A separate or built-in ladder with rungs spaced at equal distance and attached to a scaffold or platform so people can climb and descend.

Clutch—A device used to connect and disconnect a driving and driven part of a mechanism that, when connected, transmits rotary motion from the driving part to the driven member.

Coating—An elastomer or other suitable material used to impart physical, electrical or other desired properties when applied to a sling or sling component.

Combination Unit (Emergency Shower and Eyewash)—A unit combining a shower with an eye and face wash, or eyewash with a drench hose, or both.

Combustible Liquid—A liquid having a flashpoint at or above 100o F (37.80o C). Combustible liquids shall be divided into two classes as follows:

– Class II liquids have a flashpoint at or above 100oF (37.8o C) and below 140o F (60o C), except any mixture having components with flashpoints of 200o F (93.3o C) or higher, the volume of which makes up 99 percent or more of the total volume of the mixture.
– Class III liquids have flash points at or above 140o F (60o C) and are subdivided into two subclasses:
-- Class IIIA liquids have flashpoints at or above 140o F (60o C) and below 200o F (93.3o C), except any mixture having components with flashpoints of 200o F (93.3o C) or higher, the total volume of which makes up 99 percent or more of the total volume of the mixture.
-- Class IIIB liquids have flashpoints at or above 200oF (93.3o C).

Commercial Cooking Facilities—Facilities such as clubs, dining halls, snackbars, cafeterias and other places of assembly where the facility or a portion of it is devoted to the preparation of food served to the public.

Competent Person—Competent person is an individual who, by way of training and/or experience, is knowledgeable of applicable standards, is capable of identifying workplace hazards relating to the specific operation, is designated by the unit commander, unit representative or supervisor and has authority to take appropriate actions.

Compressed Gas—Any gas or mixture of gasses in a container having a pressure exceeding 40 psia at 70o F (21.1o C), or a pressure exceeding 104 psia at 130o F (54.4o C), or any liquid having an absolute vapor pressure exceeding 40 psia at 100o F (37.8o C).

Conductor—A substance or device that readily conducts heat, electricity, sound, etc. Definitions of specific conductors follow:

– *Conductors, Bridge.* The electrical conductors located along the bridge structure of a crane to provide power to the trolley.
– *Conductors, Enclosed.* Bar or wire used to transmit electricity, enclosed to minimize the possibility of accidental contact with the conductor.
– *Conductors, Open.* Bar or wire not enclosed, used to transmit electrical current and provide power (frequently used with the crane or monorail carrier).
– *Conductors, Runway (Main).* The electrical conductors located along a crane runway to provide power to the crane.

Confined Space—A space large enough and configured so a worker can bodily enter and perform assigned work; has limited or restricted means for entry or exit (for example: tanks, vessels, silos, storage bins, hoppers, vaults, manholes and pits); and is not designed for continuous human occupancy.

Confined Space Program Team—A group of professionals, consisting of representatives from installation Occupational Safety office, FES Flight and BE, working together for the purposes of organizing and controlling the installation confined space program. Commanders, functional managers or their representatives are members of the team when their particular organizations are involved.

Control—The system governing the starting, stopping, direction of motion, acceleration, speed, retardation and function of the moving member in a predetermined manner.

Controller—An electric or mechanical device or assembly of devices for starting, stopping, accelerating or decelerating a system, or which serves to govern in some predetermined manner the power delivered to the system.

Coolant—Oil or other fluid that draws off heat by circulating through a machine or by bathing a mechanical part, such as oil that is applied to a metal cutting operation to dissipate the heat.

Corrective Lens—A lens manufactured to the wearer's individual corrective prescription.

Corrosive—Any substance that burns, injuriously irritates or destructively attacks metal, organic tissues or other materials.

Counterweight—A weight used to balance or counter a load. Examples are:

– Additional weight attached to the rear of the forklift to provide better weight distribution.
– Weight used to supplement the weight of a crane to provide stability for lifting working loads.

Coupler—A device for locking together the parts of a tubular metal scaffold.

Crane—Any machine for lifting and lowering of a load and moving it horizontally, in which the lifting device is an integral part of the machine.

– *Crane, Cantilever Gantry.* A gantry or semi-gantry crane in which the bridge girders or trusses extend transversely beyond the crane runway on one or both sides.
– *Crane, Crawler.* A crane consisting of a rotating superstructure with power plant, operating machinery and boom, mounted on a base, equipped with crawler treads for travel.
– *Crane, Floor-Operated.* A crane which is controlled by an operator on the floor or an independent platform by using a pendant or nonconductive rope.
– *Crane, Gantry.* A crane similar to an overhead crane except the bridge for carrying the trolley or trolleys is rigidly supported on two (2) or more legs running on fixed rails or other runway.

– *Crane, Overhead.* A crane with a movable bridge carrying a movable or fixed hoisting mechanism and traveling on an overhead fixed runway structure.
– *Crane, Remote-Operated.* A crane controlled by an operator not in a cab or pulpit. It is controlled by any method other than pendant or rope control (for example: radio, voice, remote hydraulic control, etc.).
– *Crane, Storage Bridge.* A gantry type crane of long span usually used for bulk storage of material; the bridge girders or trusses are rigidly or non-rigidly supported on one or more legs. It may have one or more fixed or hinged cantilever ends.
– *Crane, Underhung.* A traveling bridge on two (2) or more runway tracks on which hoists and carriers may travel for the purpose of lifting, transporting and lowering loads. It is suspended under its runway tracks system, the trolley of which operates on the bottom flange of the track.
– *Crane, Wall.* A crane having a jib with or without trolley and supported from a side wall or line of columns of a building. It is a traveling type and operates on a runway attached to the side wall or columns.

Critical Load—Materials that if damaged or destroyed during a lift would present an unrecoverable loss or unacceptable risk. Air Force materials will be designated as critical loads for purposes of lifting or hoisting by an appropriate Program Manager or the functional manager at the facility where the lift will occur. Items for consideration in making a critical load determination include, but are not limited to:

– Personnel injury or significant adverse health impact.
– Damage resulting in serious economic consequences (non-availability of necessary funds to repair or replace the item).
– Damage resulting in unacceptable delay to schedule (mission impairment) or other destructive programmatic impact, e.g., loss of vital data.
– Undetectable damage that would jeopardize future operations or safety of a facility.
– Damage that may occur without exceptional care in handling because of close-tolerance installation, high susceptibility to damage or other unusual characteristic.
– Damage that would result in significant release of hazardous materials.
– Damage that may occur because the item, although noncritical, must be lifted above a critical item, e.g., loads of any sort in close proximity to a nuclear component or near concentrations of hazardous materials.

Critical Pressure—The vapor pressure of a liquid at the critical temperature.

Critical Temperature—The temperature above which a gas cannot be liquefied by pressure alone.

Crossover—A connecting track with an interlock mechanism on both ends mounted between two interlocking cranes used to transfer a carrier from one bridge to the other.

Cryogen—A cryogenic liquid boils at temperatures below -160o C (-256o F) and is used as a refrigerant. As used in this standard, normally refers to LN2 or LOX.

Cryogenics—The science of refrigeration, with reference to methods for producing very low temperatures.

Cryotainer—A double-walled, insulated container (tank) for storage of a cryogenic fluid.

Cylinder—Generally a compressed gas container having a maximum water capacity of 1,000 lbs. (453.6 kg.). This is approximately the equivalent of 120 gallons (454.2 L).

Daily or Prior—to-Use Inspection—A visual inspection of equipment performed once each day prior to initial use. If the equipment is not used on a daily basis, this inspection is performed prior to each use and is not required on those days the equipment is not used. The use of additional items such as ladders, personnel lifts or special tools or disassembly of lifting equipment is not required by this standard for this inspection. Note: The daily or prior to use inspection is not an Operational Test.

Deceleration Device—Any mechanism, such as rope-grab, rip-stitch lanyard or specifically woven lanyard, that serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limits the energy imposed on a worker during fall arrest.

Derrick—An apparatus consisting of a mast or equivalent member held at its upper end by guys or braces, with or without a boom, for use with hoisting mechanism and operating ropes.

Department of the Air Force Military Personnel—These are Air Force personnel on Regular Air Force status with the Air Force or ANG (under the provisions of either Title 10 or 32) and AFRC personnel on military duty status (on active duty, on active duty for training, or inactive duty for training), which includes Air Force Academy cadets and Reserve Officer Training Corps cadets engaged in directed training activities. Includes members of other US military services serving on extended Regular Air Force status with the Air Force or foreign-national military personnel assigned to the Air Force.

Department of Defense Civilian Personnel—Includes Senior Executive Service (SES), General Schedule (GS), Defense Civilian Intelligence Personnel System (DCIPS) and federal wage system employees, including ANG and AFRC technicians, unless in military duty status. Includes non-appropriated fund employees who are not military personnel working part time; Corps of Engineers Civil Works employees; Youth Opportunity Program and student assistance program employees; Direct-Hire Foreign-national civilians employed by the Air Force (Air Force Foreign Nationals) and Army-Air Force Exchange Service employees.

Department of Defense Military Personnel—These are non-Air Force military personnel assigned to an Air Force-led joint base.

Designated Person—Selected or assigned by the supervisor or the unit's representative as qualified to perform specific duties.

Design Working Load—The maximum intended load, being the total of all loads including the weight of the workers, materials, equipment and platform.

Dielectric Boom Shield—An insulating device installed on booms to provide electrocution protection to operators and load handlers.

Dog—A device for gripping or holding material or a machine component in place.

Dolly—A low mobile platform that rolls on casters, used for transporting heavy loads.

Double Block and Bleed—The closure or isolation of a confined space from a line, duct or pipe by locking or tagging two (2) closed in-line valves and locking or tagging open to the outside atmosphere a drain or bleed in the line between the two (2) closed valves.

Drive—An assembly of the necessary structural, mechanical and electrical parts which provides the motive power for a conveyor, monorail, crane, etc.

Dropline—A vertical line attached to a fixed anchorage to which a lanyard is attached.

Drop Section—A mechanism which will permit a section of track to be lowered out of alignment with a stationary track.

– A cylindrical or polygonal rim type of wheel around which cable, chain, belt or other linkage may be wrapped. A drum may be driven or driving. The face may be smooth, grooved, fluted or flanged;
– A cylindrical or bilged shipping container having straight sides and flat or bumped ends, designed for storage and shipment as an unsupported outer package that may be shipped without boxing or crating.

Dry Cleaning—The process of removing dirt, grease, paints and other stains from such items as wearing apparel, textiles, fabrics and rugs by the use of non-aqueous liquids (solvents, non-water based).

Electrical Worker Personal Protective Devices—Equipment designed to protect against electrical shock while working on electrically energized circuits. May include rubber insulating matting, blankets, line hose, gloves, sleeves, rain gear, footwear, safety belts, lanyards and lifelines, arc flash protective clothing and special hand tools.

Emergency Shower—A unit that cascades water over a worker's entire body to remove hazardous chemicals splashed or sprayed on the worker.

Emergency Stop Switch—A manually or automatically operated switch to cut off electric power independently of the regular operating controls.

Employee—For the purpose of this standard, the term Employee applies to all Personal Services Contractors, Department of Defense Civilian Personnel, Department of Defense Military Personnel and Department of the Air Force Military Personnel.

Energized—A circuit electrically connected to a source of potential difference or an electrical charge. Can also include mechanical, hydraulic and pneumatic pressure differences.

Energy Isolating Device—A physical device that prevents transmission or release of energy including, but not limited to: a manually operated electrical circuit breaker, disconnect switch, slide gate, slip blind, line valve, blocks and similar devices with a visible indication of the position of the device. Push buttons, selector switches and other control circuit type devices are not energy isolating devices.

Entrant—Any employee who is trained and authorized to enter a confined space.

Entry—Any action by which a person passes through an opening into a permit-required confined space. Entry includes work activities in the space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the confined space.

Entry Permit—The written authorization for entry under defined conditions into a confined space for a stated purpose during a specified time. The entry permit becomes the written record of circumstances surrounding each entry operation. See paragraph 23.4.1.2. for entry permit retention instructions.

Entry Permit System—The system for issuing entry permits and ensuring safe entry into and work within confined spaces.

Entry Supervisor—The person responsible for determining if acceptable entry conditions are present at a permit space where entry is planned.

Equalizer—A device that compensates for unequal length or stretch of a rope.

Equipment Ground—Connection to ground from one or more of the non-current carrying metal parts of apparatus or equipment.

Equivalent—An alternative design or feature which will give an equal degree or factor of safety.

Exit Access—Exit access that is a portion of a means of egress that leads to an exit.

Extendible Boom Platform—An aerial device (except ladders) with a telescopic or extendible boom. Telescopic derricks with personnel platform attachments are considered extendible boom platforms when used with a personnel platform.

Extension Ladder—A non-self-supporting portable ladder, adjustable in length, with two (2) or more sections traveling in guides or brackets arranged to permit length adjustment. Its size is designated by the sum of the lengths of the sections measured along the side rails.

Eye and Face Protectors—This equipment includes spectacles and goggles (with and without corrective lenses), face shields and hoods.

Eye and Face Wash Unit—A unit used to irrigate and flush both the face and eyes.

Eye Hazard Area or Task—A location or task where liquids, vapors, dust, particles, light, heat or other situations exist that require eye protective devices and extra precautions by personnel. Examples of eye hazards are splashes or mists from fuels, corrosive or toxic chemicals or other liquids; particles of metals from grinding, cutting or welding; dusts; and harmful levels of light from welding, ultraviolet, laser or other sources.

Eyewash Bottle—A squeeze type or plunger-actuated bottle that supplements permanent units, portable units or both.

Eyewash Unit—A unit used to irrigate and flush the eyes only.

Face Shield—A protective device worn in front of the eyes, covering a portion of, or all of, the face.

Facility Ground—A grounding system of 10 ohms or less that the entire third wire ground system, metal raceways, conduits, generators, transformers and other equipment within the facility are connected to.

Fail-Safe—A provision designed to automatically stop or safely control any motion if a malfunction occurs.

Field Check—A method of checking an instrument for a proper response in the field. It is a pass or fail functional check of the instrument. Also known as Bump Test.

Fence (Woodworking Machinery)—A device installed for the purpose of acting as a stop and guide for sawing materials. Also called a rip fence.

Fire Area—Any area of a building that is enclosed by fire-resistant partitions.

Fire Hydrant—A valved outlet connected to a water distribution system designed to permit the transfer of water from the water distribution system to a fire fighting vehicle or hose streams.

Fire Protection—Sprinkler systems and other firefighting or fire protection equipment or systems.

Fire Protection Authority—The senior individual assigned responsibility for managing the installation fire prevention and protection program or their authorized representative.

Fire Suppression System—A system which automatically or manually discharges fire extinguishing agent to suppress a fire.

Fixed Anchorage—A secure point of attachment, not part of the work surface, for droplines, lifelines or lanyards. An approved fixed anchorage shall be capable of supporting a minimum deadweight of 5,000 pounds (per person).

Fixed Ladder—means a ladder with rails or individual rungs that is permanently attached to a structure, building, or equipment. Fixed ladders include individual-rung ladders, but not ship stairs, step bolts, or manhole steps.

Flammable Liquid—A liquid having a flashpoint below 100o F (37.80o C) closed cup test and having a vapor pressure not exceeding 40 pounds psi at 100o F (37.80o C). Flammable liquids are categorized as Class 1 liquids and are further subdivided as follows:

– Class 1A have a flashpoint below 73 ^{o} F (22.8^{o} C) and boiling points below 100° F (37.8^{o} C).
– Class 1B have flashpoints below 73 ^{o} F (22.8^{o} C) and boiling points at or above 100° F (37.8^{o} C).
– Class 1C have flashpoints at or above 73° F (22.8^{o} C) and below 100° F (37.8^{o} C).

Flange—A collar, disk or plate used to hold an abrasive wheel in position on a rotating shaft.

Flashpoint—The minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid. Flightline—Any area or facility including aprons, hardstands and ramps on or in which aircraft may be parked, stored, service or maintained.

Flightline Fire Extinguisher—A wheeled portable fire extinguisher provided for the protection of aircraft. Included are various sizes of Halon 1211, carbon dioxide and dry chemical extinguishers.

Floor—The interior walking surface upon which machinery, aisles and passageways are located. This does not include platforms, walkways or catwalks.

Floor Opening—An opening measuring 12 inches or more in its least dimension in any floor, platform, pavement or yard, through which persons may fall; such as a hatchway, stair or ladder opening, pit or large manhole. Floor openings occupied by elevators, dumb waiters, conveyors, machinery or containers are excluded from this subpart.

Footwalk—A walkway with handrail, attached to a crane bridge or trolley for access purposes.

Free Fall Distance—The vertical displacement of the fall arrest attachment point on the employee's body harness between onset of the fall and just before the system begins to apply force to arrest the fall.

Functional Manager—The senior operating official at all levels exercising managerial control of an activity or operation. This individual usually can acquire and commit resources for the

abatement of occupational safety and health hazards. Functional managers are designated by MAJCOM, DRU, FOA or installment commanders.

Gauge Pressure—The pressure above or below local atmospheric pressure. Therefore, absolute pressure minus local atmospheric pressure equals gauge pressure. Gauge pressure is commonly designated by the abbreviation psig.

Goggle—A device that protects the eyes and eye sockets. They have contour-shaped eyecups or full facial contact, glass or plastic lenses and are held in place by a headband or other suitable means.

Graphics—Elements (words, emblems, colors, symbols and other visual devices) of a sign or tag used to convey a warning, caution, danger or serve as a notice of an existing or potential hazard.

Grounding Stick—A device used to ground electronic circuits and bleed off voltage or static electricity.

Grounding System—Complete ground circuit for any equipment, facility or system.

Guardrail—A protective railing built along exposed sides of stairs and platforms designed to prevent people or objects falling into an open space or stairwell. The top part of a guardrail can serve as a handrail.

Hand Chain Wheel—A wheel with formed pockets on its periphery to allow torque to be transmitted to the hoist when a force is applied to the hand chain.

Hand-Held Drench Hose—A flexible hose connected to a water supply and used to irrigate and flush eyes, face and body areas.

Hazard Identification—For the purpose of this standard, hazard identification refers to signs or tags that warn, caution or inform personnel of a hazardous situation.

Hazardous Atmosphere—An atmosphere presenting a potential for death, disablement, injury or acute illness from one or more of the following causes: a flammable gas, vapor or mist in excess of 10 percent of its lower explosive limit (LEL) or lower flammable limit (LFL); an airborne combustible dust at a concentration that meets or exceeds its LEL or LFL; atmospheric oxygen concentration below 19.5 percent or above 23.5 percent; an atmospheric concentration of any chemical substance greater than the occupational and environmental exposure limit (OEEL), which is capable of causing death, incapacitation, impairment of ability to self-rescue, injury or acute illness due to its health effects.

Hazardous Energy Control Program—A program consisting of energy control procedures, staff training and periodic inspections established before a staff member performs any servicing or maintenance on a machine or equipment where the unexpected energizing, start-up or release of stored energy could occur and cause injury. Prior to service, the machine or equipment shall be isolated from the energy source and rendered inoperative.

Hazardous Material—A substance that is explosive, flammable, poisonous, corrosive, oxidizing, irritating or otherwise harmful and may cause personal injury or harm.

Head Protection—A device worn to provide protection to workers when there is the potential for injury to the head from impact and penetration from flying, falling or stationary objects or limited electrical shock, heat or burn. Protection includes a suitable chinstrap and harness to secure the helmet to the head.

High Voltage—Any circuit, set of conductors or exposed point of contact in which the potential to ground or between conductors is greater than 600 volts nominal.

Hitch—A sling configuration whereby the sling is fastened to an object or load, either directly or around it.

– *Basket Hitch.* A sling configuration where the sling is passed under the load and has both ends, eyes or handles on the hook or single master link.
– *Choker Hitch.* A sling configuration with one end of the sling passing under the load and through an, handle or eye on the other end of the sling. Used for turning an object.
– *Vertical Hitch.* A method of supporting a load by a single vertical part or leg of the sling.

Hoist—Includes only those components furnished by the hoist manufacturer, such as drums tackle, prime movers, limiting device, mounting bases, etc. When hoists are mounted as integral parts of more complex lifting equipment, they become component parts of that equipment. They are subject to the safety standards and inspection intervals established for the end item.

Hoist Chain—The load bearing chain in a hoist.

Hook, Latch Type—A safety hook incorporating a device to bridge the hook throat opening and that requires manual movement to release the load from the hook.

Hot Work Permit—The written authorization to perform "hot work" operations such as welding, cutting, burning or heating that could provide a source of ignition.

Immediately Dangerous to Life or Health (IDLH)—Any condition that poses an immediate or delayed threat to life, that would cause immediate or delayed adverse health effects or that would interfere with a worker's ability to escape unaided from a permit-required space.

Inclined Ladder or "Ship's" Ladder"—A stairway installed at an angle greater than 50 degrees. All stairway criteria, except the angle of rise, applies to inclined ladders.

Inerting—Rendering the atmosphere of a confined space non-flammable, non-explosive or otherwise chemically non-reactive by displacing or diluting the original atmosphere with steam or a gas that is non-reactive with respect to the contents of the space. Nitrogen is a common inerting gas. Note: This procedure creates an IDLH oxygen-deficient atmosphere.

Insulated Aerial Device—An aerial device designed for work near energized electrical lines and apparatus.

Interlock—A device that prevents operation of the control that starts a machine in motion until a condition is met, such as the guard being in place.

Intrinsically Safe—As applied to equipment and wiring, equipment and wiring that are incapable of releasing sufficient electrical energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture.

Ionizing Radiation/Ionized Radiation—Electromagnetic or particulate radiation, which may cause ionization and damage within the cells or tissues of the body, and that has sufficient energy to produce direct ionization in passage through a substance. Examples of ionizing radiation are X-rays, gamma rays, alpha particles and beta particles.

Isolation—Positively preventing any unwanted form of energy (or other agent with a serious potential for hazard) from contacting a worker or operation through the use of blanking, double block and bleed or lockout and/or tagout.

Job Hazard Analysis (JHA)—A technique or procedure used by supervisors and workers that focuses on job tasks as a way to identify hazards before they occur. It focuses on the relationship between the worker, the task, the tools and the work environment. Ideally, after you identify uncontrolled hazards, you will take steps to eliminate or reduce them to an acceptable risk level. Specific documentation is required. The prescribing directives for conducting JHAs are AFI 91-202 and 29 CFR 1910.132.

Kickback—The tendency of blades and cutters to force material being cut or milled up and back toward the operator.

Ladder—means a device with rungs, steps, or cleats used to gain access to a different elevation.

Ladder Stand—A mobile fixed size, self-supporting ladder made up of a wide flat tread ladder in the form of stairs. The ladder stand may include handrails.

Lanyard—A flexible line used to secure a wearer of a body harness to a dropline, lifeline or fixed anchorage.

Lay—The linear distance for one strand to go completely around a rope.

Lifeline—A flexible line for connection to an anchorage connector at one end to hang vertically (vertical lifeline), or for connection to anchorages or anchorage connectors at both ends to span horizontally (horizontal lifeline).

Lift Section—A mechanism that will lift a section of crane trolley track out of alignment with a stationary track.

Limiting Device—A mechanical or electrical device designed to limit motion.

Limit Switch—A switch that is operated by some part of the hoist or equipment to limit travel of lifting option to prevent hoist or equipment damage.

Load Block (Lower)—The assembly of hook or shackle, swivel, sheaves, pins, bearings and frame suspended by the hoisting ropes or chains.

Load Block (Upper)—The assembly of hook or shackle, swivel, sheaves, pins and frame suspended from the boom point.

Load Rating—A rating in pounds established by the manufacturer as the maximum safe working load for an individual hoist, crane or related lifting equipment.

Load Test—Also called rated load test. A 100-percent to 125-percent test of the rated capacity (working load limit), as determined by type of equipment and designated by the manufacturer.

See individual chapters for applicable equipment—specific test procedures.

Load (Working)—The external load, in pounds applied to the crane, including the weight of load-attaching equipment such as load blocks, shackles, slings and ropes.

Lockout Device—A device that utilizes a lock and key to hold an energy isolating device in the safe position for the purpose of protecting personnel.

Low Lift Truck—A truck designed to raise a load sufficiently to permit horizontal movement. Examples are the low-lift platform truck and the pallet truck.

Lower Explosive Limit—The lowest concentration of flammable or combustible vapor, which can be ignited by a spark or flame (also referred to as "Lower Flammable Limit [LFL]" in industry).

Man-Rated—A crane specifically configured or designed and built for raising and lowering personnel in work cages or baskets, having a positive controlled powered lowering system, upper limit switch and dead-man controls.

Master Entry Plan—A written document, which must be reviewed annually by the Confined Space Program Team, that authorizes entry supervisors to issue entry permits. This document defines acceptable entry conditions for routine recurring entries into like spaces.

Maximum Intended Load—The total weight of all loads including the weight of workers, materials and scaffolding.

May—Indicates an acceptable or satisfactory method of accomplishment.

Midrail—A rail approximately midway between the guardrail and platform and secured to the uprights erected along the exposed sides and ends of platforms.

Military-Unique (Workplaces, Operations, Equipment and Systems)—Uniquely military equipment, systems, operations, or workplaces are excluded from the federal regulatory standards distributed by OSHA. However, the DoD Components must apply OSHA and other regulatory safety and health standards to uniquely military equipment, systems, operations, or workplaces, in whole or in part, as practicable. When military design, specifications, or deployment requirements render compliance with existing SOH standards infeasible or inappropriate, or when no standard exists for such military application, the DoD Components must apply risk management procedures. The results of the risk management decision must be communicated to all affected personnel.

Mishap Prevention Sign—A visual display made of some durable material (metal, wood, rigid plastic) intended to caution, warn or provide information.

Mishap Prevention Tag—A visual display, intended to caution or warn, made of materials that will withstand the environmental conditions expected in the workplace and are securely attached in an appropriate manner to ensure visibility, as close to the machine or equipment as possible.

Mobile Scaffold (Tower)—A light, medium or heavy duty scaffold that is mounted on casters or wheels.

Mobile Unit—A combination of an aerial device, its vehicle and related equipment.

Mobile Work Platform—A scaffold that provides a work level, one or more frames high, on casters or wheels, with bracing across or diagonally from the platform to the posts.

Motorized Hand Truck—A truck designed to be controlled by a walking operator.

National Consensus Standards—Select committees of federal, industrial and private sector personnel develop these standards under the sponsorship of one of the national standards-setting organizations, e.g., American National Standards Institute, National Fire Protection Association

and the American Society of Mechanical Engineers. National consensus standards are not directive, unless adopted by a regulatory federal agency or the Air Force.

Non-ionizing Radiation—Electromagnetic radiation that does not have sufficient energy to produce direct radiation when passing through a substance. Examples include radiofrequency (RF) radiation, visible light, infrared and ultraviolet.

Nonmilitary-Unique (Workplaces and Operations)—DoD military and civilian workplaces and operations that are comparable generally to those of the private sector. Examples include facilities involved and work performed in the repair and overhaul of weapons, aircraft or vehicles (except for equipment trials); construction; supply services; civil engineer or public works; medical services; and office work.

Non-Permit Confined Space—A space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazards capable of causing death or serious physical harm.

Nose, Nosing—The portion of a tread projecting beyond the face and the riser immediately below.

Notice of Hazard—A written warning of a condition, procedure or practice that constitutes an occupational hazard. As used in the context of this standard, Notice of Hazard refers to AF Form 1118.

Nuclear—Certified Equipment—Hoists and related lifting equipment approved for use with nuclear weapons as listed in TO 00-110N-16, Equipment Authorized for Use with Nuclear Weapons. The Air Force single point of contact for nuclear certification of lifting equipment is HQ AFSEC/SEWE. This office establishes the equipment as certified and ensures the equipment is listed in the MNCL (https://www.mil.nwd.kirtland.af.mil.mncl).

Occupational and Environmental Exposure Limit—The most appropriate limit adopted from established recognized standards including, but not limited to, those in AFIs and AFOSH Standards, the latest edition of the TLV® Booklet published annually by the American Conference of Governmental Industrial Hygienists, 29 CFR 1910.1000 Tables Z-1, Z-2 and Z-3, and 40 CFR 141. Occupational and environmental exposure limits are limits of exposure established to protect personnel from hazardous occupational and environmental health threat exposures. Occupational and environmental exposure limits s apply to occupational and environmental health threat exposures for individuals and/or similarly exposed groups of individuals.

Open Riser—The air space between the treads of stairs.

Operational Test—A test of mechanical and electrical controls, limit switches and safety devices through the complete operational range without a load.

Operator's Station—Location at which actuators are placed for the purpose of starting, stopping, reversing or otherwise controlling the conveyor or system of conveyors during normal operation.

Outriggers—Extendible or fixed metal arms, attached to the mounting base, which rest on supports at the outer ends.

Overload Device—A mechanical or electrical device designed to disconnect the driven equipment from the motive power in the event of an overload on the conveyor.

Oxygen-Deficient Atmosphere—An atmosphere containing less than 19.5 percent oxygen by volume.

Oxygen-Enriched Atmosphere—An atmosphere containing more than 23.5 percent oxygen by volume.

Pallet—A low portable platform of wood, metal, or fiberboard used to stack, move, store and transport supplies as a unit.

Pawl (Dog)—A device for positively holding the mechanism, drum, etc., against undesired rotation.

Pendant Station—Controls suspended from the hoist for operating the unit from the floor or portable "plug-in" pendant controls.

Permit—Required Confined Space—A confined space that has one or more of the following characteristics: contains or has a potential to contain a hazardous atmosphere, contains a material that has the potential for engulfing the entrant, has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section, or contains any other recognized serious safety or health hazard. Note: Also see Table 23.1.

Permit—Required Confined Space Program—The overall written program an organization develops for controlling and protecting workers from permit space hazards and for regulating entries into permit spaces.

Personal Fall Arrest System—An assembly of components and subsystems used to arrest a person in a fall from a working height.

Phase Change—The passing of a substance from one phase (state) to another (liquid to gas, solid to liquid, etc.).

Pinch Point—Any point other than the point of operation where it is possible for a person's body or clothing to be caught between moving parts.

Piping Systems—Any pipes or conduit used for conveying gases, liquids or semi-liquids, except those carrying solids in air or gas.

Pitch—The angle at which the fixed ladder is inclined against a structure or piece of equipment.

Plano—A lens that does not incorporate correction.

Platform—A walking or working surface elevated above the surrounding floor or ground (such as a balcony or landing) or a personnel carrying device (basket or bucket), which is a component of a mobile unit.

Point of Operation—The areas of a machine where cutting, shearing, forming, assembly, etc., takes place.

Portable Fire Extinguishers—Manually operated, hand-held or wheeled extinguishers containing a fire extinguishing agent with a means to discharge the agent and direct it onto a fire. Portable Ladder—means a ladder that can readily be moved or carried, and usually consists of side rails joined at intervals by steps, rungs, or cleats.

Powder-Actuated Tools—Tools, such as ramsets, where cartridge-type explosives are the source of power.

Pressure Regulator—A pressure and/or temperature activated device used to prevent the pressure from rising above a predetermined maximum, thereby preventing rupture of a normally charged cylinder when subjected to a standard fire test.

Primary Warning Color—This color appears as a circular band on piping systems and identifies a material which is classified by its primary hazard.

Prohibited Condition—Any set of conditions in a permit space where the hazard potential exceeds the limits authorized by the entry permit.

Proof Test—A nondestructive tension test performed by the manufacturer or qualified person to verify construction and workmanship of a lifting device. See individual chapters for applicable equipment-specific test procedures.

Proximity Warning Device—A device installed on booms that alerts or warns the operator when the boom is in proximity to energized electric power lines.

Pushbutton Station—An electrical control device consisting of pushbutton operated contacts in an enclosure used by the operator for control of the powered motions of the crane, hoist and other auxiliary equipment.

Push Stick—A strip of wood with a notch cut into one end that is used to push short lengths of material through saws or other cutting operations.

Qualified Person—A person who by possession of a recognized degree, certificate or professional standing, or who by extensive knowledge, training and experience, successfully demonstrated the ability to solve/resolve problems relating to the subject matter, the work or the project.

Rail Clamp—An attachment or device for clamping movable equipment to the rail to hold it in a fixed location.

Rail Stop—A stop mounted at the ends of conveyor rails to limit the travel of traversing machinery.

Rated Line Voltage—The manufacturer's recommended safe working line voltage.

Rated Load—Sometimes called rated capacity or working load limit. The maximum working load, as designated by the manufacturer, for which a crane, individual hoist or related hoisting equipment is designed and built. Note: HQ AFSEC/SEW establishes rated load for nuclear-certified hoists.

Rated Load Test—Also called load test. A 100-percent to 125-percent test of the rated capacity (working load limit), as determined by type of equipment and designated by the manufacturer. See individual chapters for applicable equipment-specific test procedures.

Reach Truck—A self-loading truck, generally high-lift, having load-engaging means mounted so it can be extended horizontally forward. This permits a load to be picked up and deposited in the extended position and transported in the retracted position.

Real Property Installed Equipment—Installed equipment attached to and made part of buildings and structures (such as heating systems), but not movable equipment (such as plant equipment).

Reciprocating Conveyor—Any conveyor that progressively advances material by a back and forth motion of its conveying medium. It may be equipped with hinged flights or tilting dogs or pushers.

Reeving—A system in which a rope or chain travels around drums, sheaves or sprockets.

Remote Control—A control station or any system of controls in which the actuator is situated in a remote location and is not mechanically attached to the device being controlled.

Remote Location—Emergency care that is more than three to four minutes from the workplace.

Rescue Team—A group of two or more personnel typically designated and trained by an organization to perform rescues from confined spaces within that organization.

Retrieval Line—A line or rope secured at one end to a worker's full harness or wristlets, with the other end secured to a lifting or other retrieval device. The retrieval line shall be used to remove an unconscious entrant from a confined space.

Rise—The vertical distance from the top of a tread to the top of the next higher tread.

Riser—The upright part of a step at the back of a lower tread and near the leading edge of the next higher tread.

Rope Grab—A deceleration device that travels on a lifeline and automatically engages the lifeline and locks so as to arrest a fall. A rope grab usually employs the principle of inertial locking, cam or lever locking or both.

Runner (Scaffolding)—The lengthwise horizontal bracing or bearing members.

Runway—The track and supports (rails, beams, girders, brackets and framework) system upon which the crane or trolley travels.

Runway (Catwalk)—A passageway for persons, elevated above the floor or ground level, such as a foot walk along shafting or a walkway between buildings. It is sometimes called a catwalk.

Safety Data Sheet (SDS)—Electronic, written or printed information on hazardous material prepared IAW 29 CFR 1910.1200, Hazard Communication.

Safety Device—A mechanism or an arrangement used to prevent an unsafe condition, preventing continuation of an unsafe condition, warning of an unsafe condition or limiting or eliminating unsafe effects of a possible condition.

Safety Observer—A worker trained in CPR and qualified to operate the equipment in use. Responsible for placing equipment in safe/neutral mode and administer immediate assistance to a technician in the event of an emergency. The safety observer may be the supervisor.

Scaffold—Any temporary raised platform and all the necessary vertical, diagonal and horizontal parts used for supporting workers and materials or both. Also known as a Scaffold Tower.

Secondary Warning Color—This color appears as arrows (or triangles) on piping systems and identifies a material with a second hazard distinctly different from that indicated by its primary color.

Sectional Ladder—A non-self-supporting portable ladder, nonadjustable in length, consisting of two (2) or more sections constructed so it functions as a single ladder. Its size is designated by the overall length of the assembled sections.

Seizing—The cord, tape or wire wrapped around a rope to prevent it from unraveling when it is cut in two.

Self-Retracting Lifeline and/or Lanyard—A deceleration device which contains a drum-wound line which may be slowly extracted from, or retracted onto, the drum under slight tension during normal worker movement and that, after onset of a fall, automatically locks the drum and arrests the fall.

Selvage Edge—The finished edge of synthetic webbing designed to prevent unraveling.

Service, Normal—That service that involves operation of cranes and hoists with randomly distributed loads within the rated load limit, or with uniform loads less than 65 percent of rated load, for no more than 15 percent of the time of a single work shift for manually operated cranes and hoists, and 25 percent of the time of a single work shift for electric- or air-powered cranes and hoists.

Service, Heavy—That service that involves operation of cranes and hoists within the rated load limit that exceeds normal service.

Service, Severe—That service that involves normal or heavy service of cranes and hoists with abnormal environmental conditions, such as excessively high or low ambient temperatures, exposure to adverse weather, corrosive fumes, dust-laden or moisture-laden atmospheres and hazardous locations.

Shall—Indicates a mandatory requirement.

Sheave—A grooved wheel or pulley used with a rope to change direction and point of application of a pulling force.

– *Sheave, Non-running.* A sheave used to equalize tension in two (2) parts of the rope. Because of its slight movement, it is not termed a running sheave.
– *Sheave, Running.* A sheave that rotates as the load block is raised or lowered.

Should—Indicates a preferred method of accomplishment.

Side Loader—A truck, generally a high-lift, having a load engaging means mounted so it can be extended laterally to permit a load to be picked up and deposited in the extended position and transported in the retracted position.

Side Shield—A device of metal or plastic (or both) or other material, hinged or fixed firmly to the spectacle to protect the eye from side exposure.

Snagging—Grinding that removes relatively large amounts of material without regard to close tolerances or surface finish requirements.

Span-Gas Test—Test required to allow atmospheric monitoring equipment to adjust its sensors and/or to check alarms against a known concentration of gases, accomplished daily or prior to each use.

Spectacle, Safety—A device patterned after conventional type spectacle eyewear but of more substantial construction. They may be equipped with side shields. The lenses can be plano- or corrective-protective. They may be made of clear or absorptive filter glass or plastic. Also called Safety Glasses.

Spindle—A rotating or fixed shaft-like member mounted in bearings and connected to the drive mechanism. A device for holding the work piece or a cutting tool is mounted on one or both ends.

Spreader—A curved piece of steel mounted behind a saw blade that prevents internal stresses within wood from clamping down on the saw blade.

Sprocket—A wheel with suitably shaped and spaced cogs or teeth to engage with the links of a chain.

Sprocket, Load—The hoist component that transmits motion to the load chain. Component is sometimes called load wheel, load sheave or chain wheel.

Stairs—A series of steps and landings with three or more risers. Stairs may lead users from one level or floor to another, to platforms, pits, boiler rooms or crossovers, or around machinery, tanks and other equipment.

Standby Crane—A crane not in regular service but that is used occasionally or intermittently as required.

Standing (Guy) Rope—A supporting rope that maintains a constant distance between the points of attachment to the two (2) components connected by the rope.

Step—The crosspiece of a ladder on which a person may step, also called a rung or a cleat. Also means a combination of risers or treads that may be part of a stair.

Stepladder—means a self-supporting, portable ladder that has a fixed height, flat steps, and a hinged back.

Stepstool—means a self-supporting, portable ladder that has flat steps and side rails. For purposes of the final rule, stepstool includes only those ladders that have a fixed height, do not have a pail shelf, and do not exceed 32 inches (81 cm) in overall height to the top cap, although side rails may extend above the top cap. A stepstool is designed so an employee can climb and stand on all of the steps and the top cap.

Stroboscopic Effect—The potential for fluorescent lighting to create the appearance that moving, rotating or vibrating objects are stationary.

Stop—A device to limit travel of a trolley or crane bridge or moving part of other equipment. This device normally is attached to a fixed structure and does not have energy absorbing ability.

Stop Switch, Emergency—A manually or automatically operated switch to cut off electric power independently of the regular operating controls.

Straddle Lift Truck—A general class of lift truck designed for picking up and hauling loads between its outrigger arms.

Stripper—A device that aids the load chain in leaving the load sprocket.

Superstructure—The rotating upper frame structure of a crane or other machine and the operating machinery mounted thereon.

Swing—Rotation of the crane or other machine superstructure for movement of loads in a horizontal direction about the axis of rotation. A control device for making, breaking or changing connections in an electric circuit. Any device for connecting two (2) or more continuous package conveyor lines. A mechanism that transfers a trolley, carrier or truck from one track to another at a converging or diverging section.

Switch, Limit—A switch operated by some part or motion of a power-driven machine or equipment to alter power to the machine. The purpose is generally to limit the travel of a machine or equipment component.

Switch, Main—A switch controlling the entire power supplied to a system.

Switch, Track—A device with a section of track that can be moved to permit passage of a carrier from an incoming track to one of various outgoing tracks.

System Safety Engineering Analysis—Evaluates and approves new operations previously prohibited due to the perceived risks. A team of engineers (AFMC) conducts actual demonstrations and analysis of the operation to validate overall risk assessment and recommend actions. Past examples include hot pit refueling, integrated combat turn around (ICT) and concurrent servicing.

Tag Line—A rope or cable used to prevent a load from swinging or rotating.

Tagout Device—A mishap prevention tag that is capable of being securely attached and that, to protect personnel, forbids operation of an energy isolating device and identifies the applying individual or authority who has control of the procedure.

Test load—The specific load applied in performance of the load test.

Tiering—The process of placing one load on or above another.

Tread—The horizontal part of a step. An assembly of wheels, bearings and brackets used for supporting and moving suspended loads or for carrying load connecting and conveying elements such as chain, cable or other linkage. The unit carrying the hoist mechanism that travels on overhead bridge rails. A frame on which a pair of load carrying wheels is mounted.

Truck Crane—A crane consisting of a rotating superstructure with power plant, operating machinery and boom mounted on an automotive truck equipped with a power plant for travel. Some variations use a single engine in the truck which also powers the superstructure, or a single engine in the superstructure which also powers the truck.

Tube and Coupler Scaffold—A scaffold that is made up of tubing used as posts, bearers, braces, ties, runners, base supporting posts and uprights that serve to join the various members. This type of scaffold is normally used in fixed locations.

Tubular Welded Frame Scaffold—A sectional, panel or frame metal scaffold mainly built of prefabricated welded sections. This scaffold consists of posts and bearers with connecting parts and is braced with diagonal or cross braces.

Turntable—A track device with a movable liner frame containing a straight section of track which can be rotated with a load carrier on it to align the section of track with other tracks for the transfer of carriers from one track to another.

Two-Blocking—When the lower load block comes in contact with the upper load block or boom point can cause lifting cable to break and drop load.

Valve Protection Cap—A rigid removable cover provided for cylinder/container valve protection during handling, transportation and storage.

Warehouse Tractor or Tug—An industrial vehicle designed to draw one or more non-powered trailers.

Welding, Cutting and Brazing Permit (AF Form 592)—The written authorization to perform "hot work" operations such as riveting, welding, cutting, burning or heating that could provide a source of ignition.

Wire Rope—A rope composed of steel wires, strands and a core. The individual wires are cold drawn to predetermined size and breaking loads according to use. They are then helically laid or formed around the core, which may be sisal or synthetic fiber, a metallic strand or an independent wire rope. The size, number and arrangement of wires; and the number of strands, the lay and the type of core in a rope are determined by the service for which the rope is to be used.

Work Level—A raised platform, used for supporting workers and their materials, made up of the necessary vertical, horizontal and diagonal braces, guardrails and ladder for access to the work platform.