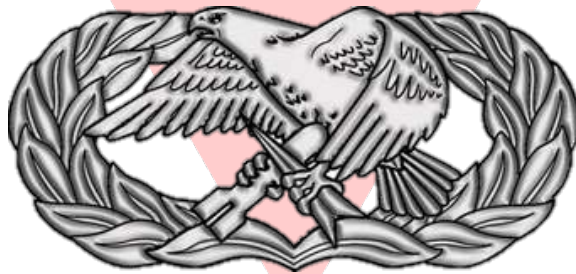


CDC 2A653

Aircrew Egress Systems Journeyman

Volume 1. Career Field Fundamentals



Air Force Career Development Academy

Air University

Air Education and Training Command

2A653 01 1902, Edit Code 6

AFSC 2A653

Author: MSgt Aaron Schmidt
361st Training Squadron
US Air Force Technical Training School
361 TRS/TRR
501 Missile Road
Sheppard Air Force Base, Texas, 76311–2264
DSN: 736-1402
E-mail address: 361TRSCDCWriters@us.af.mil

Instructional Systems

Specialist: Evangeline K. Walmsley

Editor: Catherine Parker

Air Force Career Development Academy (AFCDA)
Air University (AETC)
Maxwell-Gunter Air Force Base, Alabama 36114–3107

CAREER DEVELOPMENT COURSES (CDC) provide the knowledge you need to progress up your career-field ladder with a minimum of direction and assistance from your supervisor. They also provide information, explanations, illustrations, and problem exercises designed to teach you what you need to know about certain critical tasks common to egress.

CDC 2A653 consists of two volumes. As you progress through the volumes, you'll acquire the knowledge needed to become an egress journeyman. Volume 1 outlines the organizational structure of the wing and maintenance community with a concentration on the egress section. Volume 1 includes career field specific safety training, technical orders, tools, and support equipment.

In Volume 2, you will gain vital knowledge on aircraft hardware and time change components, common forms used in the egress section and the maintenance data collection systems, specifically IMDS (Integrated Maintenance Data System). Lastly, you will expand the knowledge you gained in technical school about the advanced concept ejection seat (ACES) II and be introduced to the Martin Baker Mk-16 ejection seat.

Upon satisfactory completion of this course and upgrade to the 5-skill level, you'll also use this CDC to prepare for the specialty knowledge test portion of the Weighted Airman Promotion System (WAPS) tests. If you are using this CDC (edit code 6) to study for WAPS and you did not use this edit code for upgrade training, please be aware that this revision deleted some material not required by the Career Field, Education Training Plan (CFETP) and also added some material which was missing. Several sections have been dramatically updated. Also, the amount of volumes have been pared down from five to two.

This is volume 1, *Career Field Fundamentals*. There are four units in volume 1.

Unit 1 covers wing and maintenance group structure, expanding on the knowledge you gained in basic training and during your time at Sheppard Air Force Base while you were attending technical training.

Unit 2 explains the Air Force occupational and environmental safety, fire protection, and health (AFOSH) program and the hazards of the egress career field. It also covers the explosive safety and nuclear surety programs and offers insight into how these programs affect you.

Unit 3 deals with technical orders (TO). The intent of this unit is to give you a better understanding of the TO system and of how to locate and select the TOs you need. This information is critical to your daily job performance.

Unit 4 explores the tools you'll use to perform duties as an egress journeyman from common hand tools to special tools such as torque wrenches. It also covers support equipment such as slings and aerospace ground equipment (AGE) like cranes, stands, and generators.

A glossary of abbreviations and acronyms used in this volume is included for your use.

Code numbers on figures are for preparing agency identification only.

The use of a name of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

To get a response to your questions concerning subject matter in this course, or to point out technical errors in the text, unit review exercises, or course examination, call or write the author using the contact information provided in this volume.

NOTE: Do not use Air Force Instruction (AFI) 38-402, *Airmen Powered by Innovation and Suggestion Program*, to submit corrections for printing or typographical errors. For Air National Guard (ANG) members, do not use Air National Guard Instruction (ANGI) 38-401, *Suggestion Program*.

If you have questions that your supervisor, training manager, or education/training office cannot answer regarding course enrollment, course material, or administrative issues, please contact Air University Educational Support Services at <http://www.aueducationsupport.com>. Be sure your request includes your name, the last four digits of your social security number, address, and course/volume number.

This volume is valued at 16 hours and 4 points.

NOTE:

In this volume, the subject matter is divided into self-contained units. A unit menu begins each unit, identifying the lesson headings and numbers. After reading the unit menu page and unit introduction, study the section, answer the self-test questions, and compare your answers with those given at the end of the unit. Then complete the unit review exercises.

	<i>Page</i>
Unit 1. Organizational Structure.....	1-1
1-1. Wing and Group Structure	1-2
1-2. Maintenance Complex Structure.....	1-11
Unit 2. Safety	2-1
2-1. Air Force Occupational and Environmental Safety, Fire Protection, and Health	2-1
2-2. Hazards of the Egress Air Force Specialty.....	2-17
2-3. Explosives Safety Program	2-33
2-4. Nuclear Surety Program.....	2-41
Unit 3. USAF Technical Order System	3-1
3-1. Technical Order System	3-2
3-2. Maintenance Assistance and Improvement Reports	3-20
Unit 4. Tools, Support Equipment and Aircraft Hardware.....	4-1
4-1. Hand Tools and Composite Tool Kits.....	4-1
4-2. Special Tools and Test Equipment.....	4-15
4-3. Support Equipment and Aerospace Ground Equipment	4-29
 <i>Glossary.....</i>	 <i>G-1</i>

Please read the menu for Unit 1 and begin ➡

Unit 1. Organizational Structure

1-1. Wing and Group Structure.....	1-2
001. Wing structure	1-2
002. Responsibilities of the maintenance and operations groups	1-3
1-2. Maintenance Complex Structure	1-11
003. Quality assurance	1-11
004. Maintenance squadrons	1-13
005. Egress section	1-16

CONGRATULATIONS! ENROLLING IN this career development course (CDC) is an important step towards becoming a successful egress systems journeyman.

No doubt since day one in basic training, you have had some extensive training about the command structure of the Air Force. As you live it, you will gain a much better understanding of how the structure is shaped and who does what and why. This extensive knowledge is gained only through the experiences you will have as you progress up the career ladder. For your first lesson, you will learn about the management dealing specifically with aircraft maintenance. All maintenance personnel need to be aware of the concepts and procedures of maintenance management. Like any large company, the maintenance complex must show a “profit.” Industry shows a profit by ensuring that costs do not outweigh sales. A company must plan and schedule its resources wisely to ensure a good profit margin.

In a like manner, the maintenance complex must show a profit. This profit is not sales but mission accomplishment. Mission accomplishment is twofold: each aircraft must be available to meet its assigned mission, and maintenance must be done on a timely and cost-effective basis. In an aircraft unit, production strength is based on a demand determined by the major command (MAJCOM).

MAJCOMs give each wing a flying requirement for the coming quarter. This is called the quarterly flying hour allocation. These quarterly allocations are based on, but not limited to, three major planning factors:

- Future training requirements forecasted by base operations.
- Number of aircraft assigned and available in your unit.
- Your unit’s aircraft status report that has been reported to MAJCOM.

The maintenance group commander (MXG/CC) must review the quarterly flying hour allocation and agree to the extent to which it can be supported. If the maintenance group (MXG) cannot support the quarterly flying hour allocation, unit funds can be reduced. A reduction in funds makes it difficult to fix airplanes. As you can see, our war readiness capability, mission capability, operational scheduling, and effectiveness rates measure our profit. This is why we must stick to the monthly maintenance and flying schedules that we make.

Have you noticed that maintenance sometimes removes a part from a serviceable aircraft and installs it on a broken or grounded aircraft that is scheduled to fly? By repairing one broken aircraft and flying it, we can reduce our flying deviations and make the planned maintenance actions on time. Such actions increase our profits.

Some maintenance actions are planned-in-advance, based on the average hours an aircraft flies per day. For example, if the quarterly allocation is 1,456 flying hours for 20 F-15s over the months of January, February, and March (91 days), then one F-15 must fly an average of 0.8 hour per day (1,459 hours divided by 20 F-15s divided by 91 days = 0.8 hour per day). However, if an F-15 has 12 flying hours allocated before the next inspection and it flies 0.8 hour per day, then it will be due for an

inspection in 15 days (12 flying hours remaining divided by 0.8 hour per day = 15 days). Usually, scheduled maintenance actions are identified 90 days in advance. Therefore, a few missed sorties on the same aircraft can cause the inspection to be slipped to a later date and another aircraft to go into inspection earlier. This could cause two aircraft to be due for inspection at the same time and upset the maintenance plan. A disruption in the maintenance plan decreases the effectiveness of maintenance scheduling, affects the flying plan, and thus causes a reduction in our profits.

In this unit, you will study basic maintenance management concepts, define the responsibilities within the maintenance complex, and discuss the different organizational structures of aircraft maintenance that you will interact with as an egress maintainer, and lastly you will learn about the role the egress section has in the maintenance community.

1-1. Wing and Group Structure

To fully comprehend your duties as an egress journeyman, you must understand where you fit in the organizational structure. There are many levels of command in the Air Force, but for the purposes of this lesson, we'll start at the wing level and work our way down to the two groups that you'll need to be familiar with: the MXG and the operations group (OG).

001. Wing structure

The Air Force holds wing commanders responsible and accountable for mission results. Therefore, the commanders of the groups in the wing focus their energies on applicable core competencies that need to be met in order to meet mission objectives.

The wing is a level of command below a numbered Air Force (NAF), which is an administrative level of command below a MAJCOM. A wing is responsible for maintaining the installation and may have several squadrons in more than one dependent group. The different types of wings are operational, air base, or specialized mission.

Operational wing

An operational wing is one that has an operations group and related operational mission activity assigned. When an operational wing performs the primary mission of the base, it usually maintains and operates the base. In addition, an operational wing is capable of self-support in functional areas such as maintenance and munitions, as needed. When an operational wing is a tenant organization, the host command provides it with varying degrees of base and logistics support. As an egress journeyman, you are a member of an operational wing. Figure 1-1 shows the organization of an operational wing with a missions support group and a medical group assigned to it. Your base may also include an air base wing; in which case, the operational wing only consists of an operations and maintenance group. We discuss these two groups in the next section.

Air base wing

An air base wing performs support functions rather than an operational mission. This type of wing maintains and operates a base. An air base wing often provides functional support to MAJCOM headquarters.

Specialized mission wing

A specialized mission wing performs a specialized mission, and usually does not have aircraft or missiles assigned. An example of a specialized mission wing is the training wing you were assigned to in technical school. A specialized mission wing may be a host or a tenant wing, depending on whether or not it maintains and operates the base.

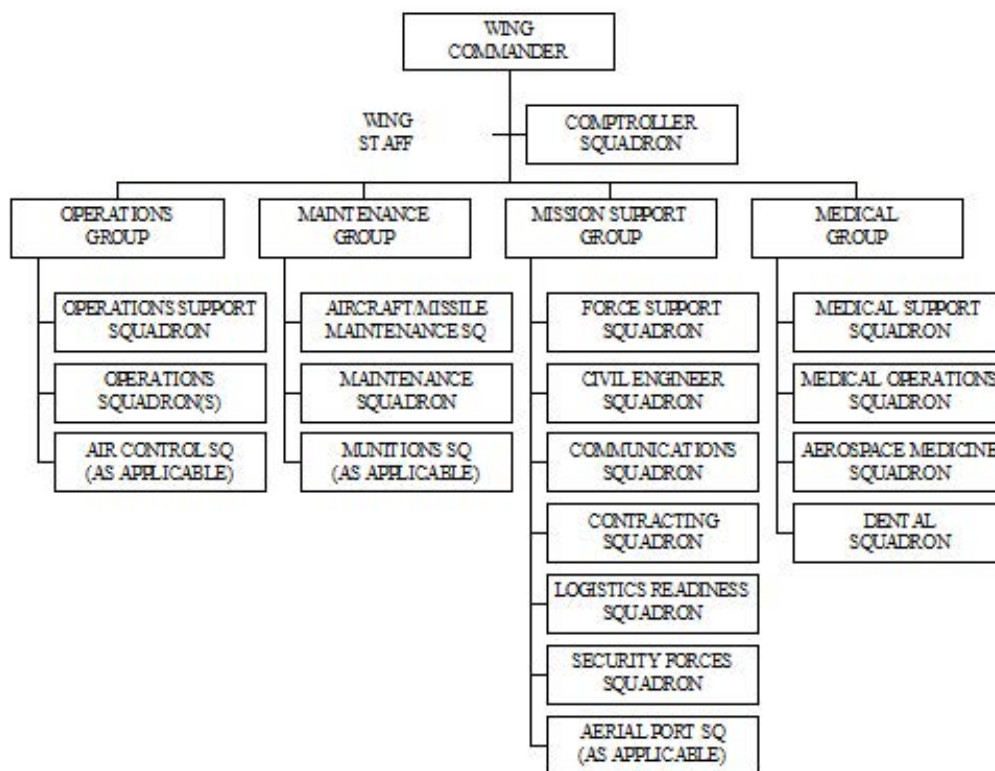


Figure 1-1. Operational wing organization structure.

002. Responsibilities of the maintenance and operations groups

As previously stated, there are two groups in an operational wing that you need to know about as an egress journeyman. The first is the MXG, of which you are a member. The second is the OG, our customers. Before we can discuss these two groups, you first need to know what a group is.

Group

A group is the next level of command below the wing. A group is a tactical echelon with minimal staff support. A group usually has two or more subordinate units. A dependent group is a mission, logistics, support, medical or large functional unit (e.g., a civil engineer group). These groups may possess small supporting staff elements, including standardization and evaluation or quality control; these are organized as sections. An independent group has the same functions and responsibilities as a like-type wing, but its scope and size do not warrant wing-level designation.

Maintenance group

The MXG is responsible for the maintenance of air and space weapon systems (fig. 1-2). Because of the cost of replacing aging aircraft with newer, more advanced aircraft, more attention to the balance of sortie production and maintenance downtime is necessary. To maintain a proper balance and get the most out of our resources, we must employ maintenance professionals with the greatest skills and proficiency possible. The MXG (to which you belong) includes maintenance operations, the aircraft maintenance squadron (AMXS), a maintenance squadron (MXS) or component maintenance squadron (CMS) and equipment maintenance squadron (EMS), and the munitions squadron (MUNS) when applicable.

A MXG also contains quality assurance (QA). QA is a section you will become very familiar with as an egress journeyman. QA is the primary technical advisory agency for maintenance; they help

production supervisors and the MXG commander resolve quality problems. They evaluate and analyze deficiencies and problem areas to identify underlying causes and recommend corrective actions.

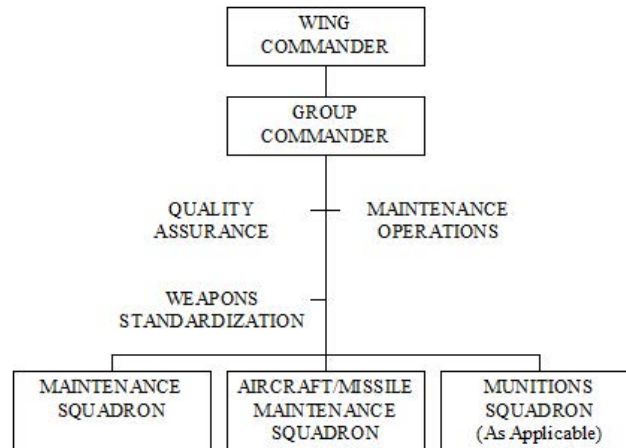


Figure 1-2. Maintenance group structure.

MXG/CC's responsibilities

The MXG/CC is responsible for equipment maintenance required to ensure balance between sortie production and fleet management. The total production effort and management of group maintenance functions are part of the group commander's responsibilities. The MXG/CC's responsibilities include, but are not limited to, the following list:

1. Ensure maintenance is performed only by personnel who are trained, qualified, and certified, unless under the direct supervision of a trainer or certifier.
2. Ensure strict adherence to technical data and management procedures.
3. Ensure standardization of maintenance discipline, procedures, organizational structures, compliance, and management philosophy.
4. Ensure aircraft maintenance data is accurate by establishing and supporting a data integrity team (DIT). This team is not required in contract and civil service organizations unless specified in the statement of work (SOW), performance work statement (PWS) or performance requirements statement (PRS). They ensure members assigned to the DIT are qualified and provided sufficient time to assess the data accurately. In addition, they ensure each aircraft maintenance work center performs a review of all documentation entered into the Integrated Maintenance Data System-Computer Database (IMDS-CDB)/G081 daily in accordance with Technical Order (TO) 00-20-2, *Maintenance Data Documentation*.
5. Ensure activity inspections (if established) are conducted in accordance with Air Force Instruction [\(AFI 21-101, Aircraft and Equipment Maintenance Management](#), and lead command guidance.
6. Approve and publish in-process inspection (IPI) listings every two years.
7. Ensure the maintenance standardization and evaluation program (MSEP) requirements are implemented in accordance with (IAW) AFI 21-101.
8. Ensure effective management of the MXG's total maintenance training program. Ensure maintenance training is accomplished according to the published (monthly) training plan. Provide aircraft, personnel, facilities and equipment to support the maintenance training program.

9. Ensure TOs are managed IAW TO 00-5-1, *AF Technical Order System*.
10. Use all personnel assigned to maintenance to accomplish critical maintenance tasks before releasing them for nonmaintenance duties.
11. Accomplish quarterly reviews of maintenance limiting factors (LIMFAC), shortfalls, and simulation requests.
12. Ensure the egress section safes all static display aircraft according to 00-80-series and weapon system technical orders.

Maintenance operations responsibilities

Maintenance operations are directly responsible to the MXG/CC for the administration, analysis, training management, and programs and resources necessary to support the group production effort and resides on the MXG headquarters staff. The planning, controlling, scheduling, and executing responsibilities of the MXG/CC are met through the actions of these functions. Figure 1-3 shows how maintenance operations is structured, and it is comprised of the following sections:

- Maintenance operations center (MOC).
- Engine management.
- Maintenance supply liaison (MSL).
- Plans, scheduling and documentation (PS&D).
- Maintenance data systems analysis.
- Maintenance training.
- Programs and resources.

MOC

As an egress journeyman, you deal with the MOC on an almost daily basis, as you call them on the radio to report estimated times of completion and report when your jobs are complete. The MOC also relays important information to you such as jobs to do, aircraft location, and lightning warnings.

Plans, scheduling and documentation

You deal with PS&D when a time compliance technical order (TCTO) needs to be coordinated and to schedule explosive time changes and other scheduled egress maintenance.

Maintenance training section

The maintenance training section directs, monitors, and schedules training for all group personnel. They coordinate egress familiarization training for flightline personnel with your shop.

Programs and resources section

The programs and resources section provides management of programs and resources such as deployment, support plans and agreements, facilities, budget, commercial contracts, manpower, communications and status of resources and training (SORTS) reporting for the MXG.

AMXS responsibilities

An AMXS services, inspects, maintains, launches, and recovers assigned and transient aircraft. It is organized (fig. 1-3) and is composed of the following:

- Maintenance supervision.
- Debrief.
- Aircraft maintenance units (AMU).
- Aircraft support flights.

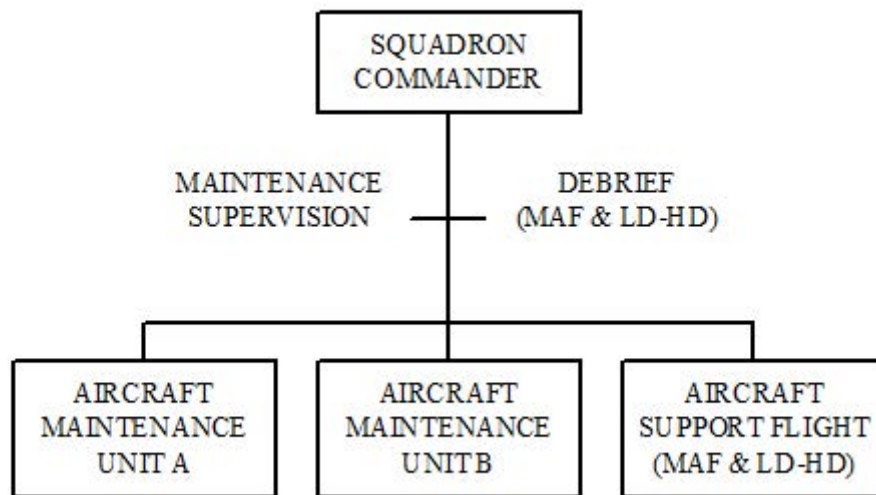


Figure 1-3. AMXS organization structure.

Maintenance supervision

Maintenance supervision is responsible for overall management and supervision of daily maintenance activities. When you become a shift supervisor, you may deal directly with an AMXS production supervisor from maintenance supervision. Ideally, you want to deal directly with your maintenance squadron production supervisor and let them coordinate maintenance activities with the other squadrons.

Debrief

Debrief tracks discrepancies, deviations, utilization, and applicable flight data for each aircraft at the termination of sorties/missions.

AMU

AMUs are responsible for servicing, inspecting, maintaining, launching, and recovering assigned aircraft and ensuring all mobility requirements are met. There should be one AMU for each supported operations squadron, but MAJCOMs have the option to organize an AMU to support multiple flying squadrons.

Aircraft support flight

An aircraft support flight provides support to flightline maintenance and generation activities. Their roles include maintaining technical orders, hazardous material, and benchstocks.

MXS responsibilities

As an egress technician, the MXS is the type of squadron you most likely will belong to as this squadron typically includes the egress section. An exception would be if you are assigned to an AMU as part of a test program on a new aircraft. If an MXS exceeds 700 personnel authorizations, commands may establish two squadrons. If two MXSs are needed, they must be designated the EMS (fig. 1-5) and the CMS (fig. 1-6). If the squadrons are split, your egress shop will be a part of the CMS. A typical MXS organization is shown in figure 1-4.

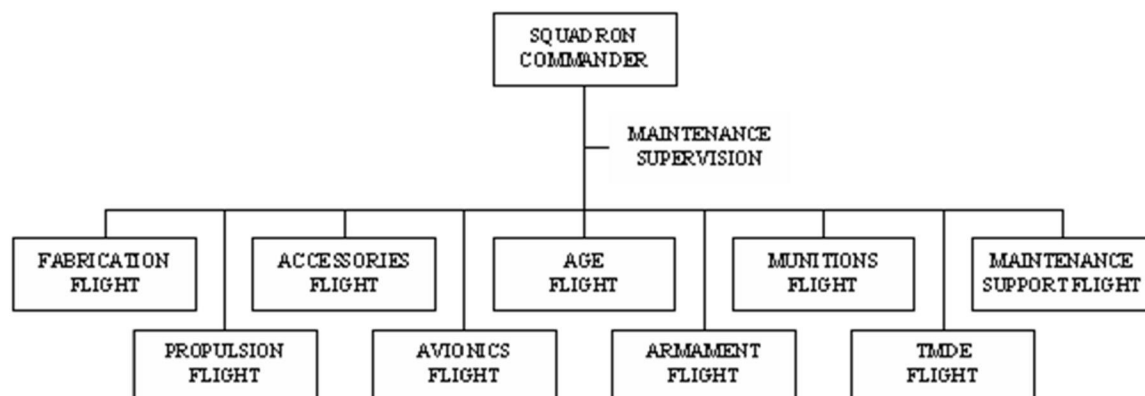


Figure 1-4. MXS organization structure.

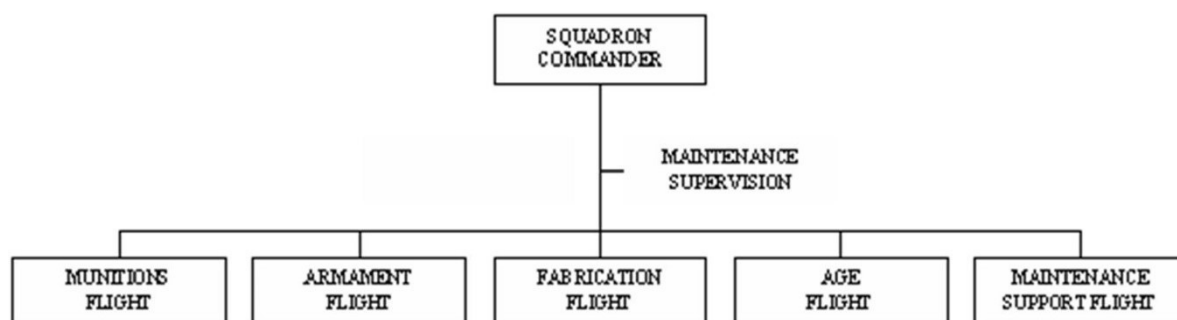


Figure 1-5. EMS organization structure.

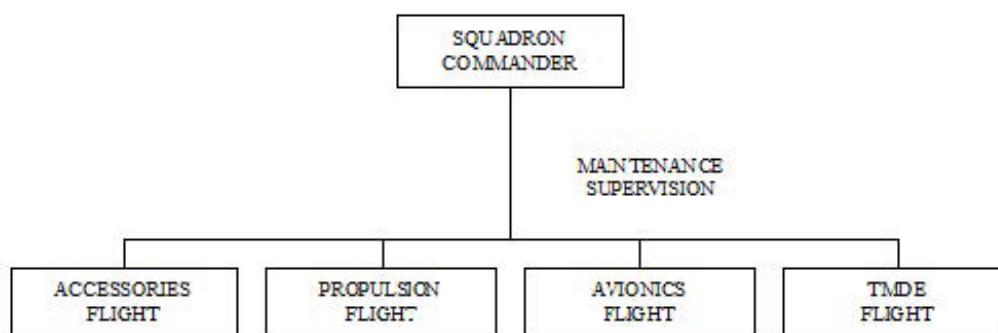


Figure 1-6. CMS organization structure.

MUNS responsibilities

On some bases, the responsibilities of MUNS are contained within the MXS or EMS; however, other bases will have a complete MUNS to provide management of munitions maintenance production and support. If your base has a separate MUNS, the organization you will mostly deal with inside this squadron is the material flight. They store, handle, inspect, ship, receive, dispose locally, and account for conventional munitions and coordinate transportation; so your shop coordinates with them on egress explosive pick-up and turn-in and also emergency requisition of egress explosive items.

OG responsibilities

The objective of the OG is to focus on the planning and execution of the wing mission air and space power. The OG operates the primary mission equipment. In our case, that is fighter and bomber aircraft, and some reconnaissance and training aircraft, too. They perform the basic mission of the Air Force, and require the support of the maintenance units (fig. 1-7). An OG is composed of the following squadrons:

- Operations support squadron.
- Operations squadron(s).
- Air control squadron (as applicable).

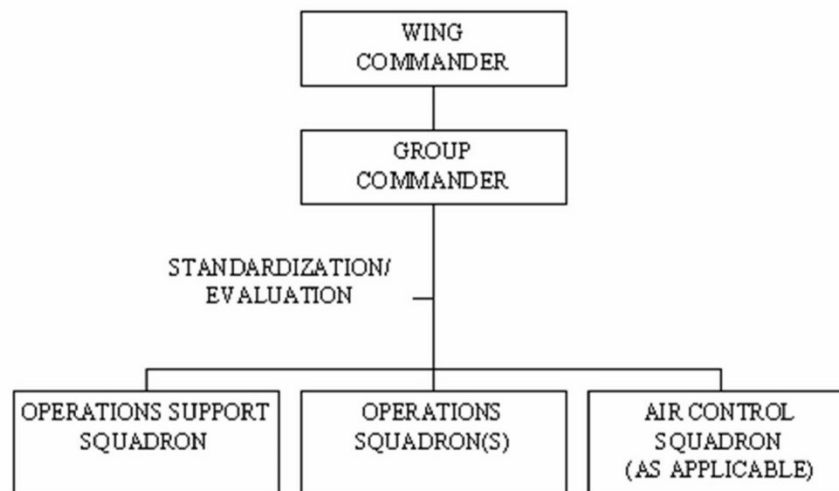


Figure 1-7. Operations group organization structure.

Operations support squadron

An operations support squadron owns responsibilities for weapons and tactics, airfield operations, wing flying operations, intelligence support, and weather services.

Aircrew flight equipment

An organization inside the operations support squadron with which you will work hand-in-hand is the aircrew flight equipment (AFE) section. AFE is a relatively new career field that combined the aircrew life support and the survival equipment career fields. There has been some recent talk about separating them back into two different sections, one belonging to the OG and the other back into MXG. The MXG section will belong to fabrication flight and maintain chutes and kits.

Air control squadron

The OG at your base may or may not include an air control squadron. An air control squadron can have a variety of roles supporting expeditionary operations such as operating and supervising communications to support Army ground maneuver units or planning and controlling combat air resources.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

001. Wing structure

1. When an operational wing is a tenant organization, what organization provides it with varying degrees of base and logistics support?
2. If your base includes an air base wing, what groups make up the operational wing?
3. What type of wing performs support functions including maintaining and operating a base?
4. What type of wing performs a specialized mission, and usually does not have aircraft or missiles assigned?

002. Responsibilities of the maintenance and operations groups

1. What type of group is responsible for the maintenance of air and space weapon systems?
2. Who is responsible for ensuring effective management of the MXG's total maintenance training program?

3. Match the organization listed in column B with its responsibilities in column A by writing the correct letter in the blank space provided. Descriptions in column B may be used once, more than once or not at all.

Column A

- ____ (1) Sustains human life during flight operations.
- ____ (2) Typically includes the egress section.
- ____ (3) Provides weather services.
- ____ (4) Manages maintenance group facilities.
- ____ (5) Accounts for conventional munitions.
- ____ (6) Coordinates egress familiarization training.
- ____ (7) Includes the MOC.
- ____ (8) Performs life support training.
- ____ (9) Recovers transient aircraft.

Column B

- a. Munitions squadron.
- b. Operations squadron.
- c. Maintenance squadron.
- d. Aircrew flight equipment.
- e. Maintenance training section.
- f. Operations support squadron.
- g. Maintenance operations.
- h. Programs and resources section.
- i. Aircraft maintenance squadron.

4. What group's objective is to focus on the planning and execution of the wing mission air and space power?

1-2. Maintenance Complex Structure

Now that you know what group you belong to, let us discuss how that group operates. First, we talk about logistics maintenance management principles and then we talk about some basic functions within the maintenance complex, including QA.

003. Quality assurance

It is important to know the composition of the MXG because the egress section does not exist as a self-sufficient entity. There are many sections within the maintenance complex that you will need to call on to help you perform your duties.

Additional skills

To become an outstanding egress journeyman, it is important to build networking skills. This means building your relationships with these sections and individuals within the sections to boost your effectiveness at mission accomplishment. We will start with QA. Later we discuss sections within your own squadron.

By now you should have a pretty good idea of what goes on in the maintenance complex, but how well are we doing our job? Are we putting forth our best effort every day? QA determines the answers to these questions. Every company must set up external controls to ensure a quality product. You as a consumer would want nothing less. The Air Force uses this same reasoning.

Quality assurance element responsibilities

High-quality maintenance is the responsibility of all maintenance personnel. QA personnel are responsible for determining aircraft and equipment condition and personnel proficiency and to increase reliability and maintainability. These people must be highly qualified. They must have the experience and background to inspect any maintenance performed to ascertain that it is consistent with established standards. QA is directly responsible to the MXG/CC; therefore, treat the QA as the

eyes and ears of the commander. QA has the authority to observe, correct, and document applicable maintenance activities performed within the MXG.

All QA inspectors complete egress certification requirements as described in [AFI 21-101](#) before evaluating ANY egress maintenance task.

QA includes the following programs:

- Maintenance standardization and evaluation program.
- Product improvement program (PIP).
- Technical order distribution office (TODO).
- Air Force repair and enhancement program (AFREP).
- Aircraft and equipment impoundment program.
- Functional check flight (FCF) program.
- Weight and balance (W&B) program.
- Hot refuel/aircraft-to-aircraft refuel.

We'll discuss the first three, the other responsibilities do not apply to your section directly.

MSEP

Quality maintenance is the responsibility of individual maintenance technicians, supervisors, and commanders. Aircraft and equipment condition, and personnel proficiency are determined through the MSEP. The MSEP is a dynamic inspection system designed to improve aircraft combat capability through high-quality maintenance and effective training.

QA identifies, through evaluation or inspection, negative trends and problem areas. Types of inspections performed by QA are personnel evaluations (PE), quality verification inspections (QVI), special inspections (SI), and management inspections (MI).

Personnel evaluations

A PE is an over-the-shoulder evaluation of a person or team's ability to perform duty-related tasks that he or she is certified to perform. The PE is accomplished during performance of the task. It evaluates the training of the individual. Certain tasks may be identified as critical or problem areas and be targeted through inspections.

Quality verification inspections

A QVI is an inspection of equipment condition, a maintenance process, or an assessment following a maintenance inspection, servicing or repair action, or verification that a technician or supervisor properly completed an inspection or repair action. Again, specific problem areas will be targeted by inspectors, if they exist.

Special inspections

An SI is an inspection not covered by PEs, QVIs, or MIs. Some examples are aircraft forms, benchstock programs, composite tool kits (CTK), technical order files, vehicle inspections, and housekeeping. This inspection can be rated or unrated, at the MXG/CC's discretion.

QA recommends possible corrective actions to supervisors and may provide on-the-spot assistance. The MSEP provides an objective sampling of equipment condition and maintenance personnel qualifications. Contrary to popular belief, QA personnel are your friends. They are there to improve your product and your abilities, if possible. Their oversight helps us maintain our integrity.

Management inspections

An MI is an inspection intended to follow up on past trends, conduct investigations, or conduct research to identify root causes of problems. These may be requested by group or squadron

commanders or workcenter supervisors. They can be nonrated and may be counted in QA trends and documented in the QA database.

Product improvement program

Through the PIP reliability and maintainability of parts, components, and equipment are enhanced. The PIP is the program used for screening and reporting deficiencies, and providing input to other agencies that can help resolve problems. Deficiencies in technical data are also reported through the PIP. The product improvement manager (PIM) is the wing focal point for all aircraft maintenance deficiency reporting, technical data, and product improvement programs and is assigned to the MXG QA.

Technical order distribution office

QA is responsible for the technical order distribution office. The TODO ensures technical orders within the group are managed in accordance with Air Force Policy Directive ([AFPD 20-1/63-1](#), *Integrated Life Cycle Management*; Air Force Instruction ([AFI 63-101/20-101](#), *Integrated Life Cycle Management*; and TO 00-5-1 and [00-5-15](#), *Air Force Time Compliance Technical Order Process*). The TODO manages the QA central technical order file which, as a minimum, must contain copies of general and procedural technical orders and copies of all TCTOs pertaining to the equipment owned, operated, or maintained by the group commander. The TODO also coordinates with QA subject matter experts for each incoming TCTO to determine applicability.

The QA TODO coordinates all incoming TCTOs with the applicable QA subject matter expert (i.e., for an egress TCTO, it will be a certified egress QA inspector) to determine applicability. Additionally, TODOs shall control electronic technical data configuration IAW [AFI 21-101](#).

004. Maintenance squadrons

There are three types of maintenance squadrons that support the AMXS: an MXS, a CMS, and/or an EMS. If an MXS exceeds 700 personnel allocations, then it will be split into the CMS and EMS. These squadrons may consist of personnel from various Air Force specialty codes (AFSC) (back shops) that are organized into flights: propulsion flight, avionics flight, test, measurement, and diagnostic equipment (TMDE) flight, accessories flight, aerospace ground equipment (AGE) flight, fabrication flight, armament flight, maintenance flight, and munitions flight. The MXS maintains AGE, munitions, off-equipment aircraft and support equipment components; performs on-equipment maintenance of aircraft and fabrication of parts; and provides repair and calibration of TMDE.

Maintenance squadron responsibilities

At different levels of command and supervision, there are differing levels of responsibility, and specific duties assigned. In order for your organization to run smoothly, the people who fill these supervisory positions must fulfill their duties properly.

Squadron commander

The squadron commander performs command functions, which are outlined by public law and applicable directives, and are common to all squadron commanders. In addition, a squadron commander is responsible to the MXG/CC for overall squadron management.

Maintenance operations

Maintenance operations consist of the maintenance operations officer and maintenance superintendent and production superintendents. As applicable, maintenance operations advise the squadron commander on technical matters, lead a mission-focused maintenance effort, and manage resources necessary to accomplish the mission. They provide necessary administration to manage assigned responsibilities and control maintenance.

Flight chief

The flight chief is responsible to maintenance operations for the management, supervision, and training of assigned personnel. He or she has many responsibilities. These responsibilities include managing shift manpower to equitably distribute all levels of supervision based on manning and workload to supervise all duty periods. A flight chief identifies imbalance between authorizations and the number of personnel assigned, or between authorized and assigned skill levels or grades to the squadron commander. He or she manages additional duties, leave, ancillary training, and assigns personnel to balance workload and minimize negative impacts on the work force.

Section chief

The section chief is responsible to the flight chief for the management, supervision, and training of assigned personnel. The section chief is a first-line supervisor of maintenance production and, as such, is the technical authority and advisor in that area.

Flights

Now that you know the command- and supervisory-level responsibilities, let's take a look at some of the flights within a maintenance squadron and their responsibilities. The specific flights include propulsion, TMDE, avionics, AGE, fabrication, munitions, armament, maintenance support, and accessories.

Propulsion flight

The propulsion flight maintains aircraft engines, propulsion components, and propellers. The flight performs engine tear-down, build-up, test, and repair of engine components. The flight is organized into sections for jet engine intermediate maintenance, test cell and noise suppression systems, accessory/modular repair, small gas turbine, engine support equipment, turboprop/turboshaft (where applicable), and support as required.

TMDE flight

The TMDE flight consists of the precision measurement equipment laboratory (PMEL) and production control, with their own QA sections. Additionally, a field assistance support team for calibration (FASTCAL) may be assigned. The PMEL maintains, calibrates, and certifies TMDE such as torque wrenches using standards traceable to the National Institute of Standards and Technology.

Avionics flight

The avionics flight primarily performs off-equipment maintenance of avionics components, electronic warfare systems and sensor pods, airborne videotape recording systems, airborne photographic systems, and on-equipment maintenance of assigned support equipment. The sections assigned to this flight are dependent on the weapons systems supported and the scope of maintenance responsibilities.

AGE flight

The AGE flight provides powered and nonpowered AGE to support the wing. Powered and nonpowered AGE items are those that are portable and required to directly support a weapon system or subsystem or to give a service to aid in the repair of such systems. The flight picks up, delivers, repairs, modifies, inspects, and services all AGE with the exception of nonpowered munitions trailers, propulsion support equipment, avionics support equipment, gaseous and cryogenic servicing units (AGE accomplishes the basic trailer and chassis maintenance), and locally designed/procured AGE, unless directed by the squadron commander.

Fabrication flight

The fabrication flight repairs, maintains, modifies, and inspects aircraft and equipment components, and locally manufactures components and necessary equipment. The flight consists of aircraft structural maintenance, metals technology, and nondestructive inspection (NDI).

Munitions flight

The munitions flight controls, accounts for, stores, ships, receives, inspects, assembles, and in some cases delivers munitions. Munitions may be part of your squadron or established in a munitions squadron. You will deal with munitions on an almost weekly basis as you pick up and turn in egress explosive items at their storage facilities.

Armament flight

Off-equipment maintenance of armament systems, guns, pylons, racks, and launchers is accomplished by the armament flight. At B-52 units, they assist with performing on-equipment periodic phase inspections.

Maintenance flight

Wheel and tire shop, repair and reclamation (R&R), aircraft inspection, refurbishment, and transient aircraft maintenance make up the maintenance flight. Wheel and tire manages build-up, repair test and storage of wheel and tire components. R&R removes, replaces, and rigs flight control surfaces/systems on assigned aircraft. They also troubleshoot, rig and replace landing gears, actuated doors, canopies and associated equipment requiring component maintenance beyond the capability of other activities. For example, if you work F-15s, the R&R section will remove canopies instead of egress because there are no egress components attached to the canopy. The aircraft inspection section performs phase, periodic, isochronal, or letter check inspections. The refurbishment section performs interior and exterior refurbishment of aircraft. Finally, the transient aircraft maintenance section recovers, services, inspects, maintains and launches transient aircraft.

Accessories flight

The accessories maintenance flight repairs, maintains, modifies, locally manufactures, and inspects aircraft and associated equipment. At bases that have aircraft with ejection seats, the flight is organized into the following sections:

- Hydraulics.
- Electrical and environmental (E&E).
- Fuel systems.
- Egress.

Hydraulic section

This section maintains pneumatic, hydraulic systems for both on and off equipment maintenance (except those associated with environmental and egress systems) and provides maintenance support on test equipment and support equipment. Section personnel maintain components of hydraulic test stands and pumping units. They also manufacture and test hose assemblies, and test rigid hoses.

E/E section

This section maintains aircraft electrical system components and manufactures, repairs, overhauls, tests, modifies, and inspects electrical components and batteries. The E&E section also maintains and repairs aircraft oxygen, environmental, pneumatic, installed fire extinguishing, vacuum, and bleed air systems and components, and gaseous and cryogenic servicing units.

Fuel systems section

The fuel systems section repairs, functionally checks and inspects aircraft fuel systems, fuel tanks, hydrazine systems, and in-flight refueling systems and components. They provide response teams for hydrazine incidents, and fuel tank build-up teams.

Egress section

This is your section, which we will cover in depth in the next lesson.

005. Egress section

Finally, we are at the section that directly involves you. You should have received the basic maintenance concepts and accountability disciplines at Sheppard AFB during your tech school training, but now that you are out of the training environment and at an operational egress shop where things just went to a new level. Just remember that egress is unlike many other sections in the maintenance squadron. Egress components cannot always be tested ensuring their operation and reliability. If something is not right or if something breaks, it will have very real consequences and will not be discovered until it is too late. It is an understatement to say we belong to a unique group of professionals. In this lesson, you will gain an understanding about the unique requirements for an egress section, and a better understanding of maintenance accountability.

Performing inspections and having maintenance disciplines helps increase the chances the lifesaving system will operate as designed when the mission depends on it and especially when someone's life is at stake.

Egress systems inspections and maintenance actions

Only egress personnel will sign off egress system discrepancies. Some of the inspections that you need to be familiar with are egress finals and seat inspections.

Red ball maintenance

The term "red ball" is a traditional descriptor, recognized throughout aircraft maintenance, and defines a situation requiring a sense of urgency and priority actions. The timeframe for a red ball action can occur usually within two hours prior to launch and lasts until the aircrew releases the aircraft back to maintenance crews. The concept is intended to prevent late takeoffs and ground aborts, by having qualified personnel ready and available. Red ball crews might need to troubleshoot, isolate, and repair malfunctions.

NOTE: Red ball maintenance does not authorize anyone to take shortcuts or deviate from technical data, and certainly does not grant permission to disregard any safety requirements. No sortie, real world or otherwise, should ever put personnel safety as a second priority.

Red ball coverage is one of the primary reasons egress goes on temporary duty (TDY) assignments that are less than 30 days. Another reason why egress would go on short TDYs is to facilitate maintenance actions that require adjustment or removal of egress components for another career field's maintenance or to search for a foreign object (FO) in the cockpit. There are times when egress goes TDY, and there is minimal maintenance to be performed on the system, take this time to expand your knowledge and expertise of the flight line and the overall mission. For TDYs lasting 30 days or more, one of the main reasons egress goes TDY is to perform egress final inspections.

Egress finals

Egress personnel conduct an egress final inspection every 30 days on the entire egress system. Egress personnel also conduct an egress final when any maintenance other than a visual inspection is performed on an integral part of an ejection seat. Any time an integral part of an egress system is disturbed, a certified egress production inspector inspects the egress system. The inspection must be an egress final inspection unless another inspection is prescribed by technical data. All aircraft that have ejection seats equipped with chutes and/or kits will have an egress final except for the F-35.

Seat inspections

Depending on the mission design series (MDS) you work, your section may perform a visual seat inspection each time a seat is removed for maintenance. Seats also have a more thorough seat inspection at specified intervals dependent upon tech data. This inspection may include operational checks, NDIs and the lubrication of moving parts. Examples of this kind of inspection are the 36-month inspection of F-16 seats and the 60-month inspection of the B-1B seats.

Inspector waivers

Sometimes at your base your shop may not have enough egress craftsmen to go around. If an insufficient number of egress production inspectors are assigned, the group commander may grant waivers to highly qualified 5-level egress journeymen in the rank of senior Airman (SrA) or higher, to perform as egress systems inspector. Waived journeymen will be monitored closely and kept to the minimum required to accomplish the maintenance mission.

Only a certified egress systems inspector is allowed to inspect any integral part of the system. Other career field 7- or 9-level inspectors may inspect and sign off egress red X's or IPIs only if they have completed the certification requirements outlined in [AFI 21-101](#), and are tracked on an approved special certification roster (SCR).

Cannibalization actions

Egress system component cartridge actuated device/propellant actuated device (CAD/PAD) cannibalization actions are considered “high-risk” and should not be performed unless priority aircraft are involved (e.g., those with a higher headquarters need or aircraft on alert status) or if lack of ready equipment will impede mission accomplishment. To ensure system integrity and validation of the explosive CAD/PAD listing, cannibalization of egress explosive components and/or seats cannot be accomplished without the approval of the MXG or deputy MXG/CC. After cannibalization actions, red X discrepancies in the aircraft Air Force Technical Order (AFTO) Form 781A, Maintenance Discrepancy and Work Document, are not cleared until IMDS 257 and 701 screens are verified. Egress personnel accomplish this action.

Aircraft static display

As you have probably seen at your base and the bases where you have conducted your training, permanent static displays of Air Force aircraft are everywhere. Those static displays would not be possible without the efforts of egress journeymen like you. Every aircraft on permanent static display must have all of the live egress explosives removed. Items removed for static display may be placed back into the ammunition supply system and used on other aircraft if they retain shelf/service life. This is all part of egress maintaining accountability for our explosive items.

In addition, occasionally operational aircraft are displayed at air shows and other public events. This is an important part of telling our Air Force story to the public. These aircraft may be displayed without removing egress and life support systems explosive components (provided proper technical order safety precautions are followed and visiting personnel do not have access to explosive items or their actuating controls). You “de-arm” these aircraft using special locks, safety pins, caps and plugs (fig. 1-9). Constant surveillance of visiting personnel must be ensured to prevent such access.

The procedures for these two types of aircraft static display are outlined in Air Force Manual (AFMAN) [91-201](#), *Explosives Safety Standards*, and the appropriate 00-80G series technical order for the MDS.

004. Maintenance squadrons

1. Match the MXS position listed in column B with its responsibility in column A by writing the correct letter in the blank space provided. Descriptions in column B may be used once, more than once or not at all.

*Column A**Column B*

- | | |
|---|----------------------------|
| ____ (1) Leads mission-focused maintenance effort. | a. Flight chief. |
| ____ (2) Identifies personnel authorization imbalances. | b. Section chief. |
| ____ (3) Performs command functions. | c. Squadron commander. |
| ____ (4) First-line supervises maintenance production. | d. Maintenance operations. |

2. Match the organization listed in column B with its responsibility in column A by writing the correct letter in the blank space provided. Descriptions in column B may be used once, more than once or not at all.

*Column A**Column B*

- | | |
|---|---|
| ____ (1) Includes transient aircraft sections. | a. Avionics flight. |
| ____ (2) Performs gun maintenance. | b. Munitions flight. |
| ____ (3) Calibrates torque wrenches. | c. Armament flight. |
| ____ (4) Inspects hydrazine systems. | d. Propulsion flight. |
| ____ (5) Repairs engine components. | e. Fabrication flight. |
| ____ (6) Performs electronic warfare systems maintenance. | f. Maintenance flight. |
| ____ (7) Maintains oxygen systems. | g. Hydraulics section. |
| ____ (8) Services avionics support equipment. | h. Fuels systems section. |
| ____ (9) Locally manufactures components. | i. Electro-environmental section. |
| ____ (10) Accepts turn-in of egress explosive items. | j. Aerospace ground equipment flight. |
| ____ (11) Manufactures hose assemblies. | k. Test, measurement and diagnostic equipment flight. |

005. Egress section

- What is the usual timeframe that a red ball action may occur?
- Why should egress maintainers go on a TDY that lasts less than 30 days?
- When is an egress final performed?
- When would a seat visual inspection be required?
- If there is a shortage of personnel capable of performing inspections, who may grant a waiver allowing a 5-level to perform inspections?

6. What type of situation would warrant a cannibalization action on a CAD/PAD device?
7. When may items removed on a permanent static display be placed back into the ammunition supply system?

Answers to Self-Test Questions

001

1. The host command.
2. An operations group and maintenance group.
3. An air base wing.
4. A specialized mission wing.

002

1. MXG.
2. The MXG/CC.
3. (1) d.
(2) c.
(3) f.
(4) h.
(5) a.
(6) e.
(7) g.
(8) b.
(9) i.
4. OG.

003

1. MSEP, PIP, TODO, AFREP, aircraft and equipment impoundment program, FCF program, W&B program and hot refuel/aircraft-to-aircraft refuel.
2. (1) c.
(2) b.
(3) d.
(4) a.

004

1. (1) d.
(2) a.
(3) c.
(4) b.
2. (1) f.
(2) c.
(3) k.
(4) h.
(5) d.

- (6) a.
- (7) i.
- (8) j.
- (9) e.
- (10) b.
- (11) g.

005

1. Usually within two hours prior to launch and last until the aircrew releases the aircraft back to maintenance crews.
 2. Red ball coverage.
 3. Every 30 days, and when any maintenance other than a visual inspection is performed on an integral part of an ejection seat.
 4. Each time a seat is removed for maintenance.
 5. Group commander.
 6. If priority aircraft are involved (such as those with a higher headquarters need or aircraft on alert status) or if lack of ready equipment will impede mission accomplishment.
 7. If they still retain shelf/service life.
- .

Complete the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).

1. (001) Who does the Air Force hold responsible and accountable for mission results?
 - a. Flight chiefs.
 - b. Section chiefs.
 - c. Wing commanders.
 - d. Squadron commanders.
2. (001) What level of organization is responsible for maintaining the installation?
 - a. Base.
 - b. Wing.
 - c. Group.
 - d. Squadron.
3. (002) What is the next level of command below a wing?
 - a. Base.
 - b. Flight.
 - c. Group.
 - d. Squadron.
4. (002) Who is responsible for ensuring the egress section safes all static display aircraft according to 00-80- series and weapon system technical orders?
 - a. Quality assurance.
 - b. Operations group commander.
 - c. Maintenance group commander.
 - d. Operational wing deputy commander.
5. (002) What section within maintenance operations coordinates egress familiarization training for flightline personnel with the egress shop?
 - a. Maintenance training.
 - b. Programs and resources.
 - c. Maintenance operations.
 - d. Plans, scheduling and documentation.
6. (002) Which squadron services, inspects, maintains, launches, and recovers assigned and transient aircraft?
 - a. Component maintenance squadron.
 - b. Maintenance operations squadron.
 - c. Equipment maintenance squadron.
 - d. Aircraft maintenance squadron.
7. (002) Which group would contain an air control squadron?
 - a. Operations group.
 - b. Maintenance group.
 - c. Mission support group.
 - d. Civil Engineering group.

8. (003) What quality assurance (QA) program is a dynamic inspection system designed to improve aircraft combat capability through high-quality maintenance and effective training?
 - a. Product improvement program.
 - b. Mission generation network program.
 - c. Air Force repair and enhancement program.
 - d. Maintenance standardization and evaluation program.
9. (003) What type of quality assurance (QA) evaluation is an over-the-shoulder evaluation of a person or team's ability to perform duty-related tasks done during performance of the task?
 - a. Special inspection.
 - b. Personnel evaluation.
 - c. Management inspection.
 - d. Quality verification inspection.
10. (003) What quality assurance (QA) program enhances reliability and maintainability of parts, components, and equipment?
 - a. Weight and balance program.
 - b. Product improvement program.
 - c. Functional check flight program.
 - d. Air Force repair and enhancement program.
11. (003) To check the applicability of a time compliance technical order (TCTO), the quality assurance (QA) technical order distribution office (TODO) coordinates with
 - a. the appropriate unit commander.
 - b. an MXS production superintendent.
 - c. the Operations Group TODO office.
 - d. the applicable subject matter expert.
12. (004) Which flight does *not* belong to a maintenance squadron (MXS)?
 - a. Avionics.
 - b. Accessories.
 - c. Fabrication.
 - d. Aircrew flight equipment.
13. (004) Within the maintenance squadron (MXS), who is responsible for managing shift manpower to equitably distribute all levels of supervision based on manning and workload to supervise all duty periods?
 - a. Maintenance operations officer.
 - b. Maintenance superintendent.
 - c. Production superintendent.
 - d. Flight chief.
14. (004) Which flight within a maintenance squadron (MXS) includes the aircraft inspection section?
 - a. Armament.
 - b. Propulsion.
 - c. Maintenance.
 - d. Test, measurement, and diagnostic equipment.
15. (005) Egress finals are conducted every
 - a. 10 days.
 - b. 15 days.
 - c. 30 days.
 - d. 31 days.

16. (005) The maintenance group commander (MXS/CC) may grant an egress production inspector waiver to a highly qualified egress
 - a. journeyman in the rank of A1C or higher.
 - b. journeyman in the rank of SrA or higher.
 - c. apprentice in the rank of SSgt or higher.
 - d. apprentice in the rank of TSgt or higher.
17. (005) Who is allowed to sign off an egress specific red X such as an egress final inspection?
 - a. Any 7- or 9-skill level inspector.
 - b. Any certified egress systems 7- or 9-level inspector.
 - c. Any egress or munitions type AFSC that are a 7- or 9-level inspector.
 - d. Any certified egress systems 7- or 9-level inspector that is tracked on an approved special certification roster (SCR).

Unit 2. Safety

2–1. Air Force Occupational and Environmental Safety, Fire Protection, and Health	2–1
006. Air Force occupational and environmental safety, fire protection, and health standards	2–2
007. Hazard reporting	2–7
008. Hazardous materials	2–10
009. Fire prevention	2–11
2–2. Hazards of the Egress Air Force Specialty	2–17
010. Egress hazards	2–17
011. Job safety procedures	2–27
2–3. Explosives Safety Program	2–33
012. Operations	2–33
013. Storage procedures	2–36
014. Explosives transportation	2–38
2–4. Nuclear Surety Program	2–41
015. Characteristics of nuclear surety	2–42
016. Personnel reliability program	2–44
017. Two-person concept and no lone zone	2–46

SAFETY IS AN INTEGRAL PART of what we egress technicians do. Because we are in the business of saving lives, safety should always be the first thing on our minds. For this reason, understanding egress hazards and safety standards is a vital part of your career progression. It is understood that you will apply these standards every day you are on the job. However, before you can comply with safety requirements, you first need to know what they are. The information presented here builds on what you’ve learned in the apprentice skills course and helps lay the foundation for all of the safety training you will receive throughout your career.

We begin with a discussion on the Air Force Occupational Safety and Health (AFOSH) program. AFOSH is designed to ensure all Air Force personnel are protected from working hazards by reducing or eliminating the likelihood of your being hurt, killed, or becoming ill while on the job. Next, we cover some hazards associated with our egress career field. Then, we look at the Air Force explosives safety program. This program applies to all personnel engaged directly or indirectly in operations that involve an explosive or an explosive-related item (such as egress systems). We end the unit with a discussion of the nuclear surety program, which is designed to prevent accidental peacetime nuclear detonations. Since the program effects all people associated in any way with nuclear weapons, we discuss how nuclear safety, reliability, and compliance with these directives apply to us in the egress career field.

2–1. Air Force Occupational and Environmental Safety, Fire Protection, and Health

Studies show that fate has nothing to do with accidents. Instead, human error is the most frequent cause of accidents. Fortunately, proper training and enforcement of safety rules go a long way toward eliminating human errors. Largely, your safety, and the safety of others, depends on what YOU do. You are responsible for observing all safety precautions when performing your duties.

Government studies show that the majority of accidents can be prevented by identifying and isolating the accident’s causes. These studies also indicated that many of the work environments in the United States could be safer. Based on these factors, Congress passed the Occupational Safety and Health

Act, the President signed it, and it became law in 1970. This law established the federal Occupational Safety and Health Administration (OSHA) to set standards and perform inspections.

The intent of the OSHA is to prevent injuries and protect the health of American workers by ensuring safe and healthful workplaces. The military services are not exempt from this law. In fact, the military services have created safety programs equal to or exceeding federal program requirements. The USAF developed the AFOSH program. AFOSH is a comprehensive and aggressive program designed to protect Air Force personnel from injury, illness, or death as the result of working conditions. This comprehensive program includes all safety precautions, fire prevention measures, and health standards that affect the safety and health of Air Force personnel at their places of work. Its guidance is mandatory for all Air Force working environments except those that are specifically exempt. In this section, we discuss four important aspects of the AFOSH program: AFOSH standards, hazard reporting, hazardous materials, and fire prevention.

006. Air Force occupational and environmental safety, fire protection, and health standards

The Air Force considers Airmen its most valuable resource. Keeping Airmen safe is so important that AFOSH training begins with your basic training and does not formally end until you retire. By that point, these principles are so ingrained that you carry them forward throughout your life. The following paragraphs discuss some important AFOSH standards, your responsibilities, and recap some guidance contained in [AFMAN 91-203](#), *Air Force Occupational Safety, Fire, and Health Standards*. Figure 2-1 is a perfect example of an accident waiting to happen. Sometimes folks win a Darwin award for their incompetence and by being a perfect example of what not to do. As an egress maintainer, you do not want that award!



Figure 2-1. Do not do this!

Training requirements

You must comply with all standards issued by the OSHA. This includes AFOSH standards, regulations, AFTOs, and emergency temporary standards.

NOTE: OSHA standards take precedence over all other guidance unless Air Force requirements are more restrictive.

Your supervisor must provide you training in job safety, fire prevention, and health, as required by OSHA and AFOSH directives, AFDs, AFIs, AFMANs, and other associated directives. Your supervisor must ensure you are trained on the hazardous chemicals or materials you are exposed to per [AFI 90-821](#), *Hazard Communication (HAZCOM) Program*, including information from the safety data sheet (SDS) for each chemical or material used. This training will include discussion on work task steps, potential hazards, any personal protective equipment (PPE) requirements, safety surveys, and preventative measures to mitigate work task hazards. At a minimum, training should include the following:

1. When PPE is necessary.
2. How to put on, take off, adjust and wear PPE.
3. Limitations of PPE.
4. Care, maintenance, useful life, and disposal of PPE.
5. Opportunity for each employee to demonstrate knowledge and understanding of training, as well as an ability to use PPE properly (hands-on training prior to work).

Retraining is required if you exhibit a lack of understanding or skill with the required work task, hazards involved with the work task, or the PPE. Do not be “that guy”! It is also required when changes in the workplace render previous training inadequate or obsolete, and when changes in the types of PPE used render previous training inadequate or obsolete.

As you progress in rank and job proficiency, you will become more directly responsible for your work area—and you will require more formal OSHA standards training. This training is accomplished through management and professional development courses and local training programs. These courses cover such areas as how to analyze job tasks for hazards, recognize and eliminate hazards in the workplace, and determine self-inspection requirements.

Personal responsibilities

As an Air Force member, you have personal responsibilities to ensure your workplace is as safe as possible. [AFMAN 91-203](#) states these responsibilities. Six of the personal responsibilities you must adhere to are as follows:

1. Comply with occupational safety and health guidance.
2. Report to the supervisor unsafe working conditions/activities promptly, including any safety, fire and health hazards, and deficiencies.
3. Report to your supervisor injuries and illnesses promptly (e.g., occupational illness and on-duty injury to Department of Defense [DOD] military and civilian personnel, and off-duty injury to DOD military personnel).
4. Comply with PPE requirements, including its use, inspection, and care.
5. Give due consideration to your safety and the safety of your fellow workers while performing assigned tasks.
6. Ensure workers comply with required medical surveillance examinations.

Work environment

In addition to the AFOSH program’s training requirements and personal responsibilities, there are many egress specific occupational safety and health standards. Let us look at [AFMAN 91-203](#) for guidance for these three aspects of your work environment:

1. Walking and working surfaces.
2. Mobile work platforms.
3. Personal protective clothing and equipment.

Walking and working surfaces

[AFMAN 91-203](#) covers hazards and human factors associated with interior and exterior walking and working surfaces such as floors, wall openings, fixed industrial stairs, and portable and fixed ladders.

Walking surfaces

Many injuries and property damage mishaps occur on walking and working surfaces. Slips and falls are among the most common mishaps. Good design and maintenance, combined with proper lighting, contribute to a safe walking or working surface. Proper layout, spacing, and arrangement of equipment in passageways or aisles are essential for orderly operations and avoiding congestion. Floors, aisles, and passageways need to be clear and in good condition without any obstructions that could endanger workers, interfere with handling of materials, or hinder anyone making an exit during an emergency. Workers are responsible for wearing proper footwear and using walking surfaces in a safe manner. The following table discusses the primary causes and descriptions of surface mishaps.

Primary Causes of Surface Mishaps	
Cause	Description
Poor housekeeping	Immediately clean obstacles in walk areas, liquid spills, sawdust accumulations, and the use of slippery surface cleaners to prevent slips, falls, and injuries.
Dangerous surface conditions	Cracks, holes, protruding nails, broken surface materials, slippery finishes, surfaces of different elevations, and improper design for the intended use can cause worker injuries.
Inadequate lighting	Incorrect or insufficient lighting may lead to slips, falls, or injuries. Building or facility managers shall ensure lighting is sufficient for walking surfaces in their work/facility and that obstacles are visible.

Of these three, the first is the easiest to avoid. Good housekeeping is very important in eliminating injury risk. Clean up as you go and you will have a safer work environment. The second and third causes can be taken care of through hazard reporting—discussed later.

Stairs and ramps

Many injuries result from falls that occur on stairs or ramps. Proper design and construction can help prevent these falls. Other aids, such as fixed handrails, can also help reduce the risk of slips. Poor lighting or housekeeping, faulty treads, and slippery surfaces often lead to injuries. Other injuries result when people run up or down stairs, fail to use handrails, wear shoes with slippery soles, or act carelessly.

Fixed ladders

Other falls are caused by using fixed ladders in poor condition. Workers attempting an activity for which they are physically unfit and other unsafe acts such as running up and down, jumping, and reaching too far out to the sides of a fixed ladder can also be hazardous. Proper worker training, safe ladder use, and proper installation and maintenance of fixed ladders and climbing devices can prevent these hazardous acts and conditions.

Portable ladders

Falls are the primary hazard. Falls result from a number of unsafe acts and conditions. The nine most common are:

1. Setting ladders on unstable surfaces.
2. Placing ladders in front of doors that open towards the ladder without proper guarding.
3. Using ladders as scaffolds.
4. Reaching too far out to the sides while on the ladder.

5. Standing too high on the ladder to maintain balance.
6. Using defective ladders (i.e., broken rails, rungs, missing hardware).
7. Improvising and using a makeshift ladder.
8. Carrying materials in hands while ascending or descending a ladder, or descending with back to the ladder.
9. Using a ladder with conductive side rails while working on electrical circuits.

These hazards can be minimized if workers and supervisors ensure equipment is inspected, maintained in good condition, and used properly.

Mobile work platforms

Chapter 16 of [AFMAN 91-203](#) covers the standards for maintenance stands and platforms. Using maintenance stands and platforms are essential aspects of your job. Before you use a stand or platform, first check the maintenance forms; then, check the following items:

1. Operate the aerial platform on a surface within the manufacturer's limits.
2. Use outriggers, stabilizers, extendable axles, or other stability enhancing means as required by the manufacturer.
3. Install guardrails and close access gates or openings per manufacturer's instructions, including bolts, pins or other locking devices on all removable railings and attachments.
4. Do not exceed the manufacturer's rated capacity for the specific configuration of the load and its distribution on the platform and any platform extensions.
5. Ensure there is adequate clearance from overhead obstructions.
6. Maintain minimum safe approach distances to energized power lines and parts.
7. Wear fall protection devices and other safety gear, as required. This applies to the operator and all personnel on the platform at all times.

If the structure has wheels, before performing any maintenance, set at least two brakes and lock all wheel casters. Lower maintenance stand platforms until locking devices engage securely and hydraulic pressure valves close.

Sadly, in the past few years, a few Air Force personnel have fallen to their deaths because guardrails were not positioned properly on maintenance stands. To make the stands safer, changes were made to the maintenance stand technical orders. You may use removable guardrails on all open sides of aircraft maintenance platforms. Replace guardrails removed for material handling as soon as material handling is complete.

Protective guardrails are not required at the platform entrance if there is a ramp or stairway (angle less than 60 degrees). Remove protective guardrails only 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. Install guardrails on all open sides if platform levels are four feet or higher above ground or floor. Provide and use bolts, pins, or other locking devices on all removable railings and attachments. If maintenance stand guardrails are not secured by bolts or quick release pins, the stand is considered unserviceable and must be immediately removed from service until repairs are made. Using stands with damaged rails or with removal guardrails installed, but not secured with a bolt or quick release pin, can result in serious injury or death.

Personal protective clothing and equipment

Chapter 14 of [AFMAN 91-203](#) covers the use, selection, care, and maintenance for protective equipment for eyes, face, head and extremities, protective clothing, respiratory devices and protective shields/barriers. Use PPE whenever there are hazards that can do bodily harm through absorption, inhalation, or physical contact. 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. Consult with the installation ground safety office and bioenvironmental engineering (BE). Supervisors shall instruct personnel in the use and care of this equipment. We will talk more about PPE later.

Jewelry

One area that [AFMAN 91-203](#) specifically talks about is jewelry safety. Mishap statistics have revealed that one of the most frequent causes of lost-time permanent partial injuries is the loss of portions of fingers due to someone's ring catching on an object. Figure 2-2 illustrates what can happen when wearing a ring while working with machinery. Because of the potential for serious injury, *no finger rings may be worn* by personnel engaged in the following work activities:

- Climbing, ascending, or descending activities where personnel could fall or jump from elevated surfaces (ladders, scaffolds, roofs, etc.).
- Warehousing, parts handling, operating equipment, packing and crating, and attaching and detaching equipment to tow vehicles.
- Moving machinery, rotating or revolving parts, or any task that could result in hands caught in moving parts.
- Exposing personnel to energized electrical circuits.
- Performing maintenance or inspections on aircraft or ground support equipment.

Also, evaluate any jewelry that presents a potential for catching, snagging, pulling, and tearing and, if necessary, restricted from wear. Jewelry (e.g., watches, bracelets, and necklaces) should be controlled in these job situations. Additionally, all these items could cause potential foreign object damage (FOD)—discussed at length, later in this course.



Figure 2-2. Result of wearing jewelry on the job.

Other AFOSH guidance

You will not find all the AFOSH guidance that you will ever require mentioned in this career development course (CDC). Why? For example, you may have to perform tasks outside your assigned AFSC that call for using specific equipment or chemicals that require guidance from other

sources. In cases where you are not sure of the standards, consult these sources for appropriate guidance:

- [AFMAN 91-203](#).
- Your supervisor.
- Your unit safety or hazard communication (HAZCOM) noncommissioned officer (NCO).
- Your wing safety office.
- Department of Labor, OSHA standards.
- NIOSH (National Institute for Occupational Safety and Health) publications, which is the index for AFOSH and OSHA standards.

The people and publications in the preceding discussions, combine to help prevent mishaps. Even though everyone expects a perfectly safe working environment, it is unrealistic to assume you are always 100 percent safe from ever hazard lurking around the corner.

REMEMBER: The ultimate responsibility for your safety rests with you!

007. Hazard reporting

A hazard is any real or potential condition that can cause injury or occupational illness to personnel; damage to or loss of a system, equipment, or property; or damage to the environment. Sometimes people “overlook” hazards because of the following reasons:

- They think the hazards are just part of the job.
- They believe someone else has already reported them.
- They do not know how to report the hazards.

To overcome these problems, the Air Force developed a hazard reporting program that provides a system for reporting, investigating, and correcting hazards. A basic premise of the program is that all personnel must know how to report a hazard. To ensure you have the knowledge you need to detect and properly report workplace hazards, we will cover the procedures for reporting hazards first; then, we will cover the hazard abatement process that you will see in your workplace. Figure 2-3 illustrates what might happen if a hazard is not reported.



Figure 2-3. Report hazards.

Reporting procedures

There are two essential elements of the Air Force's mishap prevention program:

- Detecting unsafe or unhealthy working conditions at the earliest possible time.
- Abating hazards promptly at the lowest possible working level.


Part of the mishap prevention program is the hazard reporting program we mentioned earlier. The hazard reporting program provides a system of reporting, investigating, and correcting hazards. Any person (military or civilian) in a shop or workplace may report a hazard. If you discover a hazard, your first step is to report it to your supervisor or the appropriate local agency. If the hazard is eliminated on the spot; no further action is required—unless it applies to other similar operations or to other units or agencies. If the hazard presents imminent danger, the supervisor or individual responsible for that area must take immediate action to correct the situation or apply interim control measures. If the hazard cannot be eliminated at your reporting level, submit an Air Force (AF) Form 457, USAF Hazard Report, to the base safety office (fig. 2-4). You can access the form via the Air Force's [electronic-publishing website](#). The form should be reviewed by your supervisor, but may also be submitted anonymously. You may also report hazards to the safety office by telephone or in person, but they will most likely ask you to fill out an AF Form 457. A good resource for submitting your hazard report is your unit's safety NCO in charge (NCOIC), but [AFI 91-202](#), *The US Air Force Mishap Prevention Program*, gives detailed procedures on how to properly fill out and submit the form.

If the hazard is valid, the safety office assigns an investigator who ensures that corrective action is completed and the hazard is eliminated or controlled. Once the hazard is corrected or controlled, the responsible individual completes Part II, "Action Taken" within ten working days and returns the report to the safety officer for monitoring. The investigator tells the originator about the corrective action within ten working days and conducts follow-up reviews until the action is completed. However, if you are unsatisfied with the actions taken, you can submit a reevaluation request to a higher level of safety, fire protection, or health representative. The appeals procedures are discussed in [AFI 91-202](#).

Hazard abatement

Detection of unsafe or unhealthful working conditions at the earliest possible time and at the lowest possible working level is an essential element of the AFOSH program. Just as important is the prompt abatement (ending, reduction, or lessening) of any unsafe or unhealthy working condition. Again, this should be done at the earliest possible time and at the lowest possible working level.

Air Force organization supervisors are tasked to implement a hazard abatement plan. As they are identified, each occupational hazard must be evaluated by qualified safety, fire protection, or health personnel and assigned a risk assessment code (RAC). A RAC is determined by plotting the probability that a mishap will occur and its potential severity. Hazards are identified by RACs 1, 2, 3, 4, and 5—the lower the number, the greater the hazard. Each workplace supervisor is required to use AF Form 1118, Notice of Hazard, and post RAC 1, 2, and 3 hazards in order to alert personnel to the hazardous condition, interim control measures in effect, and permanent corrective actions to be taken. The notices must be posted on, at, or as near as possible to the hazard. However, where the nature of the hazard or workplace is such that this is not practical, notices must be posted in a prominent place where all affected employees can see them. Do not remove notices until verification by the issuing authority that the identified hazard has been corrected satisfactorily or three working days have elapsed from hazard correction—whichever is greater.

HAZARD REPORT To be completed IAW AFI 91-202, Chapter 4		Control Number <i>(Assigned by safety professional)</i>	Date Submitted 2018-12-01
To: Installation Safety Office <i>(Organization & Location)</i> 82TRW/SEG Sheppard AFB, Tx		From: Contact Information <i>(Individual reporting hazard has right to remain anonymous)</i> A1C Journeyman, Egress 361TRS, Sheppard AFB, Tx	
PART I	HAZARD <i>(To be completed by individual reporting hazard)</i>		
Description <i>(Date, Time, Summary - Who, What, When, Where, How)</i> Bldg 1956 west sidewalk is cracked.			
Type <i>(Unsafe procedures, practices or conditions affecting flight, occupational (ground), weapons, systems or space safety. Is health or fire hazard involved?)</i> The sidewalk next to the west entry door is severely cracked and deteriorated. This poses a severe tripping hazard.			
Recommendations <i>(Optional)</i> Replace sidewalk or build a bridge over the crack.			
PART II	INVESTIGATION OF HAZARD		
Investigator Summary Valid Hazard <input type="radio"/> Yes <input type="radio"/> No Risk Assessment Code <i>(RAC)</i> <input type="text"/>			
<div style="height: 150px;"></div>			
Date Investigated	Investigator <i>(Name, Grade and Title/Position)</i>	Signature	
			

AF Form 457, 20151117

Previous editions currently in use as of date of this form are authorized - All others are obsolete.

Adobe® LiveCycle® Designer ES4
OPR: HQ AFSEC/SEGS

Figure 2-4. AF Form 457.

008. Hazardous materials

Hazardous chemicals are found in virtually every Air Force operation including aircraft maintenance. [AFI 90-821](#) is intended to minimize the incidence of chemically induced occupational illnesses and injuries in the workplace by establishing guidance for training employees on the health and physical hazards associated with proper preventive measures to be taken when using or handling hazardous chemicals in work centers. This program is commonly referred to as the HAZCOM program. HAZCOM is a performance-based program with separate training requirements. Its successful implementation can be measured only by evaluating worker awareness in the work center. You should always be working to expand your understanding of the HAZCOM program in order to protect yourself and your coworkers.

Safety data sheets

All employees working in an environment where chemicals are present and employees who may be exposed under normal conditions of use or in a foreseeable emergency will be provided with information about the hazardous chemicals to which they are exposed. This information is provided via the HAZCOM program and includes, but is not limited to; safety data sheets (SDS), labels, and other forms of warning, information, and training. However, the key to finding out about the hazards of the chemicals you are exposed to is the SDS. The SDS contains extensive information about a chemical's physical properties, precautions for safe handling, and first-aid procedures. Figure 2-5 shows some common PPE usually required by the SDSs in your section. At least annually, your work center's SDSs should be reconciled with its hazardous chemical inventory. Safety data sheets are standardized in a user-friendly, 16-section format, which includes information about the properties of each chemical; the physical, health, and environmental health hazards; protective measures; and safety precautions for handling, storing, and transporting the chemical.

Sections 1 through 8 contain the most useful information that you, as an egress maintainer, would need to reference on a routine basis or during an emergency. They cover all the *general* information about the chemical, like identification, hazards, composition, safe handling practices, and emergency control measures such as fire-fighting. Sections 9 through 16, contains all the technical and scientific information about the chemical that might not be relevant when deciding which PPE to wear on a task.



Figure 2-5. Wear the PPE called out by the SDS.

If a new SDS is received, but the old material is still on-hand, the SDS matching the old material must be retained as long as the material remains in the work center. SDSs may be obtained from several sources. These include, but are not limited to the following:

- Chemical manufacturer or supplier.
- Installation or unit hazardous materials pharmacy.
- DOD Hazardous Materials Information Resource System (HMIRS) on-line or compact disc read-only memory (CD-ROM).
- Environmental, Safety and Occupational Health Management Information System (ESOH-MIS).

If the SDS is not available from these sources, contact your local bioenvironmental flight for further assistance.

Reducing chemical health hazards

When using a chemical, it is very important to use the chemical's SDS to reduce your health risks. Section 8 of the SDS tells you what kind of PPE, if any, that you need to use (e.g., eye protection or gloves). It also tells you whether you need ventilation when using the chemical. If a chemical gets on your skin or in your eye, you can look at the first-aid measures in section 4, to see whether you need to worry. Of course, if a chemical is in your eye, you may need to have someone else read the SDS for you! The first-aid section contains all the relevant information for what to do during an emergency and explains the first-aid procedures on how to treat eyes, skin, and even how to treat for chemical ingestion. *To protect yourself and others, always read the SDS prior to using chemicals for any task.*

Flammable liquids

In your job, you use flammable and combustible liquids to clean and maintain ejection systems. No matter the type, use all cleaning fluids or liquids in well-ventilated rooms. [AFMAN 91-203](#) contains the standards for using, storing, and handling flammable and combustible liquids.

009. Fire prevention

Functional managers, supervisors, and building managers are responsible for keeping facilities in a condition that provide a safe workplace. This includes ensuring workers are aware of fire protection and prevention requirements. Fires in facilities can result from a multitude of circumstances. Unfortunately, improper use, selection, or placement of heaters, coffee pots, holiday decorations, and improper storage or improper disposal of flammable and combustible materials is often to blame.

Specific requirements

Chapter 6 of [AFMAN 91-203](#) outlines specific requirements for fire protection and prevention. One of the requirements deals with smoking restrictions. Smoking is not allowed inside Air Force buildings. Contact your unit safety representative (USR) for designation of approved smoking areas. Every authorized smoking area should provide an adequate number of ashtrays/ash receptacles. Smoking materials should only be disposed of in cans labeled "SMOKING MATERIAL ONLY." No other waste, trash, or any other combustible material should be disposed of in these cans. Also, when cans are emptied into waste dumpsters, the smoking materials inside should be saturated and completely extinguished.

All space heaters should be Underwriters Laboratories (UL) incorporated or host nation equivalent, equipped with automatic shut-off devices that will shut off the heater if it tips over. Space heaters must also have an overheat protection device and an automatic thermostat control. Space heaters must not be left unattended when in use. They must be disconnected when not in use, including at the end of the day or shift. They must be plugged directly into a wall receptacle, *not into multiple outlet strips or surge protectors*, and never into an extension cord. There must be a minimum distance of 36 inches between a space heater

and any heat producing appliances or combustibles. The use of portable space heaters must be IAW the manufacturers' specifications and have the concurrence of the base energy awareness manager.

NOTE: The use of space heaters in any hazardous location is prohibited.

Place coffee makers in an area free of combustibles and on non-combustible surfaces. Unplug them at the end of the day unless they have integral timers. There is no need to unplug coffee makers with integral timers. Do not use timers unless the coffee maker comes with an integral timer.

Keep furnaces and heaters in good repair and free of combustible and flammable material. Secure all heating, boiler, air conditioning, air handling, and mechanical rooms. Only fire protection, civil engineering, or other authorized personnel will have access to these areas.

Some of us like to spruce up our work centers during the holidays, but there are also specific requirements for decorations:

- Electric string lights and wiring must be UL approved and in good operating condition.
- All electrical decorations will be unplugged when building is unoccupied.
- Decorations will be noncombustible or fire retardant.
- Larger decorations (Christmas trees or fake fireplaces) will not block exits or paths of egress.
- Decorations utilizing an open flame are prohibited.

Fire alarm systems and emergency evacuation

All workcenter personnel must be familiar with the fire alarm systems, including how to report an emergency and how to activate the fire alarm system. At no time shall a fire detection, suppression, or alarm system be painted, blocked, or obstructed in any manner. All employees should know primary and secondary escape routes for every area of the building. The escape routes should be free of obstruction and doors leading outside should be easy to open.

If prevention fails and you have a fire in your facility, you will be glad you prepared for such an occasion. Your preparation should include alarm, fire-fighting, and evacuation training; fire extinguisher inspections; and reporting. You should know where and how to sound the alarm so everyone in your building is aware of the emergency. The acronym SPEED should be familiar to you.

- **S**ound the alarm.
- **P**hone the fire department.
- **E**vacuate the building.
- **E**xtinguish the fire if possible.
- **D**irect the firefighter to the fire.

Since your supervisor has already established an emergency action plan in accordance with [AFMAN 91-203](#), all you need to do is know how to do your part. Once the plan is established, you should know the primary and secondary escape routes for every area of the building. Ensure that escape routes are free of obstructions, and make sure doors leading outside can be opened easily. Do not use elevators during an evacuation. Local fire prevention instructions determine how frequently you have to practice fire evacuation drills. Train new personnel as soon as possible. All personnel will IMMEDIATELY evacuate the building whenever the fire alarm sounds, unless advised in advance that work or non-evacuation testing is being conducted on the fire alarm system.






It is imperative that all personnel be accounted for upon evacuation. The emergency action plan will include a predetermined gathering area to avoid confusion and ease accountability. Once evacuation is in progress, or complete, if the fire is manageable with a handheld fire extinguisher, it is permissible to attempt to fight the fire. To fight the fire, you must be able to select the proper extinguisher and be able to trust it.

Portable fire extinguishers

As an egress journeyman, you will often handle explosive items. These items present a fire hazard. If a fire happens, your emergency actions must be quick, accurate, and decisive. Oftentimes the proper use of portable fire extinguishers can prevent serious fires. Chapter 6 of [AFMAN 91-203](#) applies to the selection, installation, inspection, maintenance, and hydrostatic testing of portable fire extinguishers. In the egress shop when explosives are handled, a minimum of two fire extinguishers must be available for immediate use. The fire extinguishers need not be permanently located at the operation site, but they must be accessible and properly maintained.

Fire extinguisher classes

There are five different types of fire extinguishers, but you will likely only see three or four of them. They are classified by the kind of fuel being burned. The types are A, B, C, D, and K.

Classes of Fires and Fire Extinguishers		
Class		Description
A		These use water to extinguish fires fueled by wood, paper, cloth, rubber, or plastic. The water is used for its cooling effect to reduce the temperature of the burning material below its burning temperature.
B		These use the oxygen exclusion method by smothering or blanketing the burning fuel to extinguish the fire. Class B extinguishers are used on fires fueled by accelerants such as gasoline, oil, lacquer, paint, mineral spirits, and alcohol.
C		These are used to fight electrical fires, such as fires on household appliances, computers, transformers, and overheated transmission lines. Class C extinguishers contain a non-conducting extinguishing agent like carbon dioxide. However, the safest way to fight an electrical fire is (if possible) to first de-energize the circuit, and then treat the fire as a class A or class B fire, depending on the fuel involved.
D		<p>Burning metals cause class D fires.</p> <p>These materials are particularly hazardous in powder form, since airborne concentrations can cause powerful explosions, given a suitable ignition source. Some burning metals, like the magnesium found in some flares, burn so hot that water and other common extinguishing agents are not only ineffective but also hazardous. Water poured on burning magnesium can scatter the burning fuel, causing more fires and injuring the firefighters.</p> <p>Special extinguishing agents are available for controlling fire in different metals and these are marked for a specific metal. Their action is to cover the burning material and smother the fire.</p>
K		These extinguishers are designed specifically to supplement kitchen fire suppression systems. They <i>are not used</i> in egress shops.

Multiclass extinguishers

Multiclass extinguishers are quite common and cost-efficient. In your shop, you will likely find class ABC extinguishers. As the name suggests these are suitable for fighting class A, B, or C fires. Multiclass extinguishers include class ABC, class AB, and class BC. There are no class AC extinguishers.

Inspections

Supervisors make sure an inspection is accomplished on each fire extinguisher assigned to the shop at a minimum of 30-day intervals. You may be tasked to perform these inspections. If so, you will ensure the following:

- The extinguisher is located in its designated place.
- There is no obstruction to access or visibility.
- Operating instructions on the nameplate are legible and facing outward.
- Safety seals and/or tamper indicators are not broken or missing.
- There is no obvious physical damage, corrosion, leakage, or clogged nozzle.
- The pressure gauge reading or indicator is in the operable range or position.
- For wheeled units, the condition of the wheels, tires, carriage, hose, and nozzle are checked.
- The canister is full by weighing or “hefting” the unit.

Fire-fighting

All personnel who may become involved in preventing and fighting fires must be briefed thoroughly on fire hazards involving explosives, the safety precautions to be taken, and the methods for preventing and fighting fires in their area.

To use a fire extinguisher, remember, and use another acronym—PASS.

P	<i>Pull</i> the pin to arm the fire extinguisher.
A	<i>Aim</i> the nozzle at the base of the fire.
S	<i>Squeeze</i> the handle to discharge the contents.
S	<i>Sweep</i> the nozzle back and forth along the base of the fire to cool or blanket the burning material.
NOTE: Figure 2-6 illustrates the steps in this sequence.	

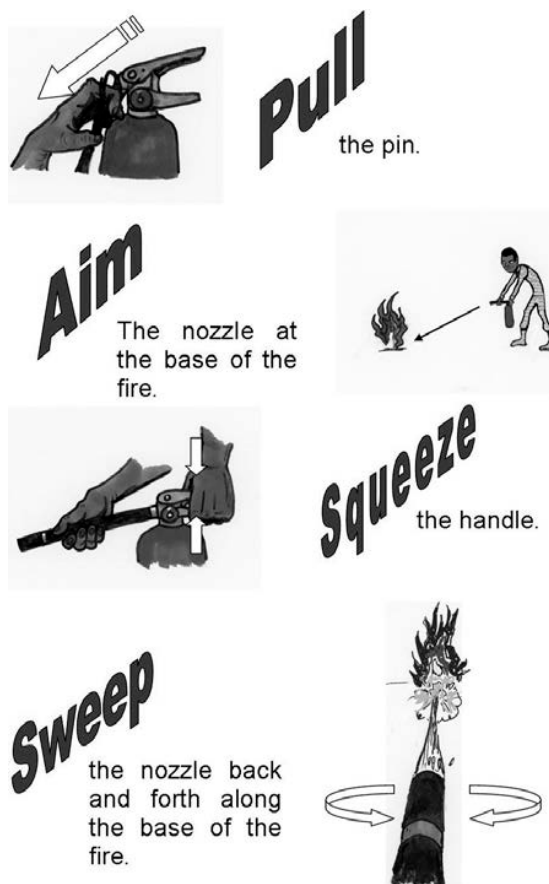


Figure 2-6. Pull, Aim, Squeeze, Sweep.

Alert the fire department personnel before you attempt to fight a fire. Post someone to direct the fire department to the location of the fire upon arrival. As the fire department approaches, the posted fire symbols make them aware of whatever dangers may be present.

NOTE: Personnel not involved in fighting a fire should evacuate the area and report the fire.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

006. Air Force occupational and environmental safety, fire protection, and health standards

1. Who must provide you training in job safety, fire prevention, and health, as required by OSHA and AFOSH directives, AFDs, AFIs, AFMANs, and other associated directives?
2. When is PPE retraining required?
3. What Air Force publication lists the personal responsibilities for the AFOSH program?

4. Besides proper layout and spacing, what is essential for orderly operations and the best way to avoid congestion in passageways?
5. What are the primary causes of surface mishaps?
6. What type of ladder should you avoid while working on electrical circuits?
7. Why must you ensure that maintenance stand guardrails are secured by bolts or quick release pins and not damaged?
8. During what five activities should you remove finger rings?

007. Hazard reporting

1. What is a hazard?
2. After discovering a hazard, what is your first step in correcting it?
3. What is the next step, if a hazard cannot be eliminated at your reporting level?
4. How is a hazard's risk assessment code determined?

008. Hazardous materials

1. What Air Force publication is intended to minimize the incidence of chemically induced occupational illnesses and injuries in the workplace by establishing guidance for training employees on the health and physical hazards associated with, and proper preventive measures to be taken when using or handling hazardous chemicals in work centers?
2. On an SDS, what information is contained in sections 1 through 8?
3. Where can you find a chemical's SDS if your shop is missing one?

4. In what section of the SDS would you find the PPE you need to use to handle the specific chemical you are using?

009. Fire prevention

1. Who designates approved smoking areas?
2. What are the fire prevention rules for coffee makers?
3. What acronym will help you in the event of a shop fire?
4. Match the class of fire extinguisher listed in column B with the type of fire you would use it on in column A by writing the correct letter in the blank space provided. The class of fire extinguisher in column B may be used only once.

<i>Column A</i>	<i>Column B</i>
1. Burning metals.	a. Class A.
2. Electrical fires.	b. Class B.
3. Kitchen fires only.	c. Class C.
4. Gasoline fires.	d. Class D.
5. Wood fires.	e. Class K.

2-2. Hazards of the Egress Air Force Specialty

Now, you may think you know everything about safety. Sorry. As an egress journeyman, there are many more occupational and environmental hazards, both on and off the flight line, of which you need to be aware. You must know the safety standards and precautions that are an everyday part of your job to perform your duties successfully. The first part of this section focuses strictly on egress hazards. After that, we focus on the job safety procedures that will ensure you apply safety at all times in the egress career field.

010. Egress hazards

As an egress journeyman, you are exposed to many potential hazards. Due to the number and variety of possible hazards, it is not practical or possible to cover them all in this CDC. For our discussion purposes, we will use four broad groups, focusing on the major areas within each group:

- Occupational health hazards.
- Environmental health hazards.
- Flightline and aircraft hazards.
- Shop hazards.

You will build on this knowledge as you gain experience on the job.

Occupational health hazards

As an egress journeyman, you may be exposed to many potential occupational health hazards. Here we look at two of the most common—noise and radio frequency (RF) radiation.

Noise

At high-sound pressure levels, noise becomes a physiological hazard. The precise level at which noise becomes dangerous is difficult to determine. However, the primary hazard is permanent hearing loss. Some insist that hearing loss after exposure to an extremely loud noise is only temporary. However, the sad fact is though the initial effect has passed and hearing seems to have returned to normal, there is permanent damage that becomes evident later in life.

Noise is measured in units of sound pressure levels called decibels, named after Alexander Graham Bell, by using A-weighted sound levels (dBA). Decibel levels closely match the perception of loudness by the human ear. In figure 2-7, you can see some typical sound levels measured by their dBA, which illustrates the change in levels. The higher levels of dBAs a person is exposed to increases the potential for hearing damage. Noise effect on hearing is not just determined by the level of dBAs; the effects also are related to these three main factors:

1. Intensity of the noise.
2. Frequency (Hertz) level of the noise.
3. Duration of exposure to the noise.

Variations in these factors cause different environments to affect hearing adversely at different levels. Despite the variables related to noise exposure, there are published damage-risk evaluations that aid in determining *maximum permissible* noise exposure. Some sources of potentially hazardous noise are the following:

- Operating aircraft engines.
- Aircraft gun and rocket firing.
- Support equipment and power tools.
- Industrial-type facilities (shop areas).
- Small arms firing ranges.

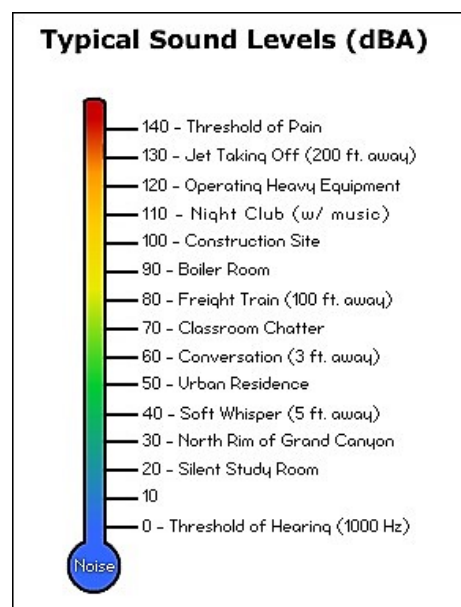


Figure 2-7. Typical sound levels (dBA).

Early symptoms of severe hearing damage are faintness, nausea, pain in the ears, and vertigo (loss of sense of balance). By taking the proper precautions, you should never be exposed to enough high-intensity sound to experience these symptoms. Most hearing loss takes place gradually, unnoticeably, so that after continued, unprotected exposure to loud noises, your hearing has accumulated enough damage to affect your daily activities.

Personnel employed in engine testing and run-up operations, flightline aircraft maintenance, and other unusually noisy activities, must wear properly fitted protection devices to guard against hearing loss. Earplugs and earmuffs may reduce the effect of noise. The earplug is used because it provides protection for the most common exposures. There are three types of earplugs:

Types of Earplugs	
Type of Earplugs	Description
Premolded	These are pliable earplugs of fixed proportions. The Bio-Environmental Flight issues these.
Formable	These are foam earplugs that you squish, insert, and hold in place until the earplug expands. You find these earplugs available in most work places and hangars.
Custom Molded	These earplugs are made to fit the exact size and shape of the individual's ear canal.

Earmuffs, worn with earplugs, provide increased protection for higher noise-level exposures. Wearing both combinations of hearing protection is commonly referred to as “double hearing protection.” According to [AFI 48-127](#), *Occupational Noise and Hearing Conservation Program*, hearing protectors will be provided at no cost to the members that work in *designated* hazardous noise areas or operate noise-hazard equipment. Workers may be fitted with pre-formed earplugs as determined by Public Health at the expense of the Air Force. If workers request custom molded devices as a personal preference, the unit is not obligated to pay for any additional examinations or the fabrication of specialized plugs. The hearing protection must be capable of attenuating worker noise exposure to below 85 dBAs. Always follow your local directives for using hearing protection equipment.

RF radiation

RF radiation is electromagnetic radiation consists of electric and magnetic energy waves moving together ranging from 3 kilohertz (kHz) to 300 megahertz (MHz). The only difference between RF and microwaves are frequency; microwaves radiate in the 300 MHz to 300 gigahertz (GHz) range. RF radiation sources include high-frequency radio transmitters, radar, and electronic countermeasure devices. The danger area differs from aircraft to aircraft. Figure 2-8 shows the danger areas for transmitters operating inside the nose cone of an aircraft. This type of transmitter often moves from side to side as well as up and down which increases the potential danger area. The energy it radiates is so strong that it can burn steel wool and set off explosives. Other aircraft operate more powerful radar units than those typically found in the nosecones of fighter aircraft.

You cannot see or hear RF radiation, and its presence may not be readily apparent. Given these characteristics, it is possible you could be injured before you feel any pain. For this reason, RF has been called the silent killer. RF radiation has been identified as the possible cause of more than 50 reported symptoms and diseases. There are some indications that long-term overexposure may lead to decreases in blood pressure, feelings of apathy, and depression. A more serious threat is that exposure to high RF levels cause internal tissue damage. The eyes and testes are especially vulnerable because they do not have the blood flow volume that can dissipate the excessive heat load. This is significant because blood circulation is one of the body's major mechanisms for coping with excessive heat.

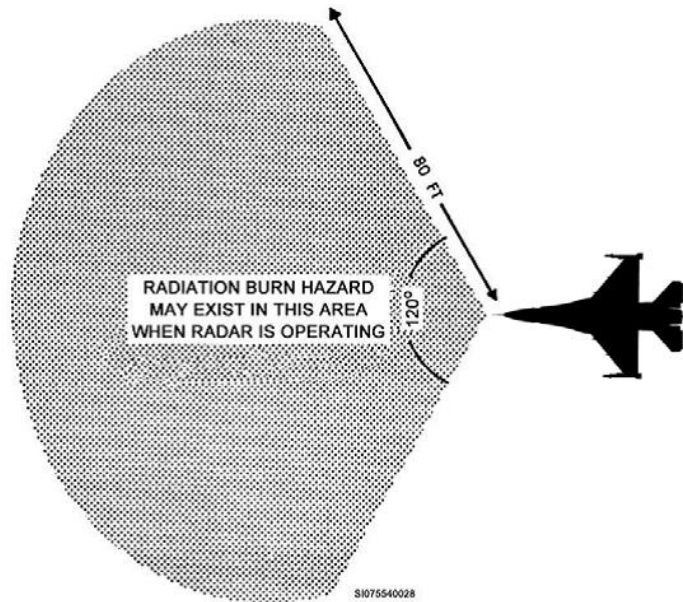


Figure 2-8. Radiation hazard area.

Proven RF effects include temporary sterility and tissue damage; RF radiation can even produce cataracts on the eyes. It is possible that continued research will identify additional and possibly more severe RF effects. For these, and many other reasons, the best policy is to prevent or limit your exposure so that you do not become a statistic.

Four factors contribute to RF radiation exposure effects:

1. Time of exposure.
2. Strength of emission.
3. Weather.
4. The number of units operating in an area.

In order to evaluate these variables, rely on common sense, good judgment, and experience. Wherever possible, avoid any radar antenna's area of radiating power. *Never* stand in the beam of a nearby radar antenna; you cannot tell if your internal organs are being heated and damaged.

Environmental health hazards

Environmental hazards are probably the most difficult to control because we can never eliminate them completely. However, there are many ways we can substantially reduce their effects and provide a safe working environment. In the following paragraphs, we cover two common environmental hazards—static electricity and lightning.

Static electricity

Static electricity really is an imbalance in the amounts of positive and negative charges in the surface of objects. In essence; static electricity is created when an object gives up electrons. An electrostatic charge appears when two dissimilar materials come together, transfer charge, and move apart, producing a voltage between them. For example, walking on a rug with leather-soled shoes can generate voltages as high as 25 kilovolts (kV). Static electricity can be produced simple things such as people removing articles of clothing, dust blowing across a flight line, liquid flowing through a pipe, and moving vehicles.

No one involved with Air Force equipment should take static electricity lightly, especially equipment involving explosives like those found in the egress system. Static electricity is a proven ignition source for many petroleum fires. In addition, static electricity has been identified as the cause of

inadvertent activation of explosive devices. As an egress journeyman, you must always be aware of your surroundings and the danger static electricity poses to explosives operations. Since a lot of egress maintenance involves explosives initiated by electrical inputs, we must always be mindful of static electricity is something.

Normal day-to-day activities can generate static electricity charges on your clothing. The electrostatic characteristics of clothing materials are affected strongly by humidity. The lower the humidity and temperature, the greater the hazard. In low humidity, almost all Air Force garments can produce a static charge of sufficient potential to cause a discharge. Wearing multiple garments does not, in itself, cause an excessive buildup of static charges. However, when you remove a garment, such as an Airman battle uniform (ABU) top, it can easily create a static charge that can be discharged when you contact any object. If you should be charged with static electricity and come into contact with an explosive component, the potential exists for an inadvertent detonation.

CAUTION: *Never* remove any clothing while you are working on or around egress systems.

High-humidity and high-temperature conditions minimize static buildup problems but do not eliminate the danger. Body perspiration adds moisture to clothing. Insulated footwear limits the dissipation of static charges to the ground. Both rubber soles and composition soles are relatively poor conductors, but most have sufficiently low resistance to dissipate static charge. The same is true for gloves. In most cases, you can dissipate a static charge through your gloves or shoe soles. However, the best protection against static-charge buildup is to dissipate any static charges through a ground. You can do this by touching a grounding point with your bare hand. During extremely cold weather, use a warm metal object, such as a wrench, to make contact with a grounding point in order to prevent your skin from freezing to the grounding point, just make sure you do not touch a grounding point wearing gloves and think you are static free.

Lightning

An electrical potential in the range of several million volts can exist between clouds and the ground during storms. Aircraft high points such as vertical stabilizers and antenna masts are very susceptible to lightning strikes. These strikes are of short duration (approximately 1/100 second) and, even though high-energy levels exist, the ramp grounding system generally conducts the energy safely to earth. Do not bet your life on this however. Even though an aircraft or an ejection seat is grounded, a severe hazard exists if lightning strikes directly (or is even within several hundred feet of) an aircraft. When there is any danger of a lightning strike, you should vacate the aircraft and flight line immediately. Be extra cautious—an electrical storm can be dangerous even if it is several miles from the servicing area. Lightning can strike through clear air up to 10 miles from the rain area of a thunderstorm. Under some conditions, lightning striking 3 to 20 miles away can induce up to 60,000 volts on an ungrounded aircraft. Such voltages can sometimes be lethal. Aircraft must be connected to a ramp ground in order to eliminate the hazard. Always check to be sure!

Lightning warnings are just as serious for inside the egress shop. While some explosive maintenance facilities are equipped with a lightning protection system designed to allow maintenance to continue during lightning conditions, *most are not*. If you are not located in a lightning protection system facility and you receive a lightning watch announcement from the MOC, begin shutting down in-shop maintenance on explosive components. Prepare and store all components not currently undergoing maintenance. Then, should MOC issue a lightning warning, you will be able to respond quickly and safely. Usually, a lightning watch is issued 30 minutes prior to the storm being within five nautical miles of the base. If a lightning *warning* has been issued, that means there is currently lightning within five nautical miles. In accordance with [AFMAN 91-201](#) you should immediately cease all explosive operations involving electrically initiated devices (EID) that are uncapped, unplugged, or

susceptible to electro-static discharge and vacate the maintenance bay where these operations are located. Only after the lightning warning is cancelled may you return to work on EIDs.

Aircraft hazards

Armed aircraft, running jet engines, variable winged aircraft, vehicle traffic, and cockpit hazards are just a few of the danger areas you can face daily on the flight line. We now discuss these hazards and the safety precautions you must take when dealing with them. These hazards can quickly take your life! So be alert!

Armed aircraft

It is unfortunate but true that maintenance personnel working on armed aircraft have caused many fatal accidents and extensive aircraft damage. “Armed” means that the aircraft has explosive weapons such as bombs, missiles, or live ammunition on board. Normally, maintenance performed on an armed aircraft is very limited. Your first concern is to know how to determine if an aircraft is armed. Generally, armed aircraft are identified by warning signs placed near the cockpit entrance and safety pins with red streamers installed on armed devices. Once you determine the armed/unarmed status, you can proceed with maintenance activities.

The exact maintenance activities that you can perform on armed aircraft are beyond the scope and requirements of this volume. Whenever you work on an armed aircraft be sure to consult the aircraft and system technical orders and follow the procedures *exactly*. If you discover something unexpected or different, alert your supervisor immediately!

Jet engine dangers

General safety standards applicable to conventional aircraft also apply to jets. However, ground handling of jet aircraft involves some additional hazards. The major danger areas include the engine intake, turbine plane of rotation, and exhaust (fig. 2-9).

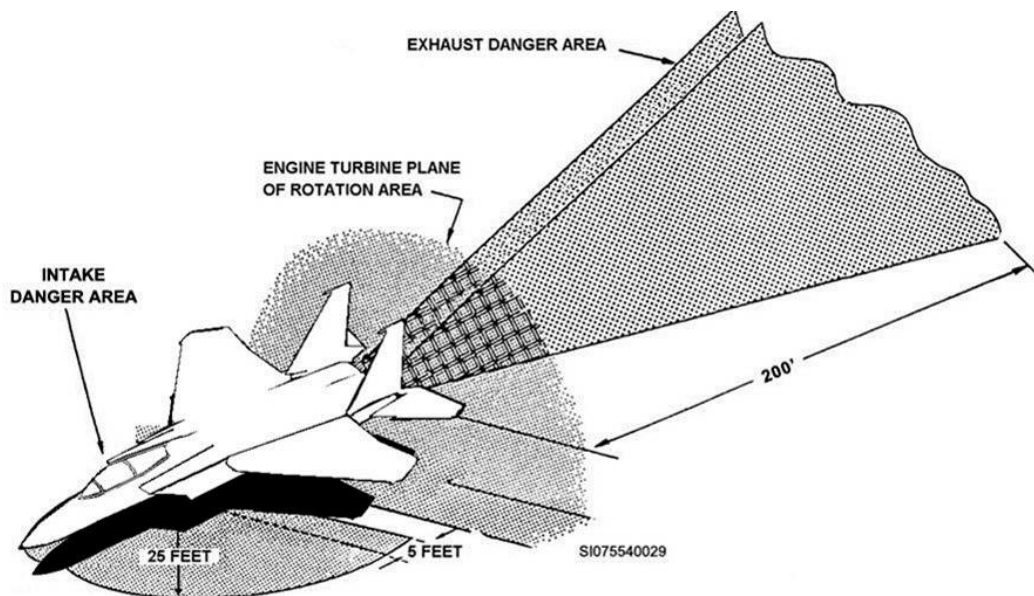


Figure 2-9. Jet engine danger area.

As an egress mechanic, you could be called to a jet that is running, with the pilot sitting in the cockpit. When jet engines are operating in front of and behind the lip of the engine intake, it is *very* dangerous—*ALWAYS* stay at least 25 feet away from the front, sides, and 5 feet to the rear of the intake. As the engine takes in air, it creates a low-pressure area directly in front of and surrounding the intake. Air outside this area rushes in to fill the void, and that air can push people and objects right into the intake of the engine. Therefore, approach an operating aircraft *at least 5 feet aft of the intake*. This is a general rule of thumb; the exact approach distance varies with the type of aircraft. You can find the aircraft specific information in the applicable technical order. Never wear loose clothing or hats or carry objects that may be drawn into the intake.

Although very rare, it is possible for the turbine wheel of an operating jet engine or a piece of aerospace ground equipment to disintegrate. Should this happen while you are standing in the plane of rotation, you could be killed or severely injured by flying parts traveling at speeds exceeding the muzzle velocity of a rifle. For this reason, *never stand in the plane of rotation when turbine engines are being operated!* This danger area is marked with a painted stripe, most often a single red line (though other colors may be used). This painted stripe marks the plane of rotation area on both aircraft and AGE.

The high velocity and heat of the exhaust from a jet engine can also kill you. On most aircraft, 200 feet to the rear is considered a safe distance. The operative word is *considered!* Like the intake area, this safe distance varies according to aircraft type and engines. Always check the aircraft's technical order to determine the safe distance from the blast area.

Variable wing dangers

On some Air Force aircraft, you will encounter a feature that presents another hazardous area—variable wings. The wings of the B-1B Lancer can be moved or swept back from a 15-degree full-forward configuration to a 67.5-degree angle where the trailing edges actually fit into slots along the length of the fuselage under the overwing fairing. At full sweep, part of the wing trailing edge is parallel to, and only inches away from, the leading edge of the horizontal stabilizer. The hydraulically actuated wings can be moved through their full range of travel when the aircraft is on the ground. The main hazard is that you can be caught between the trailing edge of the wing and the leading edge of the horizontal stabilizer or the overwing fairing. Figure 2-10 illustrates the variable wing concept and points out the danger areas.

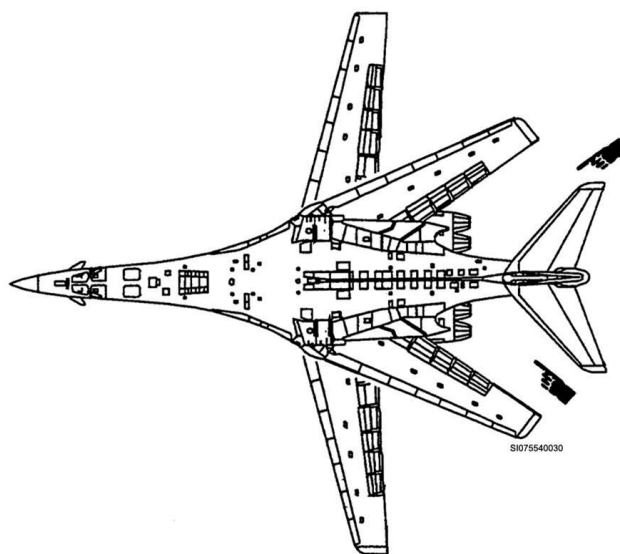


Figure 2-10. Variable wing danger area.

The fact that the wing can sever a human body is what makes this area particularly dangerous. To prevent this from happening, stay clear of the wing sweep radius when the wing positions are being varied. Also, if you perform maintenance anywhere in the wing sweep area, ensure that a responsible person is aware of where you are working.

Power-actuated surfaces

Power-actuated surfaces such as speed brakes, spoilers, flight control surfaces, weapon bay doors, and arresting tail hooks all present hazards. If you have to perform maintenance beneath or near a power-actuated surface, make sure that anyone in the cockpit knows you are there. Any intentional or inadvertent movement of the stick can move one of these surfaces; this could knock you unconscious and, possibly, cause severe injury. The spring force exerted by the tail hook could even kill you.

Cockpit safety

Because of the explosive charges used to eject the seats, canopies, and hatches the cockpits of fighter and bomber aircraft have always presented the greatest hazards to maintenance personnel. Seat, canopy, and hatch ejection systems should command the same respect as a machine gun or an aircraft cannon. They are just as dangerous!

NOTE: The catapult charge of a typical ejection seat can hurl 300 pounds at an initial rate of 60 feet per second with 5,000 pounds of thrust.



Figure 2-11. Unplanned exit.

If accidentally fired, these systems cannot only cause death or serious personal injury but also severely damage the aircraft. As a safety precaution, seat, canopy, and hatch ground safety pins with red streamers are installed while the aircraft is on the ground. Always check for the presence of safety pins. If you do not see them, back off and notify a crew chief or your supervisor.

When working in the cockpit area, exercise particular care to avoid accidental arming and firing. Do not end up taking a ride like our friend in figure 2-11! This is what can happen if you are not careful when working around an ejection seat. The newer, more advanced fighter aircraft will present newer, safer egress systems; but since the aircrew member requires accessible, fast, and easy actuating mechanisms, the mechanisms will always be present during maintenance and present the same hazards for maintenance personnel.

As an egress maintainer, cockpit safety does not just mean being aware of explosive hazards. All maintainers that require access to the cockpit need to be vigilant of obstructions and foreign objects that might be in the way of a canopy opening or closing. There have been countless incidents of maintainers closing canopies on tools or equipment, even the obvious boarding ladder still attached to the cockpit sill. ALWAYS read the warnings, cautions and notes in applicable technical data when opening and closing canopies, and ensure the cockpit sill is free of foreign objects prior to closing the canopy. Remember a last minute visual inspection of the cockpit sill and canopy area might save you many hours lost time with a damage to aircraft investigation.

Motor vehicle operations

Motor vehicles operating on the flight line are required for normal operations and maintenance. However, they present a clear and possible danger to both aircraft and ground personnel.

Carelessness, haste, and disregard of existing safety standards by flightline vehicle operators are inexcusable and are the primary sources of aircraft collisions and personnel injury. Our focus here is applicable directives covering flightline vehicle traffic.

Foreign object damage

As directed by your local wing foreign object damage (FOD) monitor, when you enter the flightline area including the runway, taxiway, parking aprons, and all accessible roadways, you must conduct a FOD check on your vehicle. At a minimum, the FOD check includes the following:

- Inspecting your tires for FOD (drive forward to check tire unseen portions in contact with pavement).
- Ensuring all external vehicle components are secured.
- Securing any/all items loaded on payload vehicle, including all tie-down device loose ends (e.g., chains, ropes, packaging) or other items that may become dislodged during movement while on the flightline area.
- Making a thorough walk around the vehicle to check for damaged, loose, or worn parts.

In addition, make every attempt to stay on paved surfaces, avoid driving on the dirt or grass, and check tires for FOD after returning to pavement if driving on unimproved surfaces (e.g., avoid taxiing aircraft or performing runway repairs). These simple FOD-prevention measures can avoid millions of dollars and hundreds of man-hours to repair or replace the damage to military aircraft.

Egress shop safety hazards

There are common hazards you will encounter inside the egress shop. These hazards include, but are not limited to, compressed air and electrical hazards. Remember, the easiest way to prevent mishaps is good housekeeping.

Compressed air hazards

Although compressed air is used in different maintenance operations, few people realize the dangers associated with using it. Serious injuries are often the result of horseplay and poor supervision.

Figure 2-12 is a humorous depiction of what can be a serious situation. Air pressure strong enough to remove dust or dirt is also strong enough to injure your eyes and ears and even penetrate your body.

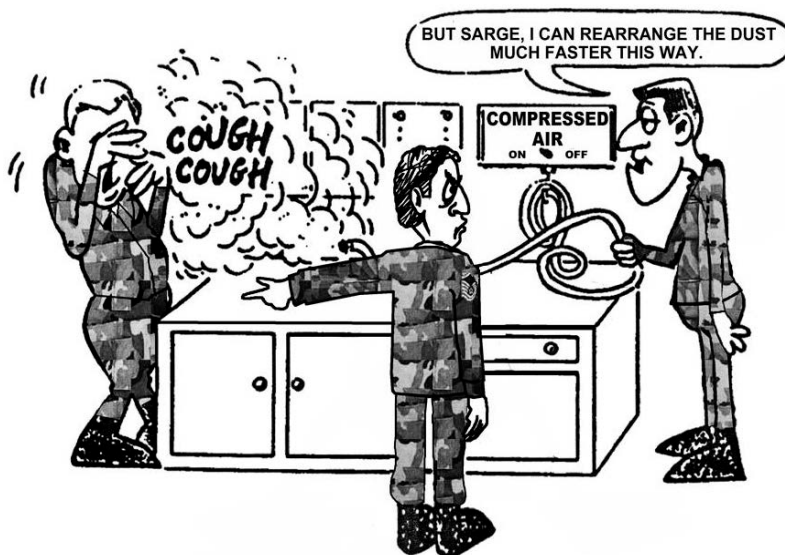


Figure 2-12. Improper use of compressed air.

Pressures as low as 10 pounds per square inch (psi) can cause serious injury. A pressure of only 4 psi can rupture the intestines. Keep in mind these cautions:

- *Do not* use compressed air at greater than 30 psi for cleaning purposes.
- *Never* direct compressed air toward a fellow worker or use it to clean loose debris from clothing.
- Use eye protection when you are cleaning with compressed air.

Horseplay will not be tolerated by your supervisors; and for your own safety and the safety of others, *you* should never tolerate it either.

Electrical hazards

The wide use of electronic equipment in most Air Force maintenance areas exposes personnel to many dangers. Poor judgment in the use and maintenance of electronic equipment and electrical tools is a major cause of injuries and equipment damage. Constantly, maintenance personnel are exposed to the dangers of severe electrical shock, burns resulting from contact with “hot” circuits, and injuries from fires caused by improper use of electrical equipment. Short circuits, overloading, accidental grounding, poor electrical contacts, and misuse of equipment are all responsible for major accidents involving electricity. Observing these seven safety precautions will minimize some of the dangers:

1. *Do not* wear metallic objects such as rings, identification tags (dog tags), necklaces, watches, metal-rimmed glasses, or bracelets when working near any electrical unit.
2. *Do not* bring metallic measuring rules, metal-cased objects, or metal tools near energized electrical circuits.
3. *Do not* depend on friction tape or rubber tape on the handles of tools to protect you from electric shock.
4. Avoid using screwdrivers with wooden handles because the wood can absorb moisture and become a conductor.
5. When you pull a fuse, always use an insulated fuse puller made especially for that purpose; *never* use your fingers or a screwdriver.
6. Clear obstructions (e.g., tools, toolboxes, and foreign objects) from the area surrounding high-voltage equipment.
7. Know the location of the main power switch in a maintenance area. If someone contacts a live circuit or if something in the equipment begins to smoke, CUT THE POWER!

Never close a switch unless you know what is connected to the circuit.

Other hazards

Some other hazards commonly encountered in the egress shop are razors and blades used for touch-up work on egress systems maintenance, lifting ejection seats onto workbenches and loading them into trucks, common chemicals, explosives, and more. Your workcenter and explosives safety training will cover instructions on how to handle all common hazards.

Another hazard egress personnel must be aware of is physical and mental fatigue. If you are not alert, your attention to detail lessens and the possibility for human error increases, which is not a good thing when dealing with a critical life-saving system that has explosives. For this reason personnel that handle explosives will not work beyond a 12-hour continuous shift. This requirement cannot be waived for exercises or inspections, but may be waived by the MXG/CC during advance defense readiness conditions, actual emergencies as defined in [DOD Directive \(DODD\) 3150.02](#), *DOD Nuclear Weapons Surety Program*, or to resolve an unexpected event (e.g., disabled vehicle, Weapons Storage & Security System (WS3) fault, hoist failure, etc.). However, if you are not performing maintenance, the duty shift may be extended to allow for shift turnover or other

administrative actions; then, you must be allowed to receive eight hours of uninterrupted sleep during the next 24-hour period. More information on duty shifts and rest periods is found in [AFI 21-101](#).

Due to the inherent danger to life, limb, and property associated with maintenance operations, personnel are empowered to terminate an operation or situation, which they perceive is unsafe or too dangerous. When supervisors/crew leaders become task-focused, junior personnel are often better able to assess the danger. Maintenance commanders and supervisors are responsible to foster a culture in their units so that a simple, but recognizable “audible” from anyone can prevent a potential mishap. Simply say “knock-it-off” or “time-out;” do it with respect, and explain why you feel something is not safe. These concepts are essential to ensuring that all personnel have a voice in any situation to identify concerns or to inform others of a developing hazardous situation. Verbalizing either of these terms sends a message to those involved in a specific action to stop, take a moment to reset, and reevaluate the current situation.

When either term is used, all current actions are halted immediately or the situation is stabilized to a safe position in order to evaluate the specific concern; this is nonnegotiable and cannot be overridden by command authority. It is important to know that the alerts provided by these terms do not prevent actions from continuing, once safety and risk concerns are addressed, but they provide all personnel with an avenue to mitigate risk effectively through immediate intervention in any evolving operation/activity.

NOTE: See Air Force Instruction ([AFI 90-802](#), *Risk Management*, and Air Force Pamphlet ([AFPAM 90-803](#), *Risk Management (RM) Guidelines and Tools*, for additional information.

011. Job safety procedures

In the last lesson, we talked about the hazards of your new career field. Luckily, there are job safety procedures that can keep you, your coworkers, and the aircrew members (who we ultimately protect) safe. Three ways to stay safe follow:

- Good housekeeping.
- PPE.
- Job safety training outline.

Let’s look at each of these in some more detail.

Good housekeeping

Good housekeeping is maintaining a neat, clean, and orderly work area that provides the opportunity to do the best job possible. The first rule of good housekeeping is personal cleanliness. If you are an orderly person and present a good appearance, it will probably reflect in your work. Next, there is your work area. Many so-called accidents can be prevented, and much pain and lost time can be avoided, if you keep your work area clean and orderly. An oil spilled on the floor may cause someone to slip and fall. If you spill a liquid, clean it up immediately in the approved manner. Keep the floor or ramp free of obstructions. An improperly positioned extension cord or dropped tool could cause you or someone else to trip.

Some units that you disassemble have small parts that can easily be lost, broken, or mixed with other parts. To avoid losing time hunting for a lost part, keep the top of your workbench neat and orderly. A cluttered bench degrades the effectiveness of your work, and often it is the starting place for an accident. Dispose worn-out or repairable parts properly and promptly. Every shop has a designated place for toolboxes that are not in use. Keep them in place with the lids closed. It does not require much time or effort to open the box. You may cause someone a bruised shin (or worse) if you leave toolbox drawers open. Coil air hoses and power cords. Do not leave large aircraft parts or equipment leaning against walls. You probably have a place to store or temporarily stow everything that comes into your shop. If not, make one.

Personal protective equipment

Always use PPE to put a barrier between you and a hazard. PPE includes goggles, rubber gloves, safety-toed boots, hearing protection, and protective helmets. Goggles protect eyes from metal shavings when working with fragment producing machinery, tools, and hardware. Goggles and rubber gloves protect eyes and hands from chemicals. Ensure that there is adequate ventilation or a ventilation system when using chemicals in order to prevent asphyxiation. Safety-toed boots protect feet and toes from dropped objects. Working in egress, you are exposed to numerous noise hazards. Earplugs and/or ear defenders protect against damaging noise when around aircraft engines, shop vacuums, and AGE equipment. Safety helmets or hard hats provide protection from impact and penetration of falling objects. Use safety helmets or hard hats any time cranes are used to remove egress components from aircraft or move egress components inside the egress shop.

Job safety training outline

Your supervisor must develop a workcenter-specific job safety training outline (JSTO) on safety, fire protection/prevention, and health requirements. Supervisors can reference [AFI 91-202](#) for additional information on preparing a JSTO. When you become a supervisor, you will document and maintain your subordinates' completed safety training in your work area on the AF Form 55, Employee Safety and Health Record, or equivalent product. The JSTO is an outline of mandatory safety training items that supervisors use to prepare a job safety-training guide.

Mandatory items

The JSTO lists mandatory items that must be briefed to your subordinates. You discuss the following areas in detail with your subordinates upon initial assignment prior to starting work or when work conditions or tasks change. This information is documented on the AF Form 55 or equivalent (fig. 2-13). Deployed and installation commanders may add more stringent requirements, but the mandatory items are as follows:

- Hazards of the job and specific safety guidance that applies to their workplace.
- Hazards of the work area environment to include awareness of the hazard communication program requirement ("Employee's Right to Know").
- Proper personal lifting techniques.
- Location of medical facilities and procedures for obtaining treatment.
- Location and use, as appropriate, of emergency and fire protection equipment.
- Emergency procedures that apply to the workplace, including evacuation, fire reporting, emergency numbers, alarm and extinguisher location(s).
- Requirements and procedures for reporting mishaps, occupational injury, and occupational illness.
- Immediately report unsafe equipment, conditions, or procedures to supervisor immediately.
- Requirements of Air Force traffic safety program, including mandatory use of seat belts and helmets, speed limits, local traffic hazards, personal risk management, and cell phone prohibition while operating a vehicle on base. If applicable, discuss motorcycle safety training requirements before riding a motorcycle.
- Purpose and location of AF Form 457.
- Location and content of Air Force Visual Aid ([AFVA](#)) 91-209, *Air Force Occupational Safety and Health Program*.
- Purpose of the AF Form 1118.

Job specific training items

These items are to be accomplished as required based on job tasks and documented prior to your subordinates performing the task. You will select specific training subjects based on the needs of the job and provide application-level training.

NOTE: Subjects listed below may not be mandatory for every job but dependent up on the type of job or tasks your subordinates will be performing.

- PPE (use, location, fit, care, limitations).
- Hazardous energy control (lockout/tagout).
- HAZCOM.
- Blood borne pathogens.
- Hearing conservation.
- Confined space program (entrant, attendant, supervisor, monitor, and rescue team).
- Manual and powered hoist.
- Respiratory protection program.
- Vehicle-mounted, elevated work platforms, and self-propelled and manual platforms.
- Fall arrest system(s).
- Forklift (material handling equipment).
- Explosives safety training.
- Pole/tower climbing.
- Wearing jewelry in the workplace.
- Portable and fixed ladder safety.
- Cardiopulmonary resuscitation (CPR) training.
- Flightline driving.
- Fetal protection program (job specific).
- Medical surveillance examination (scheduling, administration, reporting, and follow-up).

As with the mandatory items, you document the job-specific training items on AF Form 55 or equivalent product.

Maintenance and disposition

Maintain AF Form 55 or equivalent product as prescribed by the Air Force Records Information Management System (AFRIMS) records disposition schedule. When your subordinates deploy or transfer to another Air Force position or location, the AF Form 55 or equivalent product is hand-carried to the new supervisor by the individual. The new supervisor reviews the AF Form 55 or equivalent product, transfers current training completion dates as necessary, and initials HAZCOM date and other one-time training to a new AF Form 55 or equivalent product (if necessary) and retains the old form in accordance with the Air Force records disposition schedule. One year after personnel separate or retire, the supervisor destroys the AF Form 55.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

010. Egress hazards

1. What are the three noise factors that affect hearing loss?
2. What are some early symptoms that indicate that you have been exposed to potentially damaging sound?
3. What two protection devices can be used together to provide increased protection from higher noise level exposures?
4. What does RF radiation consist of?
5. What basic precaution can you take to avoid exposure to RF radiation?
6. What is an imbalance in the amounts of positive and negative charges in the surface of objects?
7. What is a possible hazard that could result from removing an ABU top?
8. What measure can you take in extremely cold weather to reduce the risk of static electricity?
9. When you approach an aircraft to perform maintenance, what is the first indication that the aircraft is armed?
10. List three major danger areas that exist around an operating jet engine.
11. What do red stripes along the side of a jet engine shroud or AGE equipment indicate?
12. What is the main hazard of an aircraft's variable wing feature?

13. What are some examples of power-actuated surfaces?
14. What are the greatest hazards inside fighter and bomber aircraft cockpits?
15. Prior to closing a canopy, what must be accomplished always?
16. At a minimum, what steps does an FOD check of your vehicle consist of?
17. List five causes of major accidents involving electricity.
18. Why should egress personnel not perform maintenance beyond a 12-hour shift?
19. Which two terms are empowered to all personnel to halt any action that may be developing into a hazardous situation?
20. What does verbalizing the terms “knock-it-off” or “time-out” convey to those involved in a specific action?

011. Job safety procedures

1. What is the first rule of good housekeeping?
2. What PPE should you use any time cranes remove egress components from aircraft or move egress components inside the egress shop?
3. When you become a supervisor, what will you use to document your subordinates' completed training?
4. When would you accomplish job specific training?

2-3. Explosives Safety Program

In the preceding sections, we discussed both general Air Force and egress-specific safety procedures. The procedures discussed are more critical to egress technicians than most other Airmen because our primary job is safety—the safety of the aircrew members is of utmost importance to our line of work. Since we have covered general safety procedures, in this section we will turn our focus to the bread and butter of our career field—egress explosives. Without explosives, we might still be launching pilots out of failing airplanes with giant springs. As you can imagine, that would prove very inefficient! Throughout the evolution of ejection seats, engineers have discovered that explosives are the quickest and most efficient method for aircrew member egress. However, the very term “explosive” means that we must take extra precautions in order to get the job done. In the past, many egress technicians have been hurt, maimed, or killed in accidents involving explosives. As the technology evolves, ejection seats and ejection systems become increasingly safer, but there are still hazards involved with working on explosives. The more you know about the hazards, the safer you and your coworkers will be.

We begin with a discussion about explosive safety principles and talk about training, standards, and responsibilities. Next, we talk about how to store explosives including basic criteria, egress-specific criteria, storage compatibility, and general storage arrangement. Then, we move on to the basics of transporting explosives. We finish with an area that you will become more familiar with as you progress in rank and may even become an additional duty manager for—the explosive safety training program.

012. Operations

As an egress journeyman, you must be thoroughly familiar with the handling precautions, personnel limits, explosive limits, and the general housekeeping rules required when you are working on or near explosives. This lesson builds on your previous training.

Handling precautions

Only properly trained personnel under the direct supervision of someone who thoroughly understands the hazards and risks involved must handle explosives. Stress to all workers that when they are handling explosives, their own safety, as well as the safety of others, is at stake.

Carry egress explosive components in protective containers designed to prevent item-to-item contact and marked to identify the contents. This is one way to accomplish two important goals: prevent damage to components and prevent inadvertent actuation.

REMEMBER: You *should not* tumble, drag, drop, throw, roll, or “walk” any explosives container.

Personnel limits

The following is the cardinal rule when any operation involving explosives is planned or conducted:

“Expose the minimum number of people to the minimum amount of explosives for the minimum amount of time.”

If you are responsible for establishing personnel limits, as outlined in [AFMAN 91-201](#), then you should design explosive operations to ensure minimum exposure of personnel to explosives in compliance with the above-mentioned cardinal rule. Supervisors are responsible for enforcing personnel limits.

Use the following guidelines to help establish personnel limits during explosive operations:

- Use the cardinal rule to prohibit tasks not necessary to the explosives operation within the immediate vicinity of the hazard. Use good judgement when non-egress maintainers are in the area performing maintenance on other systems. Preventing them from performing their duties, could unnecessarily delay maintenance.

- Do not permit unnecessary personnel to visit the operation. Official visits by casuals such as safety, QA, or other inspection personnel is always permitted, but must be supervised. Halt operations, if visitors other than authorized personnel, are present.
- Whenever concurrent operations must be performed in a single building, the operational layout must allow for quantity/distance requirements. This is normally not a concern with egress explosives.
- When explosives are present, clearly post supervisor, worker, and visitor limits at each explosive operation. Locally written instructions containing personnel limits will suffice in lieu of posting. Supervisors are responsible for ensuring these limits are not exceeded.

Explosive limits

Explosive limits are based on the *minimum quantity* of explosives necessary for the operation. The *maximum* amount of explosives of each class/division allowed will be clearly posted in each room or building used for storing explosives. Separate posting of explosives limits is not required at licensed locations when the license is posted conspicuously.

General housekeeping

Keep explosives areas clean at all times. Keep waste materials, oily rags, and combustible scrap (i.e., paper, wood, etc.) separated in approved, properly marked containers. Empty the containers at least once each working day or shift. However, be sure you empty them as often as needed.

Explosive facility-specific fire prevention





We discussed general fire prevention information in section 1-1. As you would expect, there are additional fire prevention principles specific to explosive facilities. The best method of fire prevention is to follow closely known and established fire safety practices. The following are some common sense practices:

- Never allow spark- or flame-producing devices to be brought into explosives areas.
- Never store empty or excess packing or shipping containers in an explosives storage area.
- Limit the use of devices that produce temperatures higher than 228 degrees Fahrenheit (°F) to essential and temporary use. Never use them where exposed explosives are present.
- Vehicle and AGE parking areas need to be a minimum of 100 feet from the licensed location. There may be exemptions to this, so check with AFMAN 91-201 and local policies to be certain.
- Do not temporarily park vehicles within 25 feet of any building containing explosives unless the vehicle is actively being loaded or unloaded. (Temporary means the length of time for which the presence of the vehicle or AGE is essential to completion of a single task)

Fire symbols

Fire symbols provide guidance for fire-fighting forces, security forces, and other concerned personnel when explosives are involved in a fire. Each symbol is shaped distinctively with the class/division number shown.

The fire symbols, hazards, and fire-fighting precautions are summarized below.

HAZARD DIVISION 1.1	HAZARD DIVISION 1.2	HAZARD DIVISION 1.3	HAZARD DIVISION 1.4
Mass Detonation Hazard 	Non-mass Explosion, Fragment Producing 	Mass Fire, No Blast or Fragment 	Moderate Fire, No Blast or Fragment 
<ul style="list-style-type: none"> - Do not fight fire unless rescue attempt is planned. - If there is suitable separation to symbol 1 materials and senior fire officer approves, fire-fighting forces may attempt to extinguish the fire. - If personal safety is in doubt, take cover. 	<ul style="list-style-type: none"> - Give alarm; attempt to extinguish fire if in early stage. - Fight the fire if possible. If not possible, prevent spread of fire. - Provide protection from fragmentation in case of detonation. 	<ul style="list-style-type: none"> - May be fought if explosives are not directly involved. - If white phosphorus (WP) munitions are involved, smoke is liberated. - WP munitions may explode. - Immerse phosphorus in water or spray with water continuously. - For fires involving hexachlorethane (HC) and incendiaries use dry sand or dry powder in early stage. - For fires involving pyrotechnics and magnesium incendiaries: - Protect adjacent facilities and equipment. - Do not use carbon dioxide, halon extinguishers, or water on or near munitions. - Allow magnesium to cool unless upon flammable material. In this case, use a 2-inch layer of dry sand or powder on the floor, rake the burning material onto this layer, and re-smother. 	<ul style="list-style-type: none"> - Fight these fires. - Expect minor explosions and hot fragments.

Posting explosives location

Post the symbols for the most hazardous material present near all storage locations so as to be seen from any approach roads used by the fire department. Place the smaller-sized symbols on the entrances to small rooms or areas within large buildings being used for storing or holding authorized quantities of explosives.

The person in charge of the explosives operation is responsible for posting or changing fire symbols and notifying the base emergency communication center (ECC) of any change without delay. If explosives are removed from that location, and the fire symbol is changed, the person in charge of the operation is responsible for ensuring the ECC is promptly notified of the change.

013. Storage procedures

Before explosives can be stored in your work center, four specific criteria must be met:

1. Basic storage criteria.
2. Egress-specific criteria.
3. Storage compatibility criteria.
4. General storage arrangement criteria.

Basic storage criteria

A segregated area must be set aside for the exclusive storage and maintenance of explosives. Other supplies should not be placed in explosives storage areas and operating rooms except as authorized in applicable directives. To be acceptable for normal storage, explosives must have an assigned hazard classification that includes the class/division and storage compatibility group designation.

Egress-specific criteria

In [AFMAN 91-201](#), *Explosives Safety Standards*, the net explosive weight (NEW) and NEW for quality distance (NEWQD) means the total quantity of explosive material found inside an explosive component (expressed in pounds). For example, an advanced concept ejection seat (ACES) II emergency power supply has a NEW value of 0.26 and depending on the part number, a rocket catapult can have a NEW of 25 or 42, depending on the MDS it is used on.

Egress shops must have a place to store explosives when they are removed from an aircraft. A limited quantity of in-use egress explosives components of any class/division (including 1.1) may be held in the licensed storage area when these items are removed from aircraft undergoing maintenance. The quantity must not exceed the total number of complete sets for the number of aircraft in maintenance. The following special provisions apply:

- Store ejection seats, canopies, and explosives components not undergoing actual maintenance in a licensed storage location (commonly referred to as “the bomb room”). When maintenance is complete or at a stopping point, remove the component from the maintenance area and store it in the bomb room.
- Within the egress maintenance work area, the NEWQD limitations identified in [AFMAN 91-201](#) apply to the number of seats and spare components undergoing maintenance at any one time.
- Turn in unserviceable items to the base storage activity as soon as possible. The NEWQD counts against the total NEWQD listed on the facility license.

Storage compatibility

Explosive items are assigned to compatibility groups for storage and transportation. Explosives are considered compatible if they may be stored or transported together without significantly increasing either the probability of an accident or, for a given quantity, the magnitude of the effects of such an accident. There are 13 explosives compatibility groups: A–H, J, K, L, N, and S. In some instances, items bearing the same general nomenclature, such as rockets and catapults, must be assigned to

different groups because of variations in the basic characteristics of some models or types of rockets and catapults. Two examples follow:

1. F-16 canopy rockets are 1.3 explosives while the F-22 canopy rockets are 1.2 explosives.
2. B-52 catapults are 1.4 explosives while F-16 catapults are 1.3 explosives.

Information concerning the assigned storage compatibility group for specific explosives items can be found by logging in to the Joint Hazard Classification System (JHCS) website (<https://www3.dac.army.mil>). To determine whether or not you may store explosive items together, cross reference the item's compatibility group from JHCS with the Storage Compatibility Mixing Chart found in AFMAN 91-201 (fig. 2-14).

CG	A	B	C	D	E	F	G	H	J	K	L	N	S
A	X	Z											
B	Z	X	Z	Z	Z	Z	Z					X	X
C		Z	X	X	X	Z	Z					X	X
D		Z	X	X	X	Z	Z					X	X
E		Z	X	X	X	Z	Z					X	X
F		Z	Z	Z	Z	X	Z					Z	X
G		Z	Z	Z	Z	Z	X					Z	X
H								X					X
J									X				X
K										Z			
L													
N		X	X	X	X	Z	Z					X	X
S		X	X	X	X	X	X	X	X			X	X

Figure 2-14. Storage compatibility mixing chart.

Explosives facility license

Displayed somewhere in your explosive-storage location you can will find an AF Form 2047, Explosives Facility License, and it will contain all the information AFMAN 91-201 requires. Section I contains basic information about the location. Section II covers the explosives you are allowed to store. Section II is broken down into columns labeled A-F containing the following information:

- **Column A:** Hazard class/division.
- **Column B:** Compatibility group.
- **Column C:** Nomenclature, which includes the national stock number (NSN) or DOD identification code (DODIC).
- **Column D:** Quantity, which is the number of authorized items allowed to be stored in the facility, serviceable and unserviceable.
- **Column E:** Total NEWQD based on the number of items authorized (this number does not apply to HD 1.4 items).
- **Column F:** The appropriate fire-fighting symbol and chemical symbol.

In section III, the commander of the organization or the functional manager requesting the license will be the certifying official. Section IV is the individual assigned as installation weapons safety manager and a remarks section where the installation fire protection agency will enter the specific

type, quantity, and physical placement of fire extinguishers for the location, as well as any additional fire prevention practices. Finally, section V contains the agencies the license needs to be coordinated through, prior to the approval of the weapons safety office:

- Munitions Accountable System officer.
- Security forces resource protection office (which needs to physically inspect the facility to ensure certain requirements have been met).
- Installation fire protection agency.

For more information about the explosive license, see chapter 11 in AFMAN 91-201.

General storage arrangement

Always observe precautions governing the arrangement of explosives. For example, give items that could be self-propelled priority for storage in facilities providing the greatest protection from the results of inadvertent ignition. Forward-firing explosives such as guns, rockets, missiles, and flare dispensers pose an additional hazard, and should point toward a substantial restraining construction or barricade because of their directional response and potential long-range hazard if inadvertently activated on the ground. If there is no restraining construction, position the items in such a way as to present the least hazards.

NOTE: Ejection-seat catapults and other egress system rockets are not classified as forward-firing munitions. According to Technical Order (TO) 11P1-31-7, *Rocket Catapult—Specialized Storage and Maintenance Procedures*, the principal explosive hazard associated with rocket catapults is fire and light missile.

A mistake often made in egress shops is storing serviceable and unserviceable explosive items in the same locker. Segregate serviceable items from unserviceable items, to prevent possibly installing an unserviceable item in an egress system.

014. Explosives transportation

As you would expect, there are times when explosives must be transported from one area to another. To do this safely and properly, certain rules and procedures have been established. In this lesson, we discuss four requirements for transporting explosives:

1. Vehicle requirements.
2. Vehicle inspections.
3. Operator requirements.
4. Explosive movement routes.

Vehicle requirements and vehicle inspections

The following table provides the information about requirements for vehicles used for transporting explosives. Vehicles used to transport explosives are considered explosive-laden vehicles. As you see in the table, there are eight vehicle requirements and five inspection requirements.

Requirements for Vehicles Transporting Explosives	
Type	Description
Vehicle requirements	<ul style="list-style-type: none"> • Move explosives only in an approved manner and in acceptable military vehicles. • Never move explosives in a private vehicle. • Cargo-type trucks or vans are preferred for the general transportation of explosives; however, they must have provisions for securing the explosives during transit. • No person may ride on or in the cargo compartment of a motor vehicle transporting explosives except as provided for in AFMAN 91-201. • Passengers may ride in compartments that do not contain explosives if they can be seated safely.

Requirements for Vehicles Transporting Explosives	
Type	Description
	<ul style="list-style-type: none"> • Never transport explosives in the passenger compartment of a vehicle. • Cover exposed ferrous metal in cargo compartments of vehicles before loading explosives not packaged in Department of Transportation specified containers or equivalent. • Explosives-laden vehicles must have at least two type 2A:10BC extinguishers. (In accordance with AFMAN 24-306, <i>Operation of Air Force Government Motor Vehicles</i>, one fire extinguisher must be located outside of the cab on the driver's side and the other inside the cab.)
Inspection requirements	<ul style="list-style-type: none"> • Ensure fire extinguishers are filled and in good working order. • Ensure electric wiring is in good condition and properly attached. • Ensure fuel tank and feed lines are secure and not leaking. • Ensure brakes, steering, lights, horn, and windshield wipers are functioning properly. • Ensure tires are properly inflated and free of defects.

Specifically for our career field, ejection seats and survival kits with explosive devices installed must contain required safety pins and devices, and be secured to prevent movement during transit.

Government-owned vehicles used to transport explosives must be inspected by competent personnel daily or at a frequency in accordance with local policies. This inspection is to ensure vehicles are in good mechanical condition and all safety appliances are in good order.

Operator requirements

Operators of vehicles and equipment used in transporting and handling explosives must be carefully selected, physically fit, trained, tested, and informed of the explosive hazards involved. They must be fully qualified in the operation of the type of vehicle being used. In addition, Air Force civilian drivers must have a commercial driver's license (CDL) with a hazardous materials endorsement in order to transport explosives off a military installation.

To ensure safe operation, the operator must give special attention to explosives-laden vehicles during parking, loading, and unloading movements. Special attention must be given to the following:

1. Use wheel blocks when the vehicle is parked.
2. Never refuel a vehicle within an explosives area or while explosives are on board.
3. Never load or unload explosives from a vehicle while the engine is running.
(**EXCEPTION:** Where the engine is required to provide power to support equipment used in loading and unloading the vehicle).
4. Load explosive containers in a way that will keep them from moving while they are being transported.
5. Never leave explosives-laden vehicles unattended.

Explosive movement routes

Weapons safety will designate the safest possible primary and alternate explosives movement routes to cover all phases of movement. Routes will avoid, to the maximum extent possible, built-up areas and key, mission-oriented facilities and equipment. According to AFMAN 91-201, movements of munitions to and from licensed storage locations like the egress shop are not restricted to designated routes, but your base may have requirements that more stringent.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

012. Operations

1. Who may handle explosives?
2. When should explosive operations be halted?
3. Where is the maximum amount of explosives of each class/division clearly posted?
4. How often must waste containers be emptied?
5. Which hazard class/division would you *not* use a carbon dioxide, halon, or water extinguisher to fight a fire?

013. Storage procedures

1. What does NEW and NEWQD mean?
2. What should happen to explosives when not undergoing maintenance?
3. When are explosive items considered compatible?
4. Where would you look to see the compatibility group for a specific explosive?
5. On the AF Form 2047, what information is in column D?
6. On the AF Form 2047, which agencies coordinate the license prior to being signed by the weapons safety office?
7. Which publication contains information about establishing and maintaining an explosive license?

8. How should self-propelled explosives be stored if no restraining construction is present?

014. Explosives transportation

1. How many fire extinguishers must be present on a vehicle transporting explosives and where should they be located?
2. What should happen to explosive-laden vehicles when parked?
3. How should an explosive-laden vehicle never be left?

2-4. Nuclear Surety Program

Perhaps no other weapons have had as great a psychological or political impact on the world than nuclear weapons. Most of the world's population realizes the severe consequences of a nuclear war. Just as important as the capability to deliver these nuclear devices is the necessity for an effective nuclear safety program.

Nuclear operations are not as visible a component of national security as they were during the Cold War; however, nuclear forces continue to underwrite our nation's security. The Air Force must ensure its corporate nuclear enterprise is reinvigorated. All Air Force personnel involved in nuclear operations must maintain the highest standards of professional integrity and discipline so our nuclear capability remains credible in the eyes of potential adversaries. The results of an accidental peacetime nuclear detonation would be extremely serious for our country (fig. 2-15). The political repercussions alone would deal a stunning blow to our foreign relations. People in any way associated with the nuclear weapons program must be constantly alert to prevent such an accident.



Figure 2-15. Nuclear weapons.

In this section, we explore three areas that apply to the nuclear surety program: (1) characteristics of nuclear surety, (2) the personnel reliability program (PRP), and (3) the two-person concept and no lone zone.

015. Characteristics of nuclear surety

Perfection is the standard for the safety, security, and reliability of nuclear weapons operations. The Air Force accomplishes this through a stringent nuclear surety program. This program applies to materiel, personnel, and procedures that contribute to the safety, security, and control of nuclear weapons. The goal is to assure there are no nuclear accidents, incidents, loss, or unauthorized or accidental use. The Air Force continues to pursue safer, more securable, and more reliable nuclear weapons consistent with operational requirements.

Adversaries and allies should be highly confident of the United States Air Force's ability to secure nuclear weapons from accidents, theft, loss, and accidental or unauthorized use. This day-to-day commitment to precise and reliable nuclear operations is the cornerstone to the credibility of our nuclear deterrence mission. There are three key characteristics of nuclear surety: (1) safety, (2) security, and (3) reliability.

Safety

All individuals involved with nuclear weapons are responsible for the safety of the nuclear devices. Because of the destructive potential of these weapons, and the possibility that their unauthorized or accidental use might lead to war, safety is paramount. Per [DODD 3150.02](#) four specific nuclear surety standards must be met.

1. There shall be positive measures to prevent nuclear weapons involved in accidents or incidents, or jettisoned weapons, from producing a nuclear yield.
2. There shall be positive measures to prevent *deliberate* prearming, arming, launching, or releasing of nuclear weapons, except upon execution of emergency war orders or when directed by competent authority.
3. There shall be positive measures to prevent *inadvertent* prearming, arming, launching, or releasing of nuclear weapons in all normal and credible abnormal environments.
4. There shall be positive measures to ensure adequate security of nuclear weapons.

These safety measures include inherent warhead design features that prevent accidental or unauthorized nuclear yields, delivery platform design features, and operational procedures that prevent accidental or unauthorized use. The positive measures may take the form of mechanical systems, such as permissive action links that do not allow the arming or firing of a weapon until an authorized code has been entered. They may also involve personnel monitoring systems, such as the PRP or the two-person concept.

Commanders are responsible for ensuring appropriate systems are in place, as described by appropriate Air Force policies. To track the implementation of these positive measures, the Air Force certifies its nuclear weapons systems. The Air Force's nuclear certification program includes safety design, weapon compatibility, personnel reliability, technical guidance, specific job qualifications, inspections, and weapons system safety rules (WSSR). Refer to [AFI 63-125](#), *Nuclear Certification Program*, and [AFI 91-101](#), *Air Force Nuclear Weapons Surety Program*, for more specific guidance.

Weapons system safety rules

WSSRs ensure nuclear weapons are not detonated, intentionally or otherwise, unless authorized. Safety rules apply even in wartime. While commanders may deviate from a specific rule in an emergency, they may not expend a nuclear weapon until an authentic execution order has been received. This has led to the so called "usability paradox." Nuclear weapons must be "usable enough" so an enemy is convinced they may be rapidly employed in the event of an attack. They must not be so "usable" as to allow for the unauthorized use due to individual action or mechanical error.

WSSRs are implemented through a combination of mechanical means, security procedures, flying rules, and personnel programs. Different weapon systems will have different rules based on their capabilities. Storage and movement of weapons must be consistent with WSSRs. Commanders and operators must follow applicable Air Force policies for their weapon system and must ensure that non-US personnel adhere to applicable Air Force and multinational requirements. One key component of WSSR is that, while preventing the unauthorized use of nuclear weapons, they allow for timely employment when ordered. To this end, all personnel involved in the command, control, and support of nuclear weapons must be familiar with WSSR for their system.

Security

Nuclear weapons and their components must not become vulnerable to loss, theft, sabotage, damage, or unauthorized use. Nuclear units must ensure measures are in place to provide the greatest possible deterrent against hostile acts. Should this fail, security should ensure detection, interception, and defeat of the hostile force before it is able to seize, damage, or destroy a nuclear weapon, delivery system, or critical components. Commanders are accountable for the safety, training, security, and maintenance of nuclear weapons and delivery systems, and reliability of personnel at all times. Commanders should limit the exposure of nuclear weapons outside of dedicated protection facilities consistent with operational requirements. Commanders must ensure nuclear weapons and nuclear delivery systems are maintained according to approved procedures. Commanders are responsible for considering the additional needs incurred if nuclear capabilities are deployed into their operational area.

A security infrastructure exists at bases that routinely handle nuclear weapons. However, weapons and their delivery systems may be moved to other bases to enhance survivability or may be deployed into a theater. Commanders at such locations must ensure that appropriate storage facilities are established and that proper security measures are in place. The storage of nuclear weapons on a base not only requires a secure location and additional security personnel, but also other areas such as driving routes, local flying area restrictions, aircraft parking areas, the use of host-nation or contract personnel, and other aspects of day-to-day operations. Note, too, that weapons are most vulnerable in transit or when deployed for use, so special care must be taken at those times. Commanders and, in fact, all individuals have a responsibility for force protection, and the security of nuclear weapons is a key component of that concept. All effected personnel must understand Air Force policies that outline security requirements.

Airmen should neither confirm nor deny the presence or absence of nuclear weapons at any general or specific location. This United States policy applies even if a particular location may reasonably be assumed to contain nuclear weapons, such as a missile launch facility or a bomber base. The goal of this policy is:

“To deny militarily useful information to potential or actual enemies, to enhance the effectiveness of nuclear deterrence, and contribute to the security of nuclear weapons, especially against the threats of sabotage and terrorism.” ([DODD 5230.16](#), *Nuclear Accident and Incident Public Affairs (PA) Guidance*.)

Reliability

The Air Force employs positive measures to ensure the reliability of its nuclear weapons systems and personnel in order to accomplish the mission. Reliability is also a product of the system’s safety features, including safety design, weapon compatibility, personnel reliability, technical guidance, specific job qualifications, and nuclear technical inspections. Independent inspections and staff assistance visits are also an integral part of maintaining nuclear surety.

Weapon system reliability

Through sustainment, testing, and modernization, the Air Force ensures the reliability of nuclear weapon systems. The Air Force engages the Department of Energy’s National Nuclear Security

Administration and other government agencies to ensure nuclear warheads and related interfaces continue to meet Air Force warfighting requirements. The Air Force continues to provide essential leadership of interagency reliability groups to include test planning, interface requirements and performance, and warhead design reviews.

016. Personnel reliability program

Speaking of PRP, DOD Manual ([DODM](#)) [5210.42R AFMAN 13-501](#), *Nuclear Weapons Personnel Reliability Program (PRP)*, establishes Air Force requirements and policy for the implementation of the PRP to select and maintain reliable individuals to perform duties associated with nuclear weapons. The PRP applies to active duty, Reserve, and National Guard units possessing nuclear weapons or nuclear command and control systems and equipment, and any activity certified by a service inspection activity as “nuclear capable.”

Purpose

Commanders need to ensure only trained, certified, and reliable people have access to nuclear weapons, and nuclear weapons systems. The PRP initially qualifies, certifies, and then monitors personnel assigned to nuclear operations tasks throughout their assignment. PRP is a DOD program designed to select and maintain personnel whose conduct and behavior demonstrate the highest levels of integrity, reliability, trustworthiness and allegiance to the United States. Only those who meet those standards will be authorized to perform duties on or around nuclear weapons or nuclear weapons systems. The PRP is not intended to act as a quality control tool to decertify or disqualify individuals solely for assignment purposes or risk avoidance. The denial or eligibility or the revocation of certification for assignment to PRP positions is neither a punitive measure nor the basis for disciplinary action. The failure of an individual to be certified for assignment to PRP duties does not necessarily reflect unfavorably on the individual’s suitability for assignment to other duties.

Selection

If selected for a PRP assignment your base or unit PRP monitor you will contact you. The monitor will provide you with initial PRP program training and then the monitor and your losing commander will perform an initial screening to determine your PRP eligibility. It is the losing commander’s responsibility to ensure the administrative qualification is completed within 60 days of assignment or training notification. When screening you for your PRP eligibility, the PRP monitor looks at seven areas:

1. Do you have the appropriate level security clearance?
2. Do you have a positive attitude?
3. Do you have United States’ citizenship?
4. Do you have any disciplinary issues?
5. Do you have any substance abuse issues?
6. Do you have technical competence?
7. Do you have medical approval?

NOTE: Your medical records will be reviewed by medical personnel only and if potentially disqualifying information is found. Only a competent medical authority grants approval.

Potentially disqualifying information

Potentially disqualifying information (PDI) is any information which may cast doubt about an individual’s ability or reliability to perform duties related to nuclear weapons. Some examples of PDI are listed:

- Financial irresponsibility.
- Legal issues.

- Traffic violations or citations.
- Alcohol related problems.
- Medical issues.

After your PRP monitor provides you with PRP training, you will fill out a PRP questionnaire. At that time, you will self-identify any PDI. Your PRP monitor then reviews your files in the personnel records display application (PRDA) to look for PDI. Some gaining commanders may also request copies of your last five enlisted performance reports (EPR). The PRP monitor may conduct interviews with your supervisors to determine PDI as well.

Meanwhile, your PRP package is sent to your medical treatment facility (MTF) PRP monitor for review. MTF reviews your medical records. If PDI is found in your medical records, a competent medical authority (CMA) generates a memorandum for your losing and gaining commanders and recommends either approval or disqualification.

Administrative certifier review and interview

Once your PRP monitor receives the PRP package back from the MTF, you will be scheduled for an administrative certifier interview. The administrative certifier may be your commander or your commander's vice, deputy, or equivalent (such as your maintenance officer). After the interview, the administrative certifier recommends approval or disqualification and your PRP package is forwarded to your gaining commander for consideration.

The gaining commander holds the final say on whether or not you will be approved for PRP duty. If you are denied, you will receive a different assignment. If you are approved, you are only administratively certified. You will continue on your permanent change of station to the PRP base and upon arrival, you will go through the actual certification process.

Certification

When you arrive at a PRP assignment, you will go through a certification process similar to that used administratively to select you for the assignment. The following are the reliability standards expected of all PRP members:

- Physical competence, mental alertness, and technical proficiency commensurate with duty requirements.
- Dependability in accepting responsibilities and effectively performing in an approved manner; flexibility in adjusting to changes in the working environment, including the ability to work in adverse or emergency situations.
- Good social adjustment, emotional stability, personal integrity, sound judgement, and allegiance to the United States.
- Positive attitude toward nuclear weapons duty, to include the purpose of PRP.

Your security clearance, medical records, and personnel files will be examined again to determine your PRP eligibility.

Continuous evaluation

After you are certified, you will be evaluated continuously and any PDI, such as traffic tickets, must be disclosed to your commander or certifying official. Commanders or certifying officials are responsible for ensuring all military, civilian, and contractor personnel assigned to PRP positions meet all of the requirements of the continuing evaluation process. They must also observe the behavior and performance of members certified under the PRP on a frequent and consistent basis. In addition, each time you receive a medical evaluation and/or treatment that may affect performance or reliability, the CMA must determine PRP reliability effects and, if warranted, make recommendations to the commander or certifying official.

017. Two-person concept and no lone zone

Two techniques that the Air Force employs to ensure compliance with established nuclear procedures are the two-person concept and the no lone zones. These techniques are essential to protect our nuclear enterprise.

Two-person concept

The two-person concept is central to nuclear surety tamper control measures in the Air Force. It is designed to make sure that a lone individual cannot perform an incorrect act or unauthorized procedure on a nuclear weapon, nuclear weapon system, or certified critical component. A two-person concept team consists of at least two individuals who meet the following qualifications:

- Are certified under PRP.
- Know the nuclear surety requirements of the task they perform.
- Can promptly detect an incorrect act or unauthorized procedure.
- Have successfully completed nuclear surety training.
- Are designated to perform the required task.

The two-person concept is violated when a lone individual in a no lone zone has the opportunity to tamper with or damage a nuclear weapon, nuclear weapon system, or certified critical component. Violations must be reported in accordance with [AFI 91-204](#), *Safety Investigation and Hazard Reporting*.

No lone zone

A no lone zone is an area where the two-person concept must be enforced because it contains a nuclear weapon, nuclear weapon system, or certified critical component. No lone zones must be identified by each organization with a mission or function involving the nuclear mission.

No lone zones require special safety wiring and sealing methods. The first method is seals composed of a malleable material installed with a crimping device and controlled die in order to form an impressed distinctive mark or unique identifier. The second method is seals applied with a self-locking, non-reversible feature with a unique serial number or alpha, color control system. Both types of seals are used with safety wire connected to certain switches, covers, handles, or levers. Breakage or alteration of the wire or seal provides evidence and/or detection of possible unauthorized acts, access, or tampering.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

015. Characteristics of nuclear surety

1. What characteristic of nuclear surety includes inherent warhead design features that prevent accidental or unauthorized nuclear yields, delivery platform design features, and operational procedures that prevent accidental or unauthorized use?
2. What rules ensure nuclear weapons are not detonated, intentionally or otherwise, unless authorized?
3. What characteristic of nuclear surety includes procedures for moving nuclear weapons to other bases to enhance survivability?

4. What type of nuclear reliability deals with engaging the Department of Energy's National Nuclear Security Administration and other government agencies to ensure nuclear warheads and related interfaces continue to meet Air Force warfighting requirements?

016. Personnel reliability program

1. What is the purpose of the PRP?
2. List five examples of PDI that may cast doubt about an individual's ability or reliability to perform duties related to nuclear weapons.
3. Who holds the final say on whether you will be approved for PRP duty?
4. After you arrive at a PRP assignment, you will go through a certification process. What are the standards to qualify for PRP certification?

017. Two-person concept and no lone zone

1. When is the two-person concept violated?
2. What are two methods for safety wiring and sealing within a no lone zone?

Answers to Self-TEST Questions

006

1. Your supervisor.
2. If you exhibit a lack of understanding or skill with the required work task, hazards involved with the work task, or the PPE.
3. AFMAN 91-203.
4. Arrangement of equipment.
5. Poor housekeeping, dangerous surface conditions, and inadequate lighting.
6. A ladder with conductive side rails.
7. It can result in serious injury or death.
8. (1) Climbing, ascending, or descending activities where personnel could fall or jump from elevated surfaces (ladders, scaffolds, roofs, etc.). (2) Warehousing, parts handling, operating equipment, packing and crating, and attaching and detaching equipment to tow vehicles. (3) Moving machinery, rotating or revolving parts, or any task that could result in hands caught in moving parts. (4) Exposing personnel to energized electrical circuits. (5) Performing maintenance or inspections on aircraft or ground support equipment.

007

1. Any real or potential condition that can cause injury or occupational illness to personnel; damage to or loss of a system, equipment, or property; or damage to the environment.
2. Report it to your supervisor or the appropriate local agency.
3. Submit an AF Form 457 to the base safety office.
4. By plotting the probability that a mishap will occur and its potential severity.

008

1. AFI 90-821.
2. General information about the chemical: identification, hazards, composition, safe handling practices, and emergency control measures.
3. The chemical manufacturer or supplier, installation or unit Hazardous Materials Pharmacy, DOD HMIRS on-line or CD-ROM, or through the ESOH-MIS. If the SDS is not available from these sources, the bioenvironmental flight may be contacted for further assistance.
4. Section 8.

009

1. Your USR.
2. Place them in an area free of combustibles and on non-combustible surfaces. Unplug them at the end of the day unless they have integral timers. There is no need to unplug coffee makers with integral timers.
3. **SPEED. Sound the alarm. Phone the fire department. Evacuate the building. Extinguish the fire if possible. Direct the firefighter to the fire.**
4. (1) d.
(2) c.
(3) e.
(4) b.
(5) a.

010

1. Intensity of the noise, frequency (Hertz) level of the noise, and duration of exposure to the noise.
2. Faintness, nausea, pain in the ears, and vertigo.
3. Earplugs and earmuffs.
4. Electric and magnetic energy waves.
5. *Never* stand in the beam of a nearby radar antenna.
6. Static electricity.
7. Static charge.
8. Use a warm metal object, such as a wrench, to make contact with a grounding point to prevent your skin from freezing to the grounding point.
9. Warning signs placed near the cockpit entrance and safety pins with red streamers installed on armed devices.
10. Engine intake, turbine plane of rotation, and exhaust.
11. The engine's plane of rotation danger area.
12. You could be caught between the trailing edge of the wing and the leading edge of the horizontal stabilizer or the overwing fairing.
13. Speed brakes, spoilers, flight control surfaces, weapon bay doors, and arresting tail hooks.
14. The explosive charges that eject seats, canopies, and hatches.
15. Read the warnings, cautions and notes in applicable technical data, and ensure the cockpit sill is free of foreign objects.
16. Inspect your tires. Ensure all external vehicle components are secured. Secure any/all items loaded on payload vehicle, including all tie-down device loose ends such as chains, ropes, packaging or other item

that may become dislodged during movement while on the flightline area. A thorough walk around the vehicle to check for damaged, loose, or worn parts.

17. Short circuits, overloading, accidental grounding, poor electrical contacts, and misuse of equipment.
18. Physical and mental fatigue. If you are not alert, your attention to detail is lessened and the possibility for human error increases.
19. Knock-it off and time-out.
20. Stop and take a moment to reset and reevaluate the current situation.

011

1. Personal cleanliness.
2. Safety helmets or hard hats.
3. AF Form 55, Employee Safety and Health Record or equivalent product.
4. As required based on job tasks and documented prior to your subordinates performing the task.

012

1. Only by properly trained personnel under the direct supervision of someone who thoroughly understands the hazards and risks involved.
2. Halt operations if visitors, other than authorized personnel, are present.
3. In each room or building used for storing explosives.
4. The containers must be emptied at least once each working day or shift. However, always be sure that you empty them as often as needed.
5. 1.3

013

1. Net explosive weight (NEW) and net explosive weight for quality distance (NEWQD) means the total quantity of explosive material found inside an explosive component (expressed in pounds).
2. Store ejection seats, canopies, and explosives components not undergoing actual maintenance in a licensed storage location (*commonly referred to as "the bomb room"*). When maintenance is completed or at a stopping point, remove the component from the maintenance area and store it in the bomb room.
3. If they may be stored or transported together without significantly increasing the probability of an accident or, for a given quantity, the magnitude of the effects of such an accident they are considered compatible.
4. On the Joint Hazard Classification System (JHCS) website (<https://www3.dac.army.mil>).
5. Quantity –the number of authorized items allowed to be stored in the facility, serviceable and unserviceable.
6. Munitions Accountable System officer, security forces resource protection office, installation fire protection agency.
7. Chapter 11, AFMAN 91-201.
8. Give these items priority for storage in facilities providing the greatest protection from the results of inadvertent ignition. Position them in such a way as to present the least hazards.

014

1. They must have at least two extinguishers—one mounted outside the cab on the driver's side and the other inside the cab.
2. Use wheel blocks.
3. Unattended.

015

1. Safety.
2. WSSRs.
3. Security.
4. Weapon system reliability.

016

1. The program is designed to select and maintain personnel whose conduct and behavior demonstrate the highest levels of integrity, reliability, trustworthiness, and allegiance to the United States. Only those who meet those standards will be authorized to perform duties on or around nuclear weapons or nuclear weapons systems.
2. Financial irresponsibility; legal issues; traffic violations or citations; alcohol related problems; medical issues.
3. Gaining commander.
4. Physical competence, mental alertness and technical proficiency commensurate with duty requirements. Dependability in accepting responsibilities and effectively performing in an approved manner; flexibility in adjusting to changes in the working environment, including the ability to work in adverse or emergency situations. Good social adjustment, emotional stability, personal integrity, sound judgement and allegiance to the United States. Positive attitude toward nuclear weapons duty, to include the purpose of PRP.

017

1. When a lone individual in a no lone zone has the opportunity to tamper with or damage a nuclear weapon, nuclear weapon system or certified critical component.
2. The first method is seals composed of a malleable material installed with a crimping device and controlled die in order to form an impressed distinctive mark or unique identifier. The second method is seals applied with a self-locking, non-reversible feature with a unique serial number or alpha, color control system. Both types of seals are used with safety wire connected to certain switches, covers, handles, or levers.

Complete the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to AFCDA.

18. (006) When does Air Force Occupational Safety and Health (AFOSH) training end?
 - a. It never ends.
 - b. When you graduate from basic military training.
 - c. When you complete the 2A653 career development course.
 - d. When you graduate from aircrew egress systems apprentice school.
19. (006) Who must ensure you are trained on the hazardous chemicals or materials to which you are exposed?
 - a. Your flight chief.
 - b. Your supervisor.
 - c. Your unit commander.
 - d. Your unit's explosive safety noncommissioned officer.
20. (006) Besides a good design and proper lighting what else contributes to a safe walking or working surface?
 - a. Detour signs.
 - b. Maintenance.
 - c. Close supervision.
 - d. Routine inspections.
21. (006) An aircraft maintenance stand is considered in a *safe condition* when the guardrails are
 - a. installed and secured with clevis pins.
 - b. installed and secured with safety wire.
 - c. installed and secured with quick release pins.
 - d. temporarily installed for ease of maintenance.
22. (007) The *first step* in reporting a hazard is to
 - a. report it to your commander and first sergeant.
 - b. report it to your supervisor or appropriate local agency.
 - c. submit an AF Form 457, USAF Hazard Report, to the base safety office.
 - d. submit an AF Form 457, USAF Hazard Report, to the Inspector General.
23. (007) When a hazard reported on an AF Form 457, USAF Hazard Report, is corrected, the safety office investigator must report the corrective action to the originator within how many *working* days?
 - a. 1.
 - b. 3.
 - c. 10.
 - d. 15.

24. (007) An AF Form 1118, Notice of Hazard, can be removed from a hazard
- when the commander orders its removal.
 - after the hazard has been investigated by the base safety office.
 - if two working days have elapsed since the hazard was corrected.
 - after verification by the issuing authority that the identified hazard has been corrected satisfactorily.
25. (008) What Air Force publication establishes guidance for training employees on the health and physical hazards associated with and proper preventive measures to be taken when using or handling hazardous chemicals in work centers?
- AFI 90-821, *Hazardous Communication*.
 - AFOSH STD 91-66, *General Industrial Operations*.
 - AFOSH STD 91-501, *Air Force Consolidated Occupational Safety Standard*.
 - AFI 91-301, *Air Force Occupational and Environmental Safety, Fire Protection, and Health Program*.
26. (008) Safety data sheets (SDS) must be reconciled with the work center's hazardous chemical inventory
- monthly.
 - annually.
 - quarterly.
 - every 10 days.
27. (008) If you come in contact with a chemical, which section of the safety data sheet (SDS) contains first-aid measures?
- Section 1.
 - Section 3.
 - Section 4.
 - Section 10.
28. (009) What Air Force publication establishes *specific requirements* for fire protection and prevention?
- AFI 90-821, *Hazardous Communication*.
 - AFI 91-66, *General Industrial Operations*.
 - AFMAN 91-203, *Air Force Occupational Safety, Fire, and Health Standards*.
 - AFI 91-301, *Air Force Occupational and Environmental Safety, Fire Protection, and Health Program*.
29. (009) If allowed to use a space heater in your work center, what is the *minimum distance* between the space heater and any heat producing appliance or combustible items?
- 12 inches.
 - 18 inches.
 - 24 inches.
 - 36 inches.
30. (010) The three main factors that affect hearing loss are intensity of the
- noise, proximity of the noise, and duration of exposure to the noise.
 - noise, frequency of the exposure, and duration of exposure to the noise.
 - noise, frequency level of the noise, and duration of exposure to the noise.
 - duration, frequency level of the noise, and proximity of exposure to the noise.

-
-
31. (010) The areas of the body *most vulnerable* to radio-frequency (RF) radiation exposure are the
- eyes and ears.
 - eyes and testes.
 - fingers and toes.
 - eyes and stomach.
32. (010) What is the *best protection* against static-charge buildup?
- Wear insulated footwear.
 - Dissipate static buildup through a ground.
 - Wear multiple garments as much as possible.
 - Wear gloves when touching a grounding point.
33. (010) What are considered the danger areas in relation to an aircraft with engines operating?
- 200 feet in front or 25 feet to the rear of an aircraft.
 - 25 feet in front or 200 feet to the rear of an aircraft.
 - 25 feet in front or 250 feet to the rear of an aircraft.
 - 250 feet in front or 200 feet to the rear of an aircraft.
34. (010) Who may approve egress personnel to perform maintenance past a 12-hour shift and for what reason(s)?
- MXG/CC, during exercises or Wing level inspections only.
 - Installation commander, only during exercises or Wing level inspections.
 - MXG/CC, only during advance defense readiness conditions actual emergencies.
 - MXG/CC, only to accomplish explosive maintenance if a training sortie will not be met otherwise.
35. (010) A reason someone would need to say “knock-it-off” or “time-out” would be when
- a maintainer feels the need for a break in a stressful environment.
 - a moment is needed to reset and reevaluate a possibly hazardous situation.
 - an operation is redundant or needless, and not required for mission success.
 - an urgent operation creates a situation that makes maintenance crews feel overwhelmed.
36. (011) Which form will you use to document your subordinates’ completed work area safety training?
- AF Form 2, Apprenticeship Safety Standards.
 - AF Form 55, Employee Safety and Health Record.
 - AF Form 77, Workcenter Safety Evaluation.
 - AF Form 552, Pre-hospital Evaluation/Care Report.
37. (011) You will discuss mandatory Job Safety Training Outline (JSTO) items with your subordinates upon initial assignment prior to starting work or
- when the work center’s explosive symbol is upgraded.
 - during a weekend safety briefing.
 - before starting an explosive operation.
 - when work conditions or tasks change.
38. (011) When personnel are separated or retire, their AF Form 55 will be destroyed after
- three years.
 - three months.
 - one year.
 - one month.

39. (012) If you are responsible for establishing explosives operation personnel limits, which guideline should you consider?
- a. Quality assurance (QA) is responsible for ensuring personnel limits are not exceeded.
 - b. Allow your squadron commander to visit an explosive operation with no restrictions.
 - c. At each operation when explosives are present, post supervisor, worker, and visitor limits.
 - d. Prior to starting any explosive operation, notify the base fire department of supervisor, worker, and visitor limits.
40. (012) Each time your egress shop's fire symbol is changed, which agency(s) should be notified?
- a. Security forces law enforcement desk.
 - b. Base emergency communication center (ECC).
 - c. Base safety and the maintenance operations center (MOC).
 - d. Base fire chief and the MOC.
41. (013) Which statement is *not* true about net explosive weight (NEW)?
- a. The total weight of the entire component is included in calculating the NEW.
 - b. A rocket catapult's NEW can contain between 25 or 42 pounds of explosive material.
 - c. Unserviceable explosives awaiting turn-in, *do* count against the NEW limits authorized.
 - d. In the maintenance area, NEW limits apply to the number of seats and spare components undergoing maintenance.
42. (013) The AF Form 2047, Explosive Facility License, for the egress section does *not* need to be coordinated through the
- a. Security forces resource protection office.
 - b. Munitions Accountable System officer.
 - c. Installation fire protection agency.
 - d. Installation's Judge Advocate.
43. (013) Serviceable and unserviceable egress explosive items *must* be
- a. mixed.
 - b. enclosed.
 - c. segregated.
 - d. condemned.
44. (014) Explosives are moved only in an *approved manner* using
- a. private vehicles.
 - b. military vehicles.
 - c. contractor vehicles.
 - d. aerospace ground equipment (AGE).
45. (014) Government motor vehicles used to transport explosives must be equipped with
- a. at least one dry chemical fire extinguisher.
 - b. two fire extinguishers, both inside the cab.
 - c. two fire extinguishers, both outside the cab.
 - d. two fire extinguishers, one inside and one outside the cab.
46. (014) The daily explosive-laden vehicle inspections include ensuring that
- a. the fuel tank and feed lines are secure and not leaking.
 - b. all fire extinguishers are mounted outside the vehicle.
 - c. all electric wiring is in fair condition and poses no chances of arcing.
 - d. tires are inflated 5 pounds per square inch (psi) below recommended psi.

-
-
47. (014) When can you load or unload explosives from a vehicle with the engine running?
- a. Never.
 - b. When a fully qualified operator remains at the wheel of the vehicle.
 - c. When the engine is required to provide power to support equipment used in loading and unloading the vehicle.
 - d. When the engine is required to provide power to support equipment used in removing and installing aircraft canopies.
48. (015) Nuclear safety is the responsibility of
- a. all egress journeymen.
 - b. only security forces personnel.
 - c. all individuals involved with nuclear weapons.
 - d. only those individuals charged with command of nuclear units.
49. (016) What program is designed to select and maintain personnel whose conduct and behavior demonstrate the highest levels of integrity, reliability, trustworthiness and allegiance to the United States to perform duties associated with nuclear weapons?
- a. No lone zone.
 - b. Two-person concept.
 - c. Personnel integrity program.
 - d. Personnel reliability program.
50. (016) A personnel reliability program (PRP) package must be completed within how many days of assignment or training notification?
- a. 30.
 - b. 60.
 - c. 90.
 - d. 180.
51. (016) Which is *not* a standard that is required to qualify for PRP certification?
- a. Physical competence, mental alertness, and technical proficiency commensurate with duty requirements.
 - b. Good social adjustment, emotional stability, personal integrity, sound judgment and allegiance to the United States.
 - c. Positive attitude toward nuclear weapons duty, to include the purpose of PRP.
 - d. Poor attitude and/or a lack of motivation.
52. (017) What concept is designed to ensure that a lone individual cannot perform an incorrect act or unauthorized procedure on a nuclear weapon, nuclear weapon system, or certified critical component?
- a. Two-person.
 - b. No lone zone.
 - c. Nuclear surety.
 - d. Personnel reliability program.
53. (017) No lone zones are identified by
- a. applicable technical orders.
 - b. the secretary of the Air Force.
 - c. each organization with a mission or function involving the nuclear mission.
 - d. each major command (MAJCOM) with a mission or function involving the nuclear mission.

Student Notes

Please read the unit menu for unit 3 and continue ➡

Unit 3. USAF Technical Order System

3-1. Technical Order System.....	3-2
018. Index-type technical orders.....	3-2
019. Operations and maintenance technical orders.....	3-4
020. Time compliance technical orders.....	3-12
021. Methods and procedures technical orders.....	3-14
022. Abbreviated technical orders.....	3-16
3-2. Maintenance Assistance and Improvement Reports.....	3-20
023. Maintenance assistance.....	3-20
024. Technical order improvement reports.....	3-21

IMAGINE AN F-16 performing a roll maneuver and the ejection seat travels up the rails making the pilot hit his helmet on the canopy (it HAS happened). He lands safely, but someone has a lot to answer for! You and your supervisor performed an egress final the day of the flight. A thousand things run through your head, but the worst thought is that you did not use demand-response procedures to follow the technical data in the technical order and your supervisor failed to verify the seat was secured to the rocket catapult with the washer and nut. Your mistake could have cost someone's life.

Figure 3-1 shows a potential consequence of not following technical data. Do not let this scenario happen to you! Technical orders are written to be followed. In fact, technical orders are published under authority of the Secretary of the Air Force. That means they are directed orders from the Secretary of the Air Force and disobeying technical data is the same as disobeying a direct order.



Figure 3-1. Potential consequence of not following technical data.

There are many types of Air Force technical orders and publications. You need to learn what publications you need, where to locate them, and how to use them. As an egress journeyman, you will use technical orders more often than other publications. Your duties will expand to include other publications move in rank into a supervisory position. Nevertheless, now is the time to become well acquainted with all the types of AFIs, technical orders, and other basic publications.

The Air Force and the DOD has moved to digital forms of publications. In the old days, technical data was only paper and sent to your shop by mail (postal). Now we have almost everything in digital format that is readable on all sorts of platforms like electronic tools (eTools), which are ruggedized laptop computers, tablets, and desktop personal computers.

In this volume, we cover the subject areas that lay the foundation to build your knowledge base of the technical orders systems used in the Air Force. We first cover the Air Force technical orders system. Then we discuss the methods used for using and correcting technical orders.

3-1. Technical Order System

The purpose of the Air Force technical order system is to provide clear, concise instructions for the safe and effective operations and maintenance (O&M) of centrally acquired and managed Air Force military systems and end items. The secretary of the Air Force authorizes the publication of technical. Each technical order provides the necessary information and instructions to operate, install, maintain, inspect, and modify the equipment or system it covers. There are over 90,000 technical orders used throughout the Air Force, and all of them fall into one of the five categories. You will use many various types of technical orders and support data, and each type fills a certain need. Let us discuss the five types of technical orders you will use throughout your career in egress:

1. Index technical orders.
2. O&M technical orders.
3. TCTOs.
4. Methods and procedures technical orders (MPTO).
5. Abbreviated technical orders.

018. Index-type technical orders

Technical orders that list other technical orders are called TO indexes. These indexes are designed to provide a means of selecting needed technical orders specific to items of equipment and that show the status of all technical orders. As an egress journeyman, you will deal with four primary indexes:

1. Technical order catalog.
2. Special technical order indexes.
3. Enhanced Technical Information Management System (ETIMS)
4. Lists of applicable publications (LOAP).

Technical order catalog

The technical order catalog provides information about all active, rescinded, and superseded TOs. The TO catalog is assessable via the ETIMS website that can easily be accessed through the Air Force Portal. The Tech Order List, New TOs and New Increments screens list technical orders satisfying user-entered search criteria. In addition, it provides technical order estimated delivery date (EDD), technical order history, equipment cross-referencing, and catalog notes. The ETIMS catalog is updated in real time with information for newly assigned TOs, TO increments (revisions, changes or supplements), TCTO headers, TCTOs, renumbered TOs, and reinstated/reactivated technical orders. This information is displayed by conducting an ETIMS Tech Order List and New Increments wildcard (*) search. Complete TO information (i.e., metadata) for all TOs is real time in ETIMS and displayed on the TO Detail screen. Information associated with all TO publication status changes is displayed in real time. This includes information for technical orders that were rescinded or reinstated, superseded/distributed, and/or renumbered.

Special technical order indexes

These indexes cover special classes of technical orders such as nuclear weapons support. Nuclear weapons technical orders are indexed in TOs 0-1-11N and 0-1-11N-1-CD-1. Another example of

special technical order indexes is TO 0-1-71, *Consolidated Security Assistance Technical Order Index*, which covers technical orders used by security assistance countries.

All other category 0 technical orders have been replaced by the TO catalog in ETIMS.

ETIMS

ETIMS is an electronic system used to acquire, improve, publish, catalog, manage, store, distribute, and display official technical orders needed for a safe and effective operation of the Air Force weapon systems and equipment. It is a principal automated technical order management application created to establish and manage information about Air Force technical orders. ETIMS also features an active electronic TO (eTO) content repository, an eTO publisher/transformer, and an eTO viewer with online (connected) and portable (disconnected) modes. It disseminates current real time information on available technical orders, manages the TODO accounts for the ordering of technical orders and the maintenance of technical order records, and enables the viewing of electronic technical orders. ETIMS provides a direct on-line connectivity from every base into the management system to allow technical order ordering, submission of improvements, technical order account status, and even on-line distribution to your base.

LOAP

The LOAP is a complete listing of TOs for a specific weapons system, such as the F-22 aircraft, or for a piece of equipment. The main purpose of this technical order is to help you become familiar with the technical orders you may need for the system. If you need to know a technical order number for a particular aircraft, you can look at the LOAP. If tasked to establish a technical order file, the LOAP will provide you with the minimum technical order requirements. LOAPs are identified normally in the third or fourth group by -01. Figure 3-2 is an example of an F-22 LOAP technical order.

TO 1F-22A-01		CHAPTER 1 TECHNICAL ORDERS	
TO NUMBER	TITLE	TO NUMBER	TITLE
1094-13-7	STORAGE AND MAINTENANCE PROCEDURES - CANOPY REMOVAL HOIST ASSEMBLY, PN 2001-00-1, PN 2001-00-2, 1017-001, 1017-002, AND CREW ENTRY DOOR JETTISON HOIST ASSEMBLY, PN 1017-001 (DOUGLAS)	1094-13-8	AND RECOVERY EQUIPMENT AIRCRAFT FIRE DETECTION AND EXTINGUISHING EQUIPMENT (FIRE - CATEGORY)
13A5-56-11	EJECTION SEATS	13A5-1-1	AIRCRAFT FURNISHINGS - BELTS, SAFETY AND SHOULDER HARNESS
13A5-68-2	OPERATION AND MAINTENANCE INSTRUCTION WITH PARTS BREAKDOWN, ESCAPE SYSTEM ASSEMBLY	13A5-1-2	REPAIR, CLEANING, INSPECTION AND TESTING - AIRCRAFT SAFETY BELTS, SHOULDER HARNESS AND MISCELLANEOUS PERSONNEL RESTRAINT EQUIPMENT
13A5-70-1	TECHNICAL MANUAL - INTERMEDIATE MAINTENANCE - ESCAPE SYSTEM ASSEMBLY (MCDONNELL DOUGLAS)	13A5-1-3	GENERAL USE, INSPECTION, CLEANING, REPAIR AND TESTING - AIRCRAFT AUTOMATIC OPENING LAP BELTS
	OPERATION AND MAINTENANCE INSTRUCTIONS WITH ILLUSTRATED PARTS BREAKDOWN - ORGAN - ESCAPE SYSTEM ASSEMBLY	13A5-1-4	OPERATION AND MAINTENANCE INSTRUCTION WITH PARTS BREAKDOWN, ESCAPE SYSTEM ASSEMBLY
	PART NO. J109600-1, J109600-519, J109600-527, J109600-543, J109600-547	13A5-1-5	TECHNICAL MANUAL - INTERMEDIATE MAINTENANCE - ESCAPE SYSTEM ASSEMBLY (MCDONNELL DOUGLAS)
		13A5-1-6	OPERATION AND MAINTENANCE INSTRUCTIONS WITH ILLUSTRATED PARTS BREAKDOWN - ORGANIZATIONAL - ESCAPE SYSTEM ASSEMBLY (PART NO. J109600-1, J109600-519, J109600-527, J109600-543, J109600-547)
		13A5-1-7	DECELERATION DEVICES AND PERSONAL AND SURVIVAL EQUIPMENT (FIRE - CATEGORY)
		13A5-1-8	GENERAL - IDENTIFICATION MARKING OF AIR FORCE CLOTHING AND PERSONAL FLYING EQUIPMENT
		13A5-1-9	DECELERATION DEVICES - PARACHUTES
		13A5-1-10	CLEANING OF PARACHUTE ASSEMBLIES
		13A5-1-11	OPERATION - PERSONNEL PARACHUTE

31 MAY 2017

Figure 3-2. F-22 LOAP.

019. Operations and maintenance technical orders

As the name implies, O&M technical orders are written to provide operations and maintenance instructions including troubleshooting, calibration, and servicing. Many accidents and malfunctions on aircraft and equipment can often be traced back to a maintainer's failure to observe a requirement(s) specified in a technical order *human error*. You can bet if you ever damage a piece of equipment, the first question asked will be what step in the technical order were you on? As stated in the beginning of this unit, technical orders are published under the authority of the secretary of the Air Force and disobeying technical data is the same as disobeying a direct order. The importance of following technical data cannot be stressed enough, not just for the interest of the aircraft or the equipment you are working on, but for your own safety and the safety of others.

On-equipment organizational maintenance manual sets are O&M technical order sets that include job guides, general vehicle technical orders, and wiring diagram manuals. These technical order types are the most widely used by egress technicians because they provide detailed step-by-step procedures for the following:

- On-equipment operational checkout.
- Test.
- Repair.
- Adjustment.
- Removal and replacement of accessories.

Technical order organization

The Air Force uses a number of methods to determine how instructions are placed in technical orders. If the equipment is small and simple, all information might be in a single technical order. An example is shown on the technical order cover page illustrated in figure 3-3.

TO 13A1-1-1

TECHNICAL MANUAL**REPAIR, CLEANING, INSPECTION,
AND TESTING
OF****AIRCRAFT SAFETY BELTS, SHOULDER HARNESS,
AND MISCELLANEOUS PERSONNEL
RESTRAINT EQUIPMENT**

F41608-93-D-0526

BASIC AND ALL CHANGES HAVE BEEN MERGED TO MAKE THIS A COMPLETE PUBLICATION.

DISCLOSURE NOTICE - This information is furnished upon the condition that it will not be released to another nation without the specific authority of the Department of the Air Force of the United States, that it will be used for military purposes only, that individual or corporate rights originating in the information, whether patented or not, will be respected, that the recipient will report promptly to the United States, any known or suspected compromise, and that the information will be provided substantially the same degree of security afforded it by the Department of Defense of the United States. Also, regardless of any other markings on the document, it will not be downgraded or declassified without written approval of the originating United States agency.

DISTRIBUTION STATEMENT B - Distribution authorized to U.S. Government Agencies only (Administrative or Operational Use) (30 November 2000). Other requests for this document shall be referred to 406 SCMS/GUEE, Robins AFB, GA 31098. Questions concerning technical content shall be referred to AFLCMC/WNU Sustainment.

WARNING - This document contains technical data whose export is restricted by the Arms Export Control Act (Title 22, U.S.C., Sec 2751, et seq.) or the Export Administration Act of 1979, as amended, Title 50, U.S.C., App. 2401, et seq. Violations of these export laws are subject to severe criminal penalties. Disseminate in accordance with provisions of DoD Directive 5230.25.

HANDLING AND DESTRUCTION NOTICE - Comply with distribution statement and destroy by any method that will prevent disclosure of contents or reconstruction of the document.

Published Under Authority of the Secretary of the Air Force

21 AUGUST 2017**CHANGE 1 - 15 SEPTEMBER 2017**

Figure 3-3. TO 13A1-1-1 cover page.

When the technical orders for a system are too large to use easily, there may be separate technical orders for different types of information. Figure 3-4 illustrates an example of the division of technical manuals.

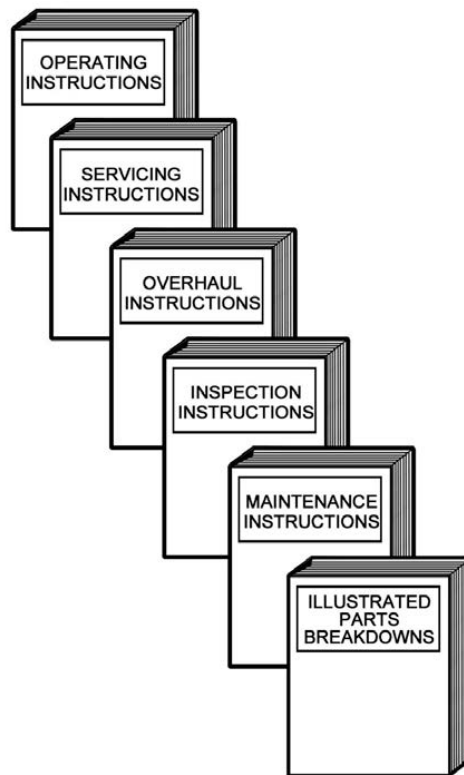


Figure 3-4. Division of technical manuals.

One way technical orders are more manageable is to combine instructions as shown in figure 3-5.

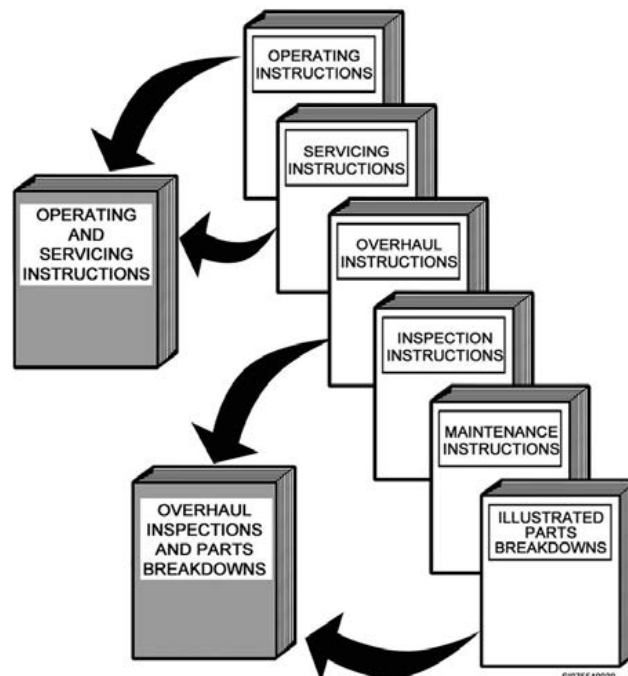


Figure 3-5. Sectionalized technical manuals.

Complex end items such as aircraft, systems, subsystems, and even sub-subsystems can be identified to make the technical order more manageable. Figure 3-6 shows how these technical orders may be divided. Here, the technical orders are divided by system.

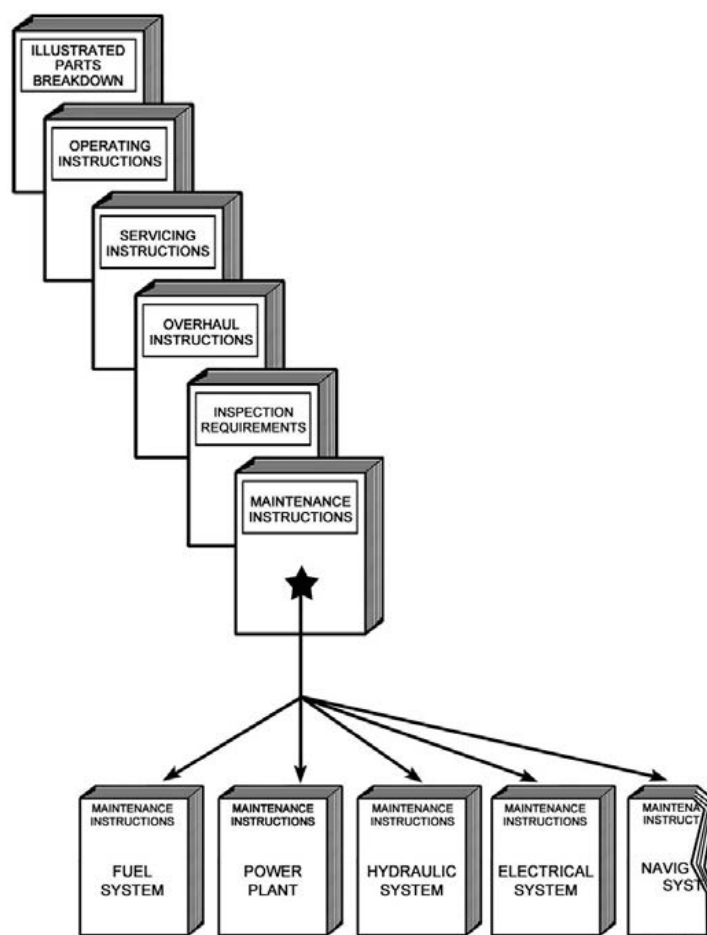


Figure 3-6. Sectionalized technical manuals divided by system.

Technical order categories

Did you ever wonder if a technical order number had anything to do with the type of equipment and systems they covered or if it was just a random number assignment? To answer this, look in TO 00-5-18, *AF Technical Order Numbering System*. We will not discuss all the material contained in the - 18. Instead, we will cover the methods used to find a technical order category.

First, you need to know the technical order number always begins with the technical order category. Technical orders are grouped into over 40 categories or broad general areas. You are familiar with the 1 for *Aircraft*. Other categories related to egress include:

0	Technical Order Catalog, Indexes, and Cross-Reference Table
00	Methods & Procedures Technical Orders
1	Aircraft
11	Armament Equipment
13	Aircraft Furnishings and In-Flight Feeding Equipment, Cargo Loading, Aerial Delivery and Recovery Equipment, Aircraft Fire Detection and Extinguishing Equipment
14	Deceleration Devices, Personal and Survival Equipment

32	Standard and Special Tools
33	Test Equipment

According to the table above, you can see category 11 technical orders covers armament equipment. Egress personnel use the 11P series, which cover egress systems, explosive devices, and equipment.

What if you want a component or system that is not listed in the table of contents? Maybe this component or system is part of a broader section and is listed as a category.

For example:

Say you need to know the TO category for canopies. Checking TO 00-5-18 table of contents first, you do not find canopies listed. So, you ask yourself, is the canopy part of a larger group that is a category? Now you have determined that the canopy is part of the airborne mechanical equipment category. This is listed as category 16. Your next step is to look at the section for category 16 to see how a canopy technical order number is developed. However, what if you did not know that the canopy is part of the airborne mechanical equipment? Is there somewhere else you can look to find the canopy?

Indeed there is! TO 00-5-18 also contains an alphabetical listing of equipment names. This can be very helpful if you only know the equipment name. When you locate the equipment name, the list references the beginning of the technical order number. Remember, the beginning of the technical order number includes the technical order category. Checking the alphabetical index, you find canopy assemblies listed under 16W2.

In addition to knowing the category of the technical order, you can also tell what information is in the technical order if you know the numbering pattern. Each category has a set pattern used to develop a technical order number. Each pattern is given in TO 00-5-18. Standardizing the numbering pattern for a technical order category helps you relate the technical order number to the equipment as well as the subsystems, type of manual, or type of instructions required for that category. Figure 3-7 gives an example of a number pattern used for the F-16 aircraft technical orders.

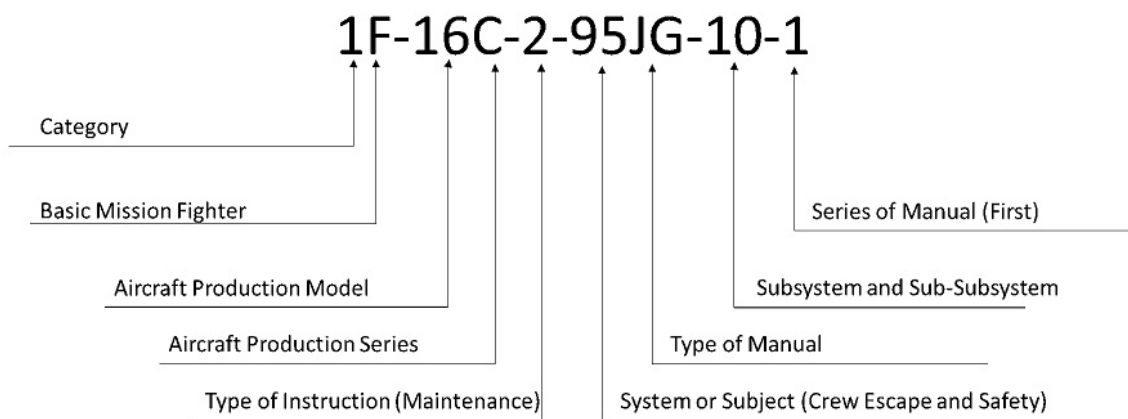


Figure 3-7. F-16 technical order number pattern.

Sectionalizing technical orders

We will use the aircraft technical order numbering system as an example for describing how technical orders are sectionalized. As mentioned before, if the equipment is small and simple, its instructions might be all contained in one technical order. However, if the equipment is large and complex, such as an aircraft, smaller groups must be formed. Sectionalizing begins at the fourth part of the technical

order number. Each division is a section of the original three-part number and develops its own number. Thus, the term *sectionalized* describes division of a technical order into sections or smaller technical orders.

TO 00-5-18 provides the numbering pattern for each technical order category of Air Force technical orders. In our discussion, we will use the detailed maintenance instructions for the F-16C aircraft. The technical order number begins as TO 1F-16C-2. Then it is divided by system, including crew escape and safety—now the technical order number is 1F-16C-2-95. However, the crew escape and safety section is still very large, so it is further subdivided into separate technical orders for specific items such as the seat. In this case the TO for the seat is 1F-16C-2-95JG-10 (JG is a job guide). For the canopy, the technical order number would be 1F-16C-2-95JG-20. As you might expect with complex systems, these instructions are still unmanageably large and can be subdivided still further into additional sections. This process creates such TOs as 1F-16C-2-95JG-20-1 and 1F-16C-2-95JG-20-2.

Sectionalizing offers two primary advantages:

1. It helps you locate information quickly.
2. It makes the technical order easier to handle.

You can also use another method to help further identify and sectionalize aircraft technical orders. Adding a letter group in the technical order number can be used to more specifically identify the type of manual. Examples of this letter grouping are discussed below:

- General vehicle (GV).
- General System (GS).
- Job Guide (JG).
- Fault Isolation (FI).

General vehicle or GV technical orders

General vehicle technical orders provide a general description of the aircraft and installed systems and provide general maintenance procedures or data applicable to two or more systems; however, they are not suitable for job guide format. The manual also contains an explanation of the technical order numbering system and the Maintenance Integrated Data Access System (MIDAS). It also has chapters that cover safety about the specific aircraft (e.g., the 1F-16CG-2-00GV-00-1 goes into detail about major component removal safety precautions). There are several recorded incidents of egress personnel causing the F-16 to tilt by removing the seat and canopy after the radar and gun systems were removed. If the engine is still installed, the one-sided balance causes the aircraft to tilt, like a seesaw at a playground. By following safety precautions outlined in the 00GV, these types of mishaps can be avoided. See figure 3-8 as an example of what can happen if technical data is not followed.

General system or GS technical orders

General system technical orders provide detailed descriptions of system and subsystem theories of operation. For example, TO 1F-16C-2-95GS-00-1 gives a detailed description of the crew escape and safety systems of the F-16C. The GS also lists special tools, test equipment, and detailed information to help your fabrication shop manufacture some special tools that cannot be bought (e.g., a seat retainer assembly [commonly called the raise bar]).



Figure 3-8. F-16D model tilted.

Job guide or JG technical orders

Job guide technical orders provide detailed procedures for equipment maintenance in a portable size intended to be used on the aircraft. However, now that eTools have replaced the majority of paper technical orders, size hardly matters anymore. (We will learn more about eTools in a later lesson). JG technical orders may be broken down into parts, with each part assigned its own technical order number. The table of contents shows how many parts make up the manual. Each JG contains complete start-to-finish maintenance instructions for each task in a logical step-by-step sequence (e.g., TO 1F-16CG-2-95JG-20-1 covers on-aircraft maintenance for the block 40/42 F-16C canopy system, fig. 3-9).

TO 1F-16CG-2-95JG-20-1	
TECHNICAL MANUAL JOB GUIDE	
ORGANIZATIONAL MAINTENANCE	
CANOPY JETTISON SYSTEM	
USAF SERIES	
F-16C/D	
AIRCRAFT	
BLOCKS 40 AND 42	
LOCKHEED MARTIN CORPORATION F3957-84-C-0047 F4920-01-D-0058	
<p>DISTRIBUTION STATEMENT E - Distribution authorized to DOD components only (Direct Military Support), 1 October 2017. Refer other requests for this document to AFMCMWMPB, 6080 Gun Ln, Sldg. 1212, HILAFB, UT 84056-5602.</p> <p>WARNING - This document contains technical data whose export is restricted by the Arms Export Control Act (Title 22, U.S.C. 2751, et seq.) or the Export Administration Act of 1979, as amended (Title 50, U.S.C., App. 2401, et seq.). Violations of these export control laws is subject to severe criminal penalties. Dissemination of this document is controlled under DoD Directive 5200.25.</p> <p>HANDLING AND DESTRUCTION NOTICE - For unclassified, limited documents, destroy by any method that will prevent disclosure of contents or reconstruction of the document.</p>	
BASIC AND ALL UPDATES HAVE BEEN MERGED TO MAKE THIS A COMPLETE PUBLICATION	
Published under authority of the Secretary of the Air Force.	
1 DECEMBER 2011	
CHANGE 8 - 1 OCTOBER 2017	

TABLE OF CONTENTS	
	Page
RD	VII
SUMMARY	XIX
I. MAINTENANCE PROCEDURES	
General	I-1
Access Panels and Doors	I-1
Cockpit Components Location	I-1
Installation of DTA/ECRL Lines	I-1
Connection of Electrical Power	I-5
Disconnection of Electrical Power	I-9
II. MAINTENANCE PROCEDURES	
Canopy Forward Frame Pairing or Forward Side Frame Pairing (Left or Right), Removal and Installation	2-1
Removal of Canopy Forward Frame Pairing	2-4
Installation of Canopy Forward Frame Pairing	2-6
Removal of Canopy Forward Nose Pairing Cover (Alternate Method)	2-12
Installation of Canopy Forward Nose Pairing Cover (Alternate Method)	2-14
Removal of Canopy Forward Side Frame Pairing	2-20
Installation of Canopy Forward Side Frame Pairing	2-24
Removal of Canopy Center Side Frame Pairing (Left or Right), Removal and Installation	2-31
Removal of Canopy Center Side Frame Pairing	2-34

Figure 3-9. Job guide.

Fault isolation or FI technical orders

Fault isolation technical orders provide information on fault isolation for a system or subsystem. These manuals help you work your way from a fault condition to the probable cause and then the remedy. On the crew escape system for the F-15C, you would need TO 1F-15C-2-95FI-00-1.

Illustrated parts breakdown

What about ordering parts for the job you are working on? There is a technical order for that! The illustrated parts breakdown (IPB) which lists part numbers, names, pictures, and other information needed to order parts or assemble a piece of equipment. When IPBs are too large to be a single book, they may be sectionalized (e.g., the 1F-16CG-4-95, the -4 indicates it is an IPB, and -95 sectionalizes it to crew escape and safety equipment systems). Figure 3-10 gives you an example of an F-16 canopy actuator that can be found in a sectionalized IPB. You may also find IPBs inside other technical orders (e.g., the IPB for everything on an ejection seat is located at the end of a 13A5 series TO).

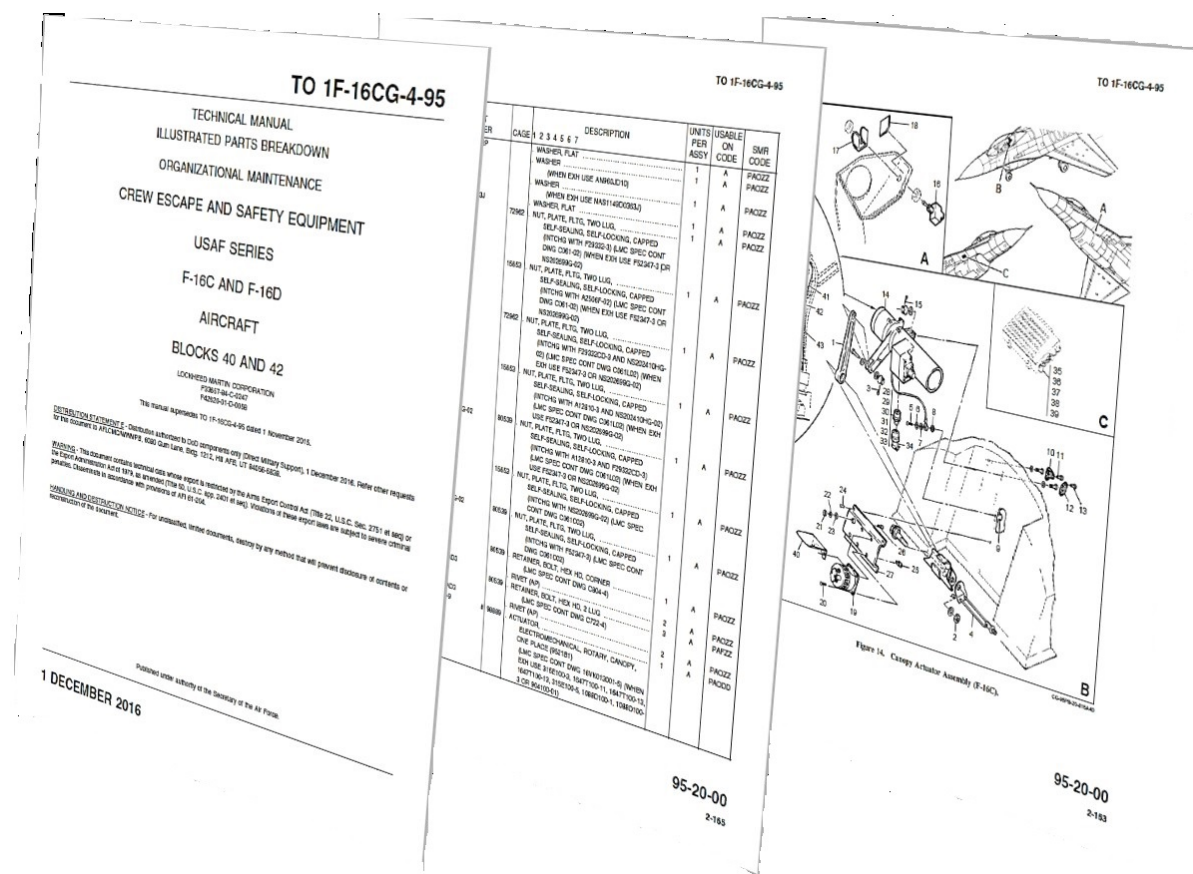


Figure 3-10. Sectionalized illustrated parts breakdown.

020. Time compliance technical orders

If your car is to retain its original design and performance characteristics, it requires continuous maintenance. At times, the manufacturer of your car may issue a recall to fix problems identified since the original manufacture. The same is true of Air Force aircraft and equipment. Besides the normal wear and tear of parts, sometimes aircraft and equipment have problems that are serious enough to cause injury to personnel or destruction of the affected equipment if not corrected.

When a problem like this arises, the Air Force issues an order, like a recall, to have the equipment inspected or modified. These are called time compliance technical orders. Modifications may be permanent or temporary. The orders may be first sent by electronic message and then issued as printed technical orders. TCTOs are the media through which modernization programs and extensive modifications are directed. Only permanent modifications are documented through TCTOs. Like a technical order, TCTOs are issued by order of the Secretary of the Air Force and will be complied in the same manner as a technical order.

As the name implies, TCTOs have a specified time within which you must accomplish the required task. The time depends on the degree of danger caused by the unsafe condition. If an unsafe condition could cause a fatal accident, the TCTO may order the use of the item halted until that condition is corrected.

TO 00-5-15 contains specific information on TCTOs. In the following paragraphs, we will discuss the three priorities of TCTOs you will encounter on the job:

1. Immediate action.
2. Urgent action.
3. Routine action.

Immediate action

Immediate action TCTOs are issued when unsafe conditions, if not corrected, could result in the following:

- Serious or fatal personal injury.
- Extensive equipment damage.
- Destruction of valuable property.

Issue of an immediate action TCTO is done through interim TCTO (ITCTO) messages. Because of their urgency, immediate action TCTO distribution is given a high priority, and commanders must ensure distribution to all affected personnel within four hours of receipt. If a formal publication of this TCTO is issued, the words IMMEDIATE ACTION are printed in red at the top center of the first page and a series of red Xs (XXXX) are printed around the border of the first page. As the name implies, immediate action TCTOs require immediate action to remove the concerned aircraft or equipment from service. Immediate compliance is required when directed.

Usually, the methods for correcting the unsafe condition are specified in the TCTO. Upon receipt of an immediate action TCTO, a red X is placed in the aircraft or equipment maintenance forms.

Urgent action

Urgent action TCTOs are identified by the words URGENT ACTION printed in red at the top center of the first technical order page, with alternately spaced red diagonals and red Xs bordering the first page. Urgent action TCTOs are issued when any of the following could result from the deficiency:

- Injury to personnel.
- Damage to property.
- Unacceptable reductions in combat efficiency.

Commanders shall ensure distribution to all affected personnel is made within 24 hours of receipt. Urgent action TCTOs specify the work must be done within a specified time limit after receipt of the TCTO. If the deficiencies specified in the TCTO have not been corrected and the time limit expires, actions must be taken to remove the aircraft or equipment from service.

Routine action

Routine action TCTOs are issued when material, mechanical, operational, or tactical deficiencies occur which could result in and of the following conditions:

- Constitutes a hazard through prolonged continued use.
- Has a negative effect on operational efficiency.
- Reduces tactical or support utility.
- Reduces the operational life of equipment.

We talked about the categories in which TCTOs can be issued—immediate, urgent, and routine action. These categories are divided further into types and levels, dependent upon what action is taken, by whom the action is taken, and the consequences if no action is taken. A TCTO can direct the inspection or modification of equipment. It can also be accomplished at base level or at the depot. Another distinction is whether the TCTO is directed for safety purposes. The responsible TCTO/modification manager under the authority of the responsible single manager issues all of them.

Eventually, the instructions in a TCTO are either included in another TO, such as an O&M technical order, or just deemed no longer necessary. Either way, the TCTO is rescinded. Rescission is what happens when the TCTO is made inactive and is taken out of publication.

021. Methods and procedures technical orders

Some technical orders are written on general subjects rather than equipment; these are called methods and procedures technical orders. MPTOs establish policies and prescribe procedures relating to such subjects as:

- Technical order system.
- Preventive maintenance.
- Scheduled equipment inspections.
- Maintenance management systems.

MPTOs can also involve instructions, methods, and procedures relating to ground handling of air and space vehicles, general maintenance practices, management of precision measurement equipment, and the safe use of Air Force equipment. An example of an MPTO is TO 00-25-234, *General Shop Practice Requirements for the Repair, Maintenance, and Test of Electrical Equipment* (fig. 3-11).

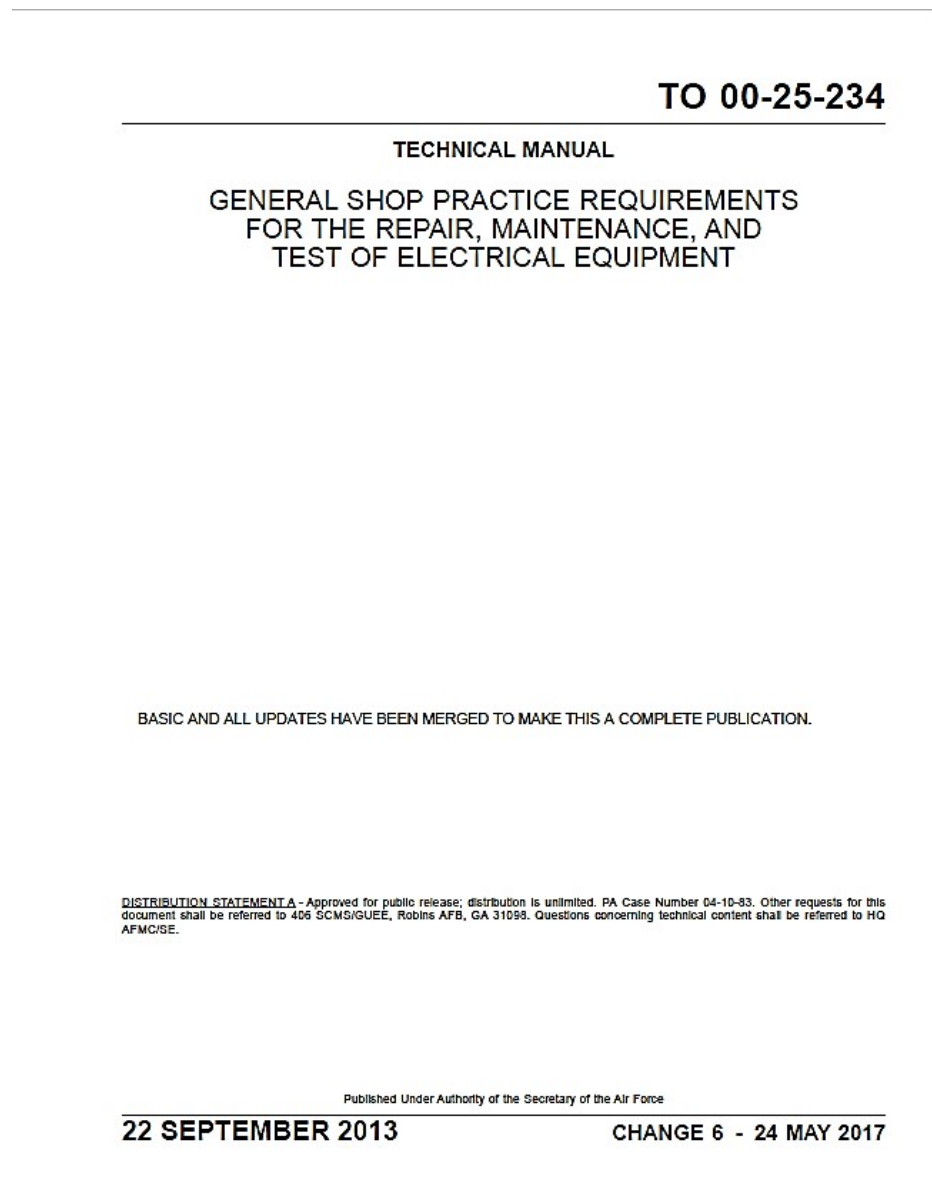


Figure 3-11. TO 00-25-234.

MPTOs use three basic groups in their numbering pattern. Sometimes a forth group may be used to sectionalize them by the equipment they cover. For this lesson, we will just cover the three basic groups, which are broken down as follows:

1. Group 1—designator 00 identifies it as an MPTO. All MPTOs begin with 00.
2. Group 2—may contain two parts. Part one is always one or more numeric characters that identify the subject matter series. Part two (if used) contains one or more alpha characters that further breakdown the subject into a subseries.
3. Group 3—one or more numeric characters that identify the specific type of technical order. Sometimes you might see alpha characters like CL, S, or SS, which indicate a series of checklists or supplements.

MPTOs are not required at the job site for DOD personnel. However, there are various series of MPTOs that are important to your job as an egress journeyman. The 00-5 series and the 00-20 series are two prime examples of MPTOs that we use on a regular basis.

00-5 series

The 00-5 series TOs are important to your job knowledge because this series provides information on the technical order system, TCTO system, and technical order numbering schemes. The important 00-5 series are discussed in the following table.

00-5 Series TOs	
Number	Title and Description
TO 00-5-1	<p><i>AF Technical Order System</i></p> <p>The 00-5-1 TO identifies and explains the various types of technical orders, management tools, and procedures for technical order accounts, ordering technical orders, and recommending technical order updates. It covers the concept and management of the USAF technical order system. It provides policy and assigns responsibilities on such subjects as technical order compliance and waivers; technical order improvement reporting; and the process of review, validation, and verification of technical orders.</p>
TO 00-5-18	<p><i>AF Technical Order Numbering System</i></p> <p>This particular system contains an alphabetical listing of equipment and gives the technical order category number where the equipment is located. This technical order lists all technical orders by equipment category. If you need to find the technical order category for stands, you would use this technical order. It also lists all technical order categories and shows examples of each category numbering system and the numbering series for each category.</p>

00-20 series

The 00-20 series of technical orders provide maintenance management information. The 00-20 series TOs discussed in the following table will apply to your job almost daily.

00-20 Series TOs	
Number	Title and Description
TO 00-20-1	<p><i>Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures</i></p> <p>This technical order covers the policies and procedures for use of the 00-20 series TOs and provides weapon system and equipment maintenance inspection and documentation guidance. The following are important areas that this technical order covers:</p> <ul style="list-style-type: none"> • Aerospace vehicle inspections. • Aerospace equipment forms documentation • Symbols and their use. • AFTO Form 781 series. • Accessory replacement and reuse procedures.

00-20 Series TOs	
Number	Title and Description
	<ul style="list-style-type: none"> • Support equipment (i.e., details how to fill out an AFTO Form 244). • Transfer, storage, and depot maintenance. • Maintenance historical documentation. <p>As stated, you will use the procedures in this technical order on an almost daily basis; most commonly, you will use this technical order to document aircraft forms and AGE forms. You will also use this technical order for IMDS entries, which we will discuss in Volume 2 of this CDC.</p>
TO 00-20-2	<p><i>Maintenance Data Documentation</i></p> <p>The 00-20-2 prescribes the rules for documenting entries on weapon systems, support systems, and equipment that have been selected for reporting by the equipment manager. It also explains the IMDS system. It provides an authoritative source for codes used and entries required in the maintenance data documentation process, reporting rules, and documentation for cannibalization actions.</p> <p>Its main purpose however, is to provide policy and guidance for individual maintenance activities (such as the egress shop) for the collection and documentation of maintenance data. It <i>does not</i> provide step-by-step procedures for filling out aircraft and equipment forms—that is provided by TO 00-20-1. We will discuss maintenance data collection in detail in Volume 2 of this CDC.</p>
TO 00-20-3	<p><i>Maintenance Processing of Reparable Property and the Repair Cycle Asset Control System</i></p> <p>TO 00-20-3 establishes policies and procedures for managing repair cycle assets. Repair cycle assets are items that must be repaired when possible (to save costs of replacement) and turned in to the repair cycle when not reparable (to be used for parts/condemned). Because of the high cost or high use of the items, their purchase, repair, and use is often tracked through the maintenance processing system. As an egress journeyman, you will use the procedures in this technical order most often when dealing with faulty actuators (e.g., the F-16 canopy actuator). We will discuss repair cycle assets in detail in Volume 2 of this CDC.</p>
TO 00-20-9	<p><i>Forecasting Replacement Requirements for Selected Calendar and Hourly Time Change Items</i></p> <p>TO 00-20-9 lists procedures and general policies for forecasting replacements time change items, such as egress explosives, environmental sensors, and recovery sequencers. This technical order tells you how to calculate due dates and how to establish dates of installation and manufacture for time change documentation. We'll discuss time change management in depth in Volume 2 of this CDC.</p>

022. Abbreviated technical orders

The last type of technical order we will discuss is the abbreviated technical order. The root word of “abbreviated” is “brief.” Excerpts or parts of one or more basic technical orders have been extracted and put into a single technical order, giving you specialized, slimmed-down instructions for specific tasks. One of the main advantages of abbreviated technical orders is that they simplify work. Included in this group are inspection work cards, sequence charts, and checklists. Let’s look at each type.

Inspection work cards

These are card sets that list, in checklist form, the inspection requirements given in the –6 aircraft inspection manual. They provide guidance, including applicable safety warnings, cautions and notes, and specific accept or reject criteria for performing an inspection. Like sectionalized technical manuals; inspection work cards are subdivided, as needed, to fit each inspection. You can take these technical orders on the job while you perform an inspection. Work card sets cover a specific type of inspection: normally, the system on which the inspection is to be performed. The inspection requirements on each card are arranged in a logical sequence. Pictures on the reverse of selected cards show the locations of components to be inspected. These work cards are used in conjunction with the inspection sequence charts. You will most often use these work cards in conjunction with an aircraft’s phase inspection. Figure 3-12 is an example of some inspection work cards.

PUBLICATION NUMBER
TO 35-1-246WC-1

INSPECTION REQUIREMENTS
INTRODUCTION

1. THESE WORKCARDS ARE DIVIDED INTO FOUR SECTIONS AS FOLLOWS:

FIGURE **CHANGE NO.** **CARD NO.**

WORKCARDS **TO 35-1-246WC-1**

PERIODIC INSPECTION

NON-POWERED AEROSPACE GROUND EQUIPMENT, AIRCRAFT GROUND SERVICING EQUIPMENT (FSC 1730), (FSC 3950), AND AIRFIELD SPECIALIZED TRUCKS AND TRAILERS (FSC 1740)

DISCLOSURE NOTICE: This information is furnished upon the condition that it will not be released to another nation without the specific authority of the Department of the Air Force of the United States, that it will be used for military purposes only, that individual or corporate rights originating in the United States, whether patented or not, will be respected, that the recipient will report promptly to the United States, any known or suspected compromise, and that the information will be provided substantially the same degree of security afforded it by the Department of Defense of the United States. Also, regardless of any other markings on the document, it will not be downgraded or declassified without written approval of the originating United States agency.

DISTRIBUTION STATEMENT C: Distribution authorized to U.S. Government Agencies and their contractors (Administrative or Operational Use) (26 May 2006). Other requests for this document shall be referred to 408 SCMS/GUEE, Robins AFB, GA 31098. Questions concerning technical content shall be referred to AFMCMW/SEV.

WARNING: This document contains technical data whose export is restricted by the Arms Export Control Act (Title 22, U.S.C., Sec 2751, et seq.) or the Export Administration Act of 1979, as amended, Title 50, U.S.C., App. 2401, et seq. Violations of these export laws are subject to severe criminal penalties. Dissemination in accordance with provisions of DoD Directive 6230.25.

HANDLING AND DESTRUCTION NOTICE: Comply with distribution statement and destroy by any method that will prevent disclosure of contents or reconstruction of the document.

31 OCTOBER 2017

Published Under Authority of the Secretary of the Air Force

RAL NON-OT APPLY S.
D MAINTEN-ER'S WAR-
ENT AREA NT/UNIT IS MAGE OR DETERMINE
UVALENT

Figure 3-12. Abbreviated technical orders - inspection work cards.

Inspection sequence charts

These come in sets similar to the work cards. However, sequence charts are used primarily for *scheduled* inspections. Also, they depict a basic planned work schedule or sequence in which the work cards may be used. The charts are a guide to preparing the actual work schedule for each inspection and are normally used by personnel such as the phase dock chief to control the assignment of work during an inspection.

Checklists

Checklists are lists of technical order items in abbreviated form. They guide the tasks or operations in the sequence deemed most practical to determine operational readiness of equipment and minimum serviceable condition. A checklist may be published for any of the following reasons:

- To prescribe sequential steps to be followed to preclude potential damage or degrade operational readiness of equipment.
- To preclude potential injury and/or damage to equipment.
- When two or more differing specialty skills (different shops) are involved in accomplishing a task.

The checklist number consists of the basic technical order number from which its information was taken, the letters CL (identifying it as a checklist), and the number of the checklist.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

018. Index-type technical orders

1. Where are all index-type technical orders in the 0 category found?
2. What is used to view electric technical orders?
3. What index-type technical order can you use to establish a technical order file for a specific weapon system?

019. Operations and maintenance technical orders

1. What types of technical orders are included in organizational maintenance manual sets?
2. Which technical order covers the Air Force's technical order numbering system?
3. Match the technical order category number in column B with its category in column A by writing the correct letter in the blank space provided. The technical order numbers in column B may be used only once.

<i>Column A</i>	<i>Column B</i>
____(1) Deceleration Devices, Personal and Survival Equipment	a. 0
____(2) Methods & Procedures Technical Orders	b. 00
____(3) Standard and Special Tools	c. 1
____(4) Armament Equipment	d. 11
____(5) TO Catalog, Indexes, and Cross-Reference Table	e. 13
____(6) Test Equipment	f. 14
____(7) Aircraft	g. 32
____(8) Aircraft Furnishings and In-Flight Feeding Equipment, Cargo Loading, Aerial Delivery and Recovery Equipment, Aircraft Fire Detection and Extinguishing Equipment	h. 33

4. What term describes division of a technical order into sections or smaller TOs?

5. Match the sectionalized technical order category letters in column B with their contents in column A by writing the correct letter in the blank space provided. The technical order category in column B may be used only once.

<i>Column A</i>	<i>Column B</i>
____ (1) Theories of operation.	a. GV.
____ (2) Determine probable cause of fault condition.	b. GS.
____ (3) Portable detailed maintenance procedures	c. JG.
____ (4) Description of aircraft, some maintenance procedures, major component removal safety precautions.	d. FI.

020. Time compliance technical orders

1. What are the three priorities of TCTOs?
2. Which TCTO has a series of red Xs (XXXXXX) printed around the border of the first page?
3. Which TCTO has alternately spaced red diagonals and red Xs bordering the first page?
4. Within how many days of receipt of an urgent action TCTO must the work be done?
5. When material, mechanical, operational, or tactical deficiencies occur, what are the conditions that routine action TCTOs are issued?

021. Methods and procedures technical orders

1. What technical order series provide information on the technical order system, TCTO system, and technical order numbering schemes?
2. Which technical order covers the concept and management of the USAF technical order system?
3. What technical order series provides maintenance management information?
4. Which technical order provides policy and guidance for individual maintenance activities (such as the egress shop) for the collection and documentation of maintenance data?

5. Which technical order would you use to find procedures for tracking the maintenance processing of a faulty F-16 canopy actuator?
6. What technical order tells you how to calculate due dates and how to establish dates of installation and manufacture for time change documentation?

022. Abbreviated technical orders

1. What is one of the main advantages of abbreviated technical orders?
2. What type of abbreviated technical orders cover a specific type of inspection and normally the system on which the inspection is to be performed?
3. What type of abbreviated technical orders is used primarily for scheduled inspections and depict a basic planned work schedule or sequence in which inspection work cards may be used?
4. How can you determine if a technical order is a checklist?

3-2. Maintenance Assistance and Improvement Reports

By now, you should know how to navigate around technical orders and find what you are looking for. What do you do if you need to do a task not covered in any TO? TOs are written for almost every situation, but occasionally something out of the ordinary needs to be accomplished and there is no technical data directing you. That is when you need maintenance assistance from a specialist authorized to resolve problems with field level maintenance.

023. Maintenance assistance

When the time comes for you to request assistance, you should do so in accordance with local policies and [AFI 21-103](#), *Equipment Inventory, Status and Utilization Reporting*, and TO 00-25-107, *Maintenance Assistance*. When assistance is needed, we sometimes refer to it as a 107, EAR (engineering assistance request) or RFA (request for assistance). According to AFI 21-101, the work center discovering the discrepancy is responsible for drafting the request for assistance. Then the work center forwards the request to QA for coordination and release through the MAJCOM to the appropriate weapon system program manager. There are four different categories for a maintenance assistance request, but the one that applies mostly to egress is the technical assistance category.

Technical assistance

Technical assistance is provided by engineers and equipment specialists to resolve problems with field level maintenance and operations of systems, commodities, and even support equipment. An engineer prepares a set of disposition instructions to be followed like a technical order. When the reply to the request is answered, it is only good for a one-time fix. If the same discrepancy is discovered again, another request must be submitted.

Drafting the technical assistance request

If you are the person drafting the 107-maintenance request, your first step is to contact QA and review your local policies for guidance. Chances are QA will come to examine the item requiring the assistance request. When they arrive, they should take pictures of the item also. You can attach those pictures to the request, after all a photo says a thousand words. Make sure you get clear pictures that show the engineer or specialist exactly what the issue is. It helps to include a ruler or some other object in the picture to help identify the size of the damage. Be as descriptive as you can, you may even explain how the damage occurred or was discovered, where it is located (right/left, forward/aft), and applicable tech data such as the technical order figure and index, part number or a stock number. There is never too much information. Figure 3-13 shows an example of a descriptive photo that should be submitted with an assistance request.

F-16DG canopy removal without AFT seat fully lowered or verifying that contact between tension tube and aft seat smoke stack does not occur.

Damage to tension tube.



Figure 3-13 Example of an assistance request descriptive photo.

024. Technical order improvement reports

As an egress systems journeyman (and a TO user), you play an important part in ensuring the accuracy of the technical orders you use. How? Let us say you are doing a job and find what you feel is an error in the maintenance procedures in the TO that covers the job you are doing. In this case, you should do something to correct it. To do this, you use [AFTO Form 22](#), Technical Manual (TM) Change Recommendation and Reply. Instructions for submitting a change to tech data can be found in the TO 00-5-1. Another good time to submit an improvement report could be after you submit an RFA (e.g., a note or warning before a step in the TO which might help prevent the damage seen in figure 3-13).

Refer to figure 3-14 displaying the different fields of AFTO Form 22 as we discuss them in the following paragraphs.

Technical order deficiency

The term *deficiency* denotes an error or defect that changes the meaning of instruction. It also used to identify information that is insufficient to perform a task or function adequately.

AFTO Form 22, Technical Manual (TM) Change Recommendation and Reply

Personnel use AFTO Form 22 for recommending changes and improvements to technical orders. It must be completed digitally and then submitted in an email attachment to the affected item's PIM. The PIM then forwards your AFTO Form 22 through coordination channels to the technical order manager.

NOTE: To make a change or improvement to the F-22/F-35 systems, check with your local policies for a procedure that may be different from what is described in this CDC.

TECHNICAL MANUAL (TM) CHANGE RECOMMENDATION AND REPLY (Use IAW Completion Instructions and TO 00-5-1)				LCN	OMB NO. 0704-0188
1. PIM (or equivalent)		2. MAJCOM CCP (After Review, Return to PIM)			
ORGANIZATION		ORGANIZATION			
NAME		NAME			
PHONE		INITIAL SUBMIT DATE		REVIEW DATE	
<input type="checkbox"/> APPROVED <input type="checkbox"/> DISAPPROVED		<input type="checkbox"/> APPROVED <input type="checkbox"/> DISAPPROVED			
E-MAIL		E-MAIL			
Click to sign		Click to sign			
3. LEAD COMMAND CCP (After Review, Return to PIM)		4. TO MANAGEMENT ACTIVITY (After Receipt, Forward to Evaluator)			
ORGANIZATION		ORGANIZATION			
NAME		NAME			
PHONE		REVIEW DATE		RECEIPT DATE	
<input type="checkbox"/> APPROVED <input type="checkbox"/> DISAPPROVED					
E-MAIL		E-MAIL			
Click to sign		Click to sign			
5. LOCAL CONTROL NUMBER (LCN)		8. PRIORITY (Check One)		7. CHANGE TYPE (Check One)	
		<input type="checkbox"/> EMERGENCY <input type="checkbox"/> URGENT <input type="checkbox"/> ROUTINE		<input type="checkbox"/> CORRECTION <input type="checkbox"/> IMPROVEMENT	
8. INITIATOR		9. INITIATOR SUPERVISOR			
NAME		NAME			
RANK		PHONE		DATE	
E-MAIL		E-MAIL			
Click to sign		Click to sign			
10. PUBLICATION NUMBER		11. BASIC DATE		12. CHANGE NUMBER	
14. WORK PACKAGE/WORK CARD ID		15. PAGE NUMBER		16. PARAGRAPH NUMBER	
17. FIGURE/TABLE NUMBER					
18. SHORT DESCRIPTION OF DEFICIENCY					
19. DEFICIENCY					

AFTO FORM 22, 20170309

PREVIOUS EDITION IS OBSOLETE

Figure 3-14. Example AFTO Form 22.

Recommendation priorities

If you submit a recommended change (RC), you need to identify on the AFTO Form 22 if it is an “improvement” or “correction.” An *improvement* results in an addition or significant change to a process or procedure that allows a function to be performed better, safer, faster, or cheaper. A *correction*, simply fixes a minor error or omission to the technical order (i.e., typographical error, or updating a reference or the name of something). Identifying the difference between an improvement and a correction helps you determine the recommendation priority. There are three priorities for TO deficiency reports:

1. Emergency.
2. Urgent.
3. Routine.

Prior to submittal, assess your improvement report in terms of mission impact, safety, damage to equipment, work simplification, urgency of the need for change, and manpower savings. This assessment determines the priority of the submission.

Emergency reports

Emergency reports require immediate action to correct a technical order deficiency because if not corrected, the deficiency **WOULD** result in one or more of the following:

- A fatality or serious injury to personnel.
- Extensive damage or destruction of equipment or property.
- Inability to achieve or maintain operational posture (mission essential), including field-level work stoppage.

Emergency reports are submitted as a “high” precedence SMTP email directly to the organization with management responsibility for the technical order. The email message subject will be “EMERGENCY AFTO Form 22” and will have a copy of the AFTO Form 22 attached. A read receipt on the email message is required. Initiators must notify the technical order manager of the emergency submittal by telephone or email. The technical content manager (TCM) must then disapprove or downgrade the report, or issue an ITCTO, interim supplement, or a rapid action change within 48 hours.

Urgent reports

Urgent reports require action to correct a deficiency because if it is not corrected, it COULD cause one or more of the following situations:

- Personnel injury.
- Damage to equipment or property.
- Reduction in operational efficiency.
- Jeopardy to the safety or success of the mission.
- Result in over \$25,000 or 1,000 man-hours annual savings to the Air Force.
- Any deficiency found in a TCTO.

All technical TCTO deficiencies are submitted as urgent, as are reports identifying and replacing Environmental Protection Agency hazardous materials. The TCM must take appropriate action within 40 calendar days after receipt of the report or disapprove/downgrade within 15 calendar days.

Routine reports

Routine reports require action on deficiencies that do not fall into emergency or urgent categories. The TCM must respond within 45 calendar days, and changes to technical data should be published within 365 days.

When to submit improvement reports

The person who discovers a deficiency initiates the AFTO Form 22. Submit emergency reports immediately, urgent reports on an expedited basis, and routine reports as soon as practicable. If you feel a process or procedure could or should be improved to help the Air Force, whether by saving lives, time, materials, or money, it is your duty to submit a technical order improvement report. Doing this will ensure that we have the best, most up-to-date technical orders possible, the best processes, and the safest work environment.

The review process

Reviewers will check the RC for validity, accuracy, and completeness. They may consult with you to make corrections to the RC. If the RC is disapproved, the reviewer will return it to you. If the reviewer approves the RC, the RC is returned to the PIM, and then sent to the lead command control point reviewer.

After that, the RC is forwarded to the technical order manager and TCM for evaluation. Like the initial reviewer, the TCM reviews the RC for validity, accuracy, and completeness. The TCM then assigns an appropriate disposition and provides required remarks. Joint Computer Aided Acquisition and Logistics Support (JCALS) automatically notify the submitter and the technical order manager with interim and final disposition information. Approved RCs are implemented as technical order updates by the method and within the time prescribed by its recommendation priority. TCMs review approved routine RCs for possible recommendation priority upgrade and expedited publication every 90 days until incorporated.

The disposition definitions are in the following table:

Disposition Definitions	
Disposition	Definition
Approved	The intent of the recommendation will be included in the technical order within 365 calendar days.
Deferred	The recommendation is approved but will not be published within 365 calendar days, OR the changes are minor and will be incorporated upon the next change or revision.
Abeyance	Evaluation delayed for management reasons, such as obsolete systems and equipment or technical orders.
Advisement	Engineering study is required before evaluation can be completed.
Duplicate	An RC identifying the same deficiency and solution was submitted earlier.
Disapproved	The RC was disapproved and the reason will be explained.

Normally, the PIM conducts the follow-up. For emergency RCs, the PIM may follow-up with the evaluator within 48 hours of submission; for urgent and routine RCs, PIMs may follow-up within 14 calendar days of submission to the MAJCOM or lead command reviewers and within 45 calendar days of submission to the evaluator. Once it comes back to you, the initiator, if you find the results unacceptable, you may submit the RC for reconsideration, but with a new local control number referencing the previously assigned control number and giving rationale for the resubmission.

The Airmen Powered by Innovation program and monetary awards

The Innovative Development through Employee Awareness (IDEA) program has recently been renamed to the Airmen Powered by Innovation (API) program and is formalized with guidance found in [AFI 38-402](#), *Airmen Powered by Innovation and Suggestion Program*. The core value, "excellence in all we do," drives us to develop a sustained passion for the continuous improvement and innovation that propels the Air Force into a long-term, upward vector of accomplishment and performance." (For Air National Guard [ANG] members, please read [ANGI 38-401](#), *Suggestion Program*, as there are some beneficial differences in your program that is specific to the ANG).

Want to make more money? Sure, we all do! Well, if your improvement-type RC is approved or deferred, you may submit your idea to API program. The Air Force API program is an incentive program that promotes improvement and/or resource savings through ideas submitted by military, civilian employees, and Air Force Reserve Command members.

Your submission must be within 90 working days of the date of notification for RC approval. A copy of the approved RC must be available for review by the first-level evaluator. Do not wait and take a chance of missing a monetary reward; contact your base product improvement manager that is located in the QA flight. The improvement RC must document the API categories, which are intangible benefits and/or tangible savings and the monetary savings for tangible and a justification. This is all part of the RC's evaluation process. The initiator will NOT submit an idea with the RC. The RC documentation (i.e., AFTO Form 22) itself establishes the discovery date and owner of any resulting confirmatory idea. In addition; an idea cannot be submitted to dispute a disapproved RC.

Monetary awards are paid upon validation of tangible savings and/or intangible benefits, not implementation of the idea. Tangible savings are computed based on validated savings for the first year of operation except when the improvement has a significant up-front investment, but will yield tangible savings for more than one year (normally three years). The evaluator will manually calculate the average annual net savings.

Approved ideas with pending implementation dates must be paid upon validation of reported tangible savings and/or intangible benefits. Payment will not be delayed until the idea is implemented. Awards

will differ according to the job responsibility of the submitter. All monetary awards are subject to applicable tax rules. The monetary award for any one idea is between \$100 and \$10,000 dollars. All active duty Air Force military members and civilian employees are paid from Air Force appropriated funds including the following:

- Air Force Reserve personnel on active duty status.
- Air Force Academy cadets.
- Reserve Officer Training Corps cadets who have enlisted in the USAF Reserve, Obligated Reserve Section.
- ANG Title 5 and Title 10, United States Code (U.S.C.) employees.
- Air Force military and Air Force federal civilian retirees, if they submitted their idea before retiring.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

023. Maintenance assistance

1. Which publication tells who is responsible for submitting a request for maintenance assistance?
2. Which agency sends the maintenance assistance request to the appropriate weapons system program managers?
3. Who provides technical assistance from a 107 request, and besides field level maintenance and operations of systems, which other types, which type of problems will they resolve?
4. Under which circumstances may a 107 request be reused?
5. What is your first step when drafting a 107-maintenance assistance request?
6. Which information should be included on a 107 request?

024. Technical order improvement reports

1. Which form is used to submit a change to a technical order?
2. Which TO provides instructions on how to fill out the form used to make a change/improvement in a TO?

3. What does the term deficiency denote?
4. To whom does the PIM forward a recommended change?
5. When submitting a technical order improvement, what conditions should be met?
6. When submitting a technical order change, what conditions should be met?
7. What are the three priorities for a technical order improvement/change?
8. For a technical order deficiency that requires immediate action, which priority should it be submitted as and what conditions determine that priority?
9. For an urgent technical order deficiency report, what conditions determine that priority?
10. How should technical order deficiency reports that involve TCTOs and EPA hazardous materials be prioritized?
11. If emergency reports are submitted immediately, and urgent reports are submitted on an expedited basis, how are routine reports submitted?
12. Who may submit an idea for improvement to the API program?
13. Which document establishes the discovery date and owner of an idea?
14. Who is eligible to receive a monetary reward from the Air Force appropriated funds?

Answers to Self-Test Questions

018

1. All other category 0 technical orders have been replaced by the technical order catalog in ETIMS.
2. ETIMS.
3. The LOAP.

019

1. Job guides, general vehicle technical orders, and wiring diagram manuals.
2. TO 00-5-18, *AF Technical Order Numbering System*.
3. (1) f; (2) b; (3) g; (4) d; (5) a; (6) h; (7) c; (8) e.
4. Sectionalized.
5. (1) b; (2) d; (3) c; (4) a.

020

1. Immediate, urgent, routine.
2. Immediate.
3. Urgent.
4. Work must be done within a specified time limit after receipt of the TCTO.
5. Constitute a hazard through prolonged continued use; have a negative effect on operational efficiency; reduce tactical or support utility; reduce the operational life of equipment.

021

1. 00-5 series.
2. 00-5-1.
3. 00-20 series.
4. 00-20-2.
5. 00-20-3.
6. 00-20-9.

022

1. They simplify work.
2. Inspection work cards.
3. Inspection sequence charts.
4. If it has the designation letters CL.

023

1. AFI 21-101.
2. QA.
3. Engineers and equipment specialists resolve problems with field level maintenance and operations of systems, commodities, and even support equipment.
4. Never; it is a one-time fix and another request must be submitted.
5. Contact QA and review local policies.
6. Be as descriptive as you can, you may even explain how the damage occurred or was discovered, where it is located (right/left, forward/aft), and applicable tech data such as the technical order figure and index, part number or a stock number.

024

1. AFTO Form 22, Technical Manual (TM) Change Recommendation and Reply.
2. 00-5-1.
3. That an error or defect that changes the meaning of instruction. It also used to identify information that is insufficient to perform a task or function adequately.
4. TO manager.

5. Will result in an addition or a significant change to a process or procedure that allows a function to be performed better, safer, faster, or cheaper.
6. Fixes a minor error or omission to the technical order (i.e., typographical error or updating a reference or the name of something).
7. Emergency, urgent, routine.
8. Emergency report. A fatality or serious injury to personnel; extensive damage or destruction of equipment or property; inability to achieve or maintain operational posture (mission essential), including field-level work stoppage;
9. Personnel injury; damage to equipment or property; reduction in operational efficiency; jeopardy to the safety or success of the mission; result in over \$25,000 or 1,000 man-hours annual savings to the Air Force; any deficiency found in a TCTO.
10. Urgent.
11. As soon as practicable.
12. Military, civilian employees, and Air Force Reserve Command members.
13. The RC documentation, (i.e., AFTO Form 22).
14. Air Force Reserve personnel on active duty status; Air Force Academy cadets; Reserve Officer Training Corps cadets who have enlisted in the USAF Reserve, Obligated Reserve Section; Air National Guard Title 5 and Title 10, U.S.C. employees; Air Force Military and Air Force federal civilian retirees, if they submitted their idea before retiring.

Complete the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to AFCDA.

54. (018) What type of technical orders list other technical orders?
- Index-type technical orders.
 - Time compliance technical orders.
 - Methods and procedures technical orders.
 - Operations and maintenance technical orders.
55. (018) Which electronic system allows the viewing of technical orders?
- Air Force Technical Order Portal.
 - Electric Technical Order Database.
 - Integrated Technical Order Viewing System.
 - Enhanced Technical Information Management System.
56. (018) How often is complete information for all technical orders updated in the Enhanced Technical Information Management System (ETIMS)?
- Daily.
 - Weekly.
 - Monthly.
 - In real-time.
57. (018) What type of technical order is a *complete list* of all technical orders for a specific weapons system or a piece of equipment?
- Time change technical order (TCTO).
 - List of applicable publications (LOAP).
 - Operations and maintenance (O&M) technical order.
 - Consolidated security assistance technical order index.
58. (019) Operations and maintenance (O&M) technical orders are written to provide
- a complete listing of TOs for a specific weapon system or a piece of equipment.
 - organization and method procedures including group and work center requirements.
 - operation and maintenance instructions including troubleshooting, calibration, and servicing.
 - procedures relating to scheduled equipment inspections and maintenance management systems.
59. (019) Which technical order would contain detailed safety precautions for major component removal?
- Job guide (JG).
 - General vehicle (GV).
 - General system (GS).
 - Troubleshooting manual (TM).
60. (020) What type of time change technical order (TCTO) is issued when *unsafe* conditions, if *not corrected*, could result in serious or fatal personal injury?
- Routine action.
 - Urgent action.
 - Immediate action.
 - Emergency action.

61. (020) An *immediate action* time change technical order (TCTO) must be distributed to all affected personnel within how many hours of receipt?
- 2.
 - 4.
 - 10.
 - 24.
62. (020) What type of time change technical order (TCTO) is issued when a deficiency could result in injury to personnel, damage to property, or unacceptable reductions in combat efficiency?
- Routine action.
 - Urgent action.
 - Immediate action.
 - Emergency action.
63. (020) What type of time change technical order (TCTO) is issued when material, mechanical, operational or tactical deficiencies occur which could result in conditions that reduce the operational life of equipment?
- Routine action.
 - Urgent action.
 - Immediate action.
 - Emergency action.
64. (021) Which methods and procedures technical order (MPTO) explains the Integrated Maintenance Data System (IMDS)?
- Technical Order (TO) 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures*.
 - TO 00-20-2, *Maintenance Data Documentation*.
 - TO 00-20-3, *Maintenance Processing of Reparable Property and the Repair Cycle Asset Control System*.
 - TO 00-20-9, *Forecasting Replacement Requirements for Selected Calendar and Hourly Time Change Items*.
65. (021) Which methods and procedures technical order (MPTO) provides step-by-step procedures for filling out aircraft forms?
- Technical Order (TO) 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures*.
 - TO 00-20-2, *Maintenance Data Documentation*.
 - TO 00-20-3, *Maintenance Processing of Reparable Property and the Repair Cycle Asset Control System*.
 - TO 00-20-9, *Forecasting Replacement Requirements for Selected Calendar and Hourly Time Change Items*.
66. (022) What type of abbreviated technical orders provide guidance, including applicable safety warnings, cautions and notes, and specific accept or reject criteria for performing an inspection?
- Checklists.
 - Job guides.
 - Inspection work cards.
 - Inspection sequence charts.

-
-
67. (022) What type of abbreviated technical orders most often are used by a phase dock chief to control the assignment of work during an inspection?
- a. Checklists.
 - b. Job guides.
 - c. Inspection work cards.
 - d. Inspection sequence charts.
68. (022) What type of abbreviated technical orders may be published when two or more differing specialty skills are involved in accomplishing a task?
- a. Checklists.
 - b. Job guides.
 - c. Inspection work cards.
 - d. Inspection sequence charts.
69. (023) Who coordinates a maintenance assistance request through the major command (MAJCOM) to the appropriate weapon system program manager?
- a. Quality assurance.
 - b. Maintenance supervision.
 - c. Plans, scheduling and documentation.
 - d. The work center who discovered the discrepancy.
70. (023) After the request for assistance is answered, the reply is good
- a. for a one-time fix only.
 - b. every time the same discrepancy is found on an identical item.
 - c. for any aircraft that has the same discrepancy on the same component.
 - d. for all identical components with the same discrepancy, belonging to the same base.
71. (024) Which priority would you use to submit a technical order (TO) change that *could* cause damage to equipment or property?
- a. Urgent.
 - b. Routine.
 - c. Immediate.
 - d. Emergency.
72. (024) If a routine recommended technical order (TO) change is approved, it is included in the TO
- a. immediately.
 - b. within 90 calendar days.
 - c. within 180 calendar days.
 - d. within 365 calendar days.
73. (024) In order to receive a monetary award you must submit your recommended technical order change to the Airmen Powered by Innovation (API) program within how many days of the date of notification for recommended change approval?
- a. 90 working days.
 - b. 90 calendar days.
 - c. 180 working days.
 - d. 180 calendar days.
74. (024) If you submit an idea to the Airmen Powered by Innovation (API) program and it is approved with tangible savings and/or intangible benefits, how much money will you receive?
- a. \$200.
 - b. No less than \$100 and no more than \$10,000.
 - c. No less than \$500 and no more than \$10,000.
 - d. More than \$10,000, and less than \$100.

Student Notes

Please read the unit menu for unit 4 and continue ➡

Unit 4. Tools, Support Equipment and Aircraft Hardware

4-1. Hand Tools and Composite Tool Kits.....	4-1
025. Using common hand tools	4-2
026. Using composite tool kits	4-9
4-2. Special Tools and Test Equipment.....	4-15
027. Using special tools	4-15
028. Using test equipment	4-23
4-3. Support Equipment and Aerospace Ground Equipment	4-29
029. Using slings	4-29
030. Cranes	4-33
031. Using maintenance stands.....	4-35
032. Using power units	4-39
033. Using light carts.....	4-41

AN AIRCRAFT IS A PRECISION FLYING MACHINE, but to remain useful, it must be maintained by the skilled hands of various maintenance personnel. Your skill as a mechanic depends not only on your ability to diagnose and correct malfunctions, but also on your ability to select, use, and care for tools and equipment.

There is a great deal of self-satisfaction in using tools properly. It is reassuring to know that you are working as competently with a tool as those who trained you. A toolbox full of good, clean tools seems almost to say, “Pick me up and go to work, carefully, and correctly.” Sometimes, too, maybe you prefer a particular wrench over the others. Somehow, that wrench almost has a “personality” of its own.

Even if you think of a tool as just a cold piece of steel, you know that steel needs to be cared for and used correctly. Remember, you may immediately exchange a damaged tool for a usable one. However, it is better to protect tools through proper use than to continually exchange one tool for another because you never learned how to use them properly.

Like tools, care should also be taken when maintaining and operating support equipment and AGE. This equipment, if used incorrectly, can cause damage, injury, or even loss of life. In this unit, we will discuss many of the tools used by egress journeymen and also support equipment, AGE, and aircraft hardware and plumbing. The knowledge you gain from studying this unit will be valuable not only during your assignment to the egress shop but throughout your life.

4-1. Hand Tools and Composite Tool Kits

The lessons in this section discuss some of the hand tools you will use to maintain egress systems. Most of us know how to identify, select, care for, and use tools. Yet, many of us have become complacent with our tools. We “throw” them into the toolbox when we complete a task. A cracked handle, a dull or chipped blade, or worn joints are discrepancies inspectors find every day. Remember, the tools you use cannot do the work alone; take pride in your work and use your hand tools correctly.

Additionally, because of the exacting requirements and close specifications of aircraft egress systems, some special tools are needed during egress maintenance. While each egress system uses a variety of special tools, some apply to all systems.

025. Using common hand tools

Common hand tools are the most widely used instruments when performing aircraft maintenance. While some of them may seem familiar to you, others may not. Do not let that worry you. As you become familiar with your job, their names and uses will become second nature to you. As mentioned in the last unit, there is a technical order for everything. TO 32-1-2, *Use of Hand Tools*, gives instructions on how to use hand tools appropriately and safely. TO 32-1-101, *Use and Care of Hand Tools and Measuring Tools*, gives instructions on how to care for all of the tools located in your work center. If one of your many additional duties is tools, it would be in your interest to familiarize yourself with these technical orders.

Screwdrivers and bits

The screwdriver is a tool for installing and removing screws. Do not use a screwdriver for prying, for opening boxes, or as a chisel. Using a screwdriver as a chisel or as a pry bar can bend or break the handle or blade. The most commonly used types of screwdrivers fall into one of four categories:

- Common.
- Cross-point.
- Cross-tip.
- Offset.

As an egress journeyman, you will use another type of screwdriver: the torq-set screwdriver. That is because torq-set screws are the most common fastener used on airframes. An example of the torq-set pattern is shown in figure 4-1.

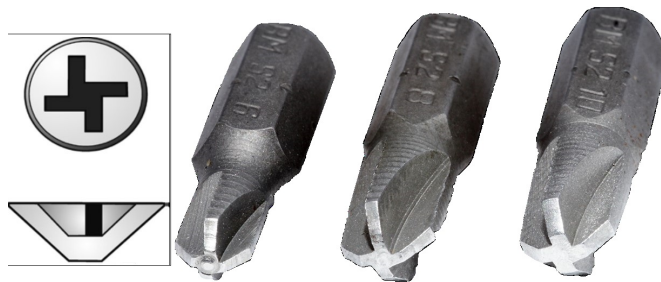


Figure 4-1. Torq-set pattern.

To prolong the life of a screwdriver and prevent damage to the screw head, the correct screwdriver must be used. Figure 4-2 shows an offset screwdriver, which can be used to reach a screw that is located in a recessed position where a straight screwdriver cannot access.

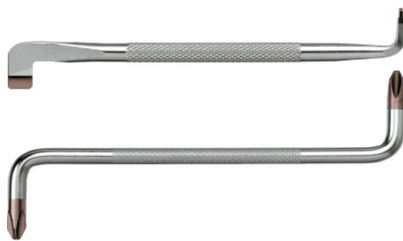


Figure 4-2. Offset screwdriver.

Screwdriver bits are screwdriver blades with a square, hex, or notched shank so it can be used with other tools such as a ratcheting screwdriver, a speed handle, or a socket wrench.

When a screwdriver becomes nicked, the edges become rounded. When other damage occurs it will not fit a screw slot. In both cases it can be reground or filed. Do not expose screwdrivers to excessive heat, as it may reduce the hardness of the blade.

Replace a screwdriver that has a worn or damaged handle or rounded tip. After use, wipe the screwdriver clean, and place it

in a rack or tool box. For long-term storage, apply rust-preventive compound to all metal surfaces and store in a dry place. A poor fitting screwdriver will damage the screw head, slip off the screw, and

cause personal injury. Use a screwdriver that has parallel sides and exactly fits the screw slot. Never pound on a screwdriver with a hammer. Do not use a screwdriver as a chisel.

Hammers

There are many different types of hammers, each designed for a specific purpose. Most people are familiar with the carpenter's hammer (used for driving and pulling nails); however, you probably will not find this type of hammer in your CTK.

Keep the faces of hammers and mallets in their original shape and free from chips, dents, and dirt. Loose handles, a sweaty palm, or an oily handle are the cause of most accidents when using hammers and mallets. Some journeymen have a tendency to “choke” the hammer by gripping the handle close to the head. Holding the hammer in this way greatly reduces the force of the blow, and it is harder to hold the head in the proper position. The proper way to hold any hammer is near the end of the handle. The handle is shaped for gripping without slipping from your grasp at this position, and gives you the best control and impact with the least effort. The face of the hammerhead is slightly convex. The outside edge is rounded to eliminate a sharp edge that could mar the surface of an object struck at an improper angle.

The wrist and arm motion depends on the power of the impact required. Light blows are almost entirely from a wrist motion. Heavy blows come from the wrist, forearm, and shoulder. Strike the object fully with the face of the hammer parallel to the work, as illustrated in figure 4-3. This spreads the force of the blow over a greater area and avoids damaging the edge of the hammer face. Correct use transmits the force of the blow to the object without damage to the object or the hammer.

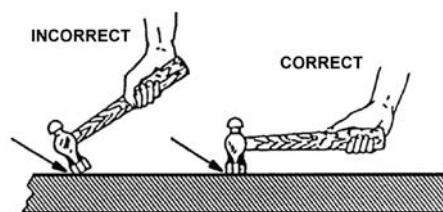


Figure 4-3. Holding a hammer.

In the following table we discuss the types of hammers you will use most often as an egress journeyman.

Frequently Used Hammers	
Hammer	Description
Ball peen	Used for forming soft metal, peening rivet heads, and striking metal in out-of-the-way places and egress personnel use this type of hammer the most.
Cross peen	Used as a chisel for removing rivet heads and for stretching or bending metal.
Straight peen	Used like the cross peen but differs from the cross peen in that its peening edge is turned ninety degrees (this keeps the handle parallel to the struck surface).
Soft-faced	<p>Can deliver heavy blows to machined, highly polished, or soft surfaces without damaging the surface.</p> <p>Inserted soft-faced hammers provide the user with a dual-purpose hammer. Any two faces may be assembled on a single-handle holder. The faces of these hammers are color coded to allow you to select the proper face hardness for a task. For example, a soft face is colored brown and used on soft rubber and wood. A green face is considered tough and can be used on lead, plastic, or rawhide. A yellow face is extra hard and can be used on rawhide, fiber, and copper.</p> <p>Soft-faced hammers should be used for driving materials that a hard-face hammer would damage. In fact, you should seldom use a hard-face hammer, except with a punch, chisel, drift, or block, or similar object.</p>

Check for cracks in a hammer's handle. Replace the handle if cracked. Check for loose heads and replace missing or makeshift wedges to be sure the head is tight. If not tight, replace the handle. Replace hammers with worn or chipped faces or claws.

Periodically, rub a small amount of linseed oil into wooden handles to prevent the wood from drying out and shrinking. Lightly lubricate metal parts when storing the hammer for a lengthy period. Wipe oil and grease from rubber mallets to prevent damaging the rubber.

WARNING: *Never etch on a fiberglass handle*, as this weakens the handle. Instead, etch information on the hammer head only, or use a permanent marker/sticker.

Pliers

Pliers are used when hand grip alone is not sufficient to do the job, when you are holding something hot, or when you need to perform light cutting. As an egress journeyman you will most often use pliers when removing or installing safety wire and cotter pins. A common tendency among inexperienced mechanics is to use pliers as an all-purpose tool. Do not be guilty of this mistake! Pliers are not to be used as wrenches. Pliers used in place of a wrench will unquestionably damage the material and may, if they slip, injure you or others. Pliers are made in a variety of shapes and sizes. The four most common types used by egress journeymen are the slip-joint, diagonal-cutting, lineman's side cutting, and flat-nose pliers.

Slip-joint pliers

Slip-joint pliers have serrated (grooved) jaws, with a rod-gripping section, a cutting edge, and a pivot. The serrated jaws and rod-gripping section hold objects. You can use the cutting edge to cut soft wire and nails. However, cutting hard materials or large gauge wire will spring the jaws, making the pliers useless. The pivot adjusts the jaw opening to handle different sizes from large to small objects.

Diagonal cutting pliers

Diagonal cutting pliers have a fixed pivot. The jaws are offset by about 15 degrees and are shaped to give enough knuckle clearance while making flush cuts (fig. 4-4). Diagonal cutting pliers cut small, light materials such as wire, cotter pins, and similar materials. Do not use these pliers for holding or gripping objects.



Figure 4-4. Diagonal cutting pliers.

Flat-nosed pliers

Other pliers found in your toolbox are the flat-nosed pliers with flat, serrated jaws of varying lengths. They also have a fixed pivot and curved handles which may have insulated sleeves. Flat-nosed pliers with a wide jaw are commonly called “duckbills”, the same as the lineman's side cutting pliers because just like those pliers, they resemble a duck's bill (fig 4-5). Another type of flat-nosed plier you will use is a needle-nose plier, which has a thinner nose. They are very good for holding objects in tight places, crimping or bending thin metal, and forming loops in wire.



Figure 4-5. Flat-nosed pliers “duckbills.”

Care of pliers

A good rule to follow when using any pliers is “if it takes excessive force to do the job, then chances are you are using the wrong tool.” Like other tools, keep pliers clean. Give them an occasional bath in an approved cleaning solvent to wash off dirt and grit. Also, give the joint pin an occasional drop of oil. Do not remove insulation on handles or oil handles which are insulated. Do not use pliers for prying or for removing nuts or bolts. Replace any pliers that have broken jaws, handles, or cutting edges.

If you are using flat-nosed pliers to break and remove safety wire from a component, you are using the wrong tool. Always use diagonal cutting pliers by cutting the wire close to the hole, exercising caution not to damage the component.

Wrenches

A wrench is a tool designed to tighten or loosen nuts, bolts, studs, and pipes. Wrenches are formed from steel alloy in order to prevent breakage. There are many different types of wrenches, each with its own use. If you use the proper wrench for a task, you will not break the wrench, damage the equipment, or cause personal injury. Wrenches are tools designed to exert a twisting force, as in turning nuts or bolts. Most nuts and bolt heads have six sides. A wrench is designed to fit the sides or flats of these nuts or heads. You should always pull a wrench—never push. Pushing on a wrench is dangerous. If the nut or bolt suddenly breaks loose, invariably you will strike your knuckles on some part of the work surface. If you must push, use the base or palm of your hand and hold your hand open; this may save your knuckles from cuts and bruises.

The most common types of wrenches you will use are the adjustable open-end, the open-end, the box-end (fig. 4-6), and the socket (fig. 4-7).

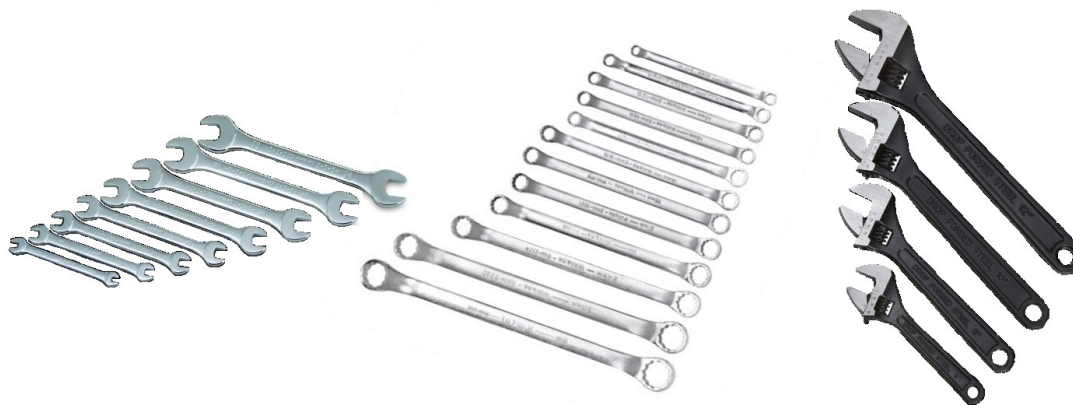


Figure 4-6. Types of wrenches.

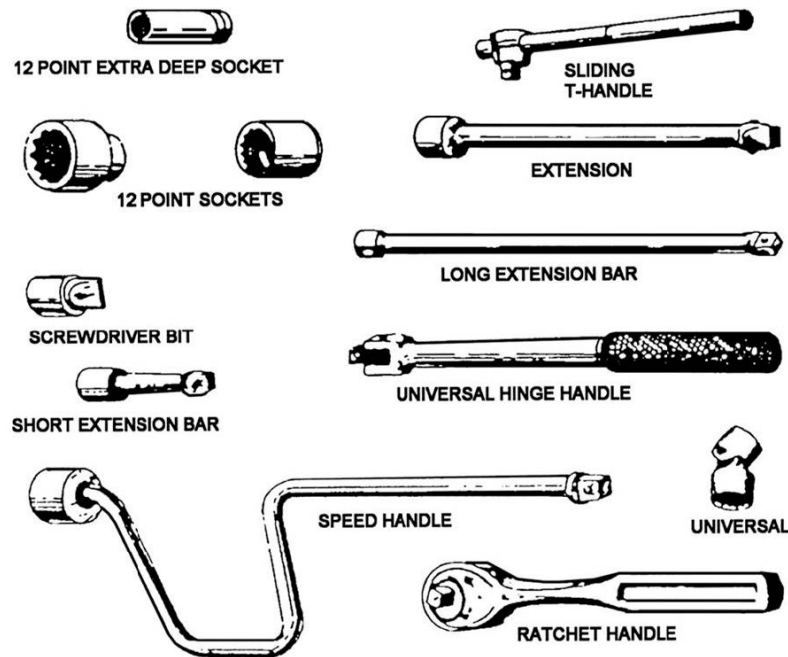


Figure 4-7. Socket wrenches and accessories.

Adjustable open-end wrenches

The adjustable open-end wrench has one fixed and one adjustable jaw. The adjustable jaw is set against the face of the nut by turning a knurled worm gear. Exercise care when using an adjustable wrench. Always use the fixed jaw for applying pressure to tighten or loosen nuts or bolts. Use adjustable wrenches to remove and/or install nuts, bolts, and studs when the correct size wrench or socket is not available.

Never hammer on the handle of an adjustable wrench to loosen or tighten a nut and do not use an extension on the handle to get more leverage.

Open-end wrenches

Wrenches with an opening on one or both ends are called open-end wrenches. The wrench length is determined by the size of the jaw opening. If a wrench has a smaller opening, it will have a shorter length. This proportions the lever advantage of the wrench to the size of the nut or bolt. For a given amount of pull, a shorter length produces less torque and reduces the possibility of rounding the corners off the bolt head or nut. Most jaw openings are offset from the shank by 15 degrees. Turning the wrench over after each stroke reverses the angle of the head. The 15-degree angle of the jaw, plus turning the wrench over, enables you to continue turning a hexagonal nut, even when the swing of the wrench is limited.

Box wrenches

A box wrench gets its name from the fact that it surrounds (or boxes with no openings) the nut, bolt head, or stud on all sides. Egress personnel mostly use box-end wrenches of the 6-point, and 12-point openings, along with splined wrenches. The six-point box-end wrench is not as common, since it is not as versatile as the 12-point. The 12-point opening is more common, as it may be used on both square and hexagonal bolt heads. Box wrench openings are offset from the shank by 15 degrees. A box wrench should be used whenever possible, as it provides the best protection for both the user and the equipment. The major disadvantage of the box wrench is that there must be enough clearance above and around the bolt head to place the wrench over the bolt head. Splined wrenches and socket wrenches have squared-off teeth so that they snugly fit splined bolt heads, which resemble the shape of a gear.

You can apply more torque to tighten (when required) or loosen a nut or bolt with a box-end wrench than with any other hand tool of the same grade. This makes them good tools to use to finish securing fasteners that have been tightened with an open-end wrench. Another advantage of these wrenches is that there is little or no danger of their slipping off a nut when they are used properly.

The *ratchet-box wrench* is the handiest type of box-end wrench to have in your CTK. The ratchet-box wrench is commonly referred to by egress technicians as a “dog-bone.” Ratchet-box wrenches are either reversible or nonreversible. A ratchet-box wrench does not have to be lifted up and repositioned each time the shank has reached its maximum travel between two obstructions. Ratchet-box wrenches provide an easy means of removing and/or installing nuts or bolts which are not under strain. Do not use these wrenches to torque down or to free nuts and bolts.

Combination wrenches

Wrenches that have one box-end and one open-end are called combination wrenches. Both ends are the same size. The length of the wrench varies with the size of the head.

Socket wrenches

The socket wrench (commonly called a “socket”) is a round hardened metal sleeve with a square opening, called the “drive” in one end, and a 6-point, 12-point, or splined opening in the other, which fits onto a bolt or nut. They are available in both common (short) and deep (long) lengths. The length of the socket does not determine its size. Common sockets are suitable for most applications, and deep-well sockets may be used to reach nuts where the bolt’s thread grip extends too far past the nut for a common socket to reach it. Usually, socket wrenches are purchased in sets, but individual pieces may be purchased for replacement as needed. The size of a socket wrench is expressed as the size of the drive (usually either $\frac{1}{4}$ inch, or $\frac{3}{8}$ inch in egress shops) or by the size of the fastener it is designed for (usually from $\frac{3}{16}$ inch up to $\frac{15}{16}$ inch). For example, a socket wrench with a $\frac{3}{8}$ inch drive that fits a $\frac{3}{4}$ inch nut is referred to as a $\frac{3}{8} \times \frac{3}{4}$ socket wrench. The following table describes the variety of accessories associated with socket wrenches.

Socket Wrench Accessories	
Accessory	Description
Handles, extensions, and adapters	As shown in figure 4–7, there are many varieties of drives and adapters. The three most commonly used handles are the ratchet handle, the speed handle, and the hinge handle. All three are available in both $\frac{1}{4}$ ” and $\frac{3}{8}$ ” drives sizes.
Ratchet handles	Ratchet handles, commonly called ratchets, may be used with sockets directly attached or with extension devices. On the back of the head of the ratchet is a switch used to control the direction of the drive. It may be used to install or remove, depending on the switch position. The ratchet handle is not designed for heavy work due to its having moving, ratcheting gears inside the head, and less leverage than the hinged handle.
Speed handles	The speed handle has a brace-type shaft with a revolving grip on the top. It is pretty handy when you need to remove a very long bolt or very many bolts or screws. In relation to the fastener, you need a lot of vertical clearance to use a speed handle. It is not worth using on a nut or bolt that has a lot of torque on it.
Hinged handle	If you need to break the torque on a bolt or nut, the hinged handle is the tool to use, unless you can use a box-end wrench. It provides increased leverage for loosening nuts or bolts. The hinged handle is often called a “breaker bar,” since it is used to break loose difficult fasteners. It looks a lot like a ratchet handle, but it only has a hinged adapter that may be rotated in 90-degree steps instead of having moving, ratcheting gears inside the head.
Extensions	Extensions range from 2 to 17 inches in length, and are used with any socket/handle combination in order to gain required clearance above a nut or bolt. Extensions are made in different drive sizes to fit specific types of work. The drive size refers to the size of the end that fits in the socket and into the drive receptacle at the

Socket Wrench Accessories	
Accessory	Description
	other end. The ones you use will be in the same drive sizes as your socket sets. The 1/4-inch drive is used for light work and the 3/8 inch for heavier work.
Adapters	<p>Use the <i>socket wrench adapter</i> to change the drive size between the socket and the handle. It usually increases or decreases the fractional size by one (e.g., 1/4 inch to 3/8 inch). The value of the socket wrench adapter is that it allows the freedom to use handles with socket sets that have different sized drives, giving them even more versatility.</p> <p>A <i>universal adapter</i>, or U-joint, can be used with many combinations of handles, extensions, and sockets to reach nuts and bolts at various angles. This is handy when you cannot get at a bolt or nut with a straight drive line. With experience, you can work out any number of combinations for hard-to-reach places.</p>

Care for wrenches

Clean all wrenches after each use. Return wrenches that come in sets to their cases after use. Apply a thin film of oil to the metal parts of all wrenches before storing them. For long-term storage, cover the wrenches with a rust-preventive compound and carefully store them in a dry place.

Files

Your tool kit should contain a small assortment of round, triangular, and flat files. Use files to cut, smooth off, or remove small amounts of metal, wood, plastic, or other material. Files are made in various lengths, shapes, and cuts. Every file has five parts:

1. Point.
2. Edge.
3. Face or cutting teeth.
4. Heel or shoulder.
5. Tang.

The different types of files and their uses are discussed in depth in TO 32-1-101. However, it is important to follow these safety tips:

- If a file is designed to be used with a handle, *never* use the file without the handle. Holding the sharp tang in your hand while filing can cause serious injury.
- Do not use a file for prying. The tang end is soft and bends easily. The body is hard and very brittle and a light bending force will cause it to snap.
- Do not hammer on a file. This is very dangerous because the file will more than likely shatter.

In addition, take steps to care for your files. Break in a new file should by using it first on brass, bronze, or smooth iron; never use a new file to remove the fins or scales on cast iron. Do not use a new file on a narrow surface such as sheet metal, because the narrow edge of the metal is likely to break off the sharp points in the file teeth. After using a new file, the teeth will clog up with metal filings and the clogged teeth will scratch the work. One way to prevent this is by rubbing chalk between the teeth before filing. Clean the files with a file scorer and a file cleaner brush and remember to clean them often. Also, when storing files, separate them so they cannot brush against each other or against other tools.

Punches

Sometimes in our line of work, we need to use punches, such as when replacing the rubber portion of the F-16 or F-22 ejection control handle. There are two basic types of punches: solid, which are the most common, and hollow, which usually are designed to punch holes in leather, paper, and other similar materials. Since we do not do a lot of leatherwork in egress, we will focus on solid punches.

Solid punches mark metal, drive pins, align holes, and do other similar jobs. The only type of punch you will likely use as an egress journeyman is a drive pin punch (fig. 4-8).



Figure 4-8. Drive pin punch.

Drive pin punch

The drive pin punch has a flat tip, which may be tapered. Point diameter may range from 0.03 to 1/2 inch, and the length from 3 to 6 inches. Standard drive pin punches usually come in sets of nine. These punches are used to remove straight or tapered pins. Be sure to use the right size punch for the pin being removed.

Care of punches

Clean punches with a clean rag after each use and apply a light coat of oil before storing. Store punches so that the edges will not be damaged. Replace punches that have mushroomed ends if they cannot be reconditioned. Reconditioning includes virtually any minor, common sense maintenance action and is discretionary. Common sense acts of reconditioning are normally within the capability of any level of maintenance and are not to be construed as a repair.

026. Using composite tool kits

Composite tool kits, better known as “CTKs” are a major part of the tool and equipment management program. The tool and equipment management program encompasses all facets of tool accountability, control, and storage procedures. It includes CTK management, special tool procedures, and tool storage and facility requirements. The program is designed to consolidate individual hand tools and special tools into central locations, maximize joint use, and reduce foreign object damage potential through strict control and accountability.

Objective of the tool and equipment management program

The tool and equipment management program’s objectives are to prevent and eliminate FOD to aircraft, engines, missiles, training and support equipment, and to reduce costs through strict, effective control and accountability of assets. To ensure standardization among maintenance units, the MXG/CC is responsible for the tool and equipment management program. Squadron maintenance supervisors are responsible for executing an effective tool program. The tool and equipment management program is outlined in [AFI 21-101](#). The AFI lists the Air Force minimum requirements; MAJCOMs may impose additional requirements.

CTKs

CTKs are designed to provide a quick and simple inventory method for tool accountability. Each tool in the kit is shadowed; its shape cut out so that it is obvious if the tool is not present. All CTKs and tools are clearly marked with the owning section’s unique identifier code. All tools and equipment are

inspected at least annually for serviceability according to TO 32-1-101. The flight commander/chief designates CTK custodians to manage and control CTKs. CTK custodians are responsible for tool and equipment accountability and control within their respective areas, but everyone is always responsible for his or her own actions.

EXCEPTION: A different person may be assigned as the hazardous material (HAZMAT) monitor.

The flight chiefs and/or section NCOICs determine the type, size, contents, and number of CTKs required for their work centers. You will find that each work center has different requirements; if you traveled over to the fuels section, for example, and looked in one of their CTKs, you would see they have very different tools inside. For that matter, an egress shop that works F-22s would have very different CTKs than one that works U-2s.

Tool accountability

The Air Force is constantly upgrading its tool accountability software, and most bases have recently moved from the Tool Accountability System (TAS) to a product called TCMax. Regardless of which database/software system you are using at your base, the products provide a computerized system with hardware and software designed to control and account for tools and equipment in each maintenance shop. They are broad enough to cover the needs of the entire Air Force, yet specific enough to identify the smallest individual tool in your inventory. The flexibility of these systems allows every shop to be successful in controlling tools and equipment, preventing FOD, and ensuring efficient operations.

In accordance with AFI 21-101, ALL UNITS (even aircrew flight equipment) must mark all their tools, equipment, and CTKs with a worldwide identification code (WWID) code (except replacement “spare” tools, until they are to be used). The WWID code consists of nine characters (numbers and letters). Every tool is marked with the code assigning it to a CTK. The first two characters are based on the wing/unit’s assigned personnel accounting symbol (PAS) code which identifies the base. The squadron/unit is identified in the third character, and the work center is the fourth character. The remaining five are available for numbering that is customizable to just that work center.

This system makes it possible to quickly identify the origin of any properly marked Air Force tool that may be found anywhere in the world. When implemented correctly, this system leads to superb equipment accountability.

Master inventory listing

A master inventory listing (MIL) is developed for each CTK or series of identical CTKs. The MIL is usually extracted from the tool accountability software. For in-shop CTKs, the MIL may reside in the database (i.e., TAS/TCMax). However if the CTK is dispatchable to the flight line, a hard copy of the MIL must be attached to the CTK. As the name implies, the Master Inventory Listing, is a list that contains all the items in a CTK. Everything in a CTK must be listed on the MIL, even spools of safety wire, rolls of tape, and the FOD bag. Missing or broken/removed items must be documented in the tool database and for dispatchable CTKs, they will also be identified as missing, broken/removed on a locally generated form and/or the hard copy MIL. Always check your local policies for proper tool documentation and requirements.

Accountability, control, and inventory

Accountability means knowing where tools are and who has responsibility for them. Flight commanders/chiefs and section chiefs, through CTK custodians, are responsible for tool and equipment accountability and control. When an individual signs for a tool or piece of equipment, that person is accountable for it until it is returned to the tool room when the accountability transfers back to the CTK custodian (through a representative or tool room employee).

Units use tool accountability software for the following reasons:

- Track, issue, and receipt all assigned tools, equipment, tool kits, HAZMAT items, and technical orders.
- Track authorizations/restrictions for special tools/equipment (by individual).
- Track CTK and support section inspections.
- Track spare, lost, and damaged (removed) tools.
- Develop and manage tool/equipment inventories.
- Develop and manage deployment kits (import/export).

If tool accountability software is not available (i.e., at a deployed location), units will use AF Form 1297, Temporary Issue Receipt, or another MAJCOM or locally approved form designed for accountability and control of CTKs, equipment, and tools.

All CTKs, tools, and equipment are accounted for at the beginning and end of each shift. Shift inventories are always documented by both outgoing and incoming personnel. CTKs present during tool room shift inventories do not need to be opened for inventory. A visual inventory of all CTKs should be done when issued for use, at the completion of job or tasks, and when returned to the tool room. Accomplish a CTK inventory after maintenance actions have been performed on any aircraft or equipment before conducting:

- Engine runs.
- Landing gear retractions.
- Flight control operational checks.

NOTE: It is also a good idea to inventory your tools *before* you close a canopy! Improper tool control is often the cause of canopy/sill damage.

A comprehensive inventory of all tools, equipment, and CTKs is conducted at least annually or when the CTK custodian changes. The purpose of this inventory is to perform an extensive inspection of all tools and equipment, including condition, identification markings, and accuracy of the MIL. Inspect all tools for serviceability according to TO 32-1-101. CTK custodians document these inventories and maintain the most current inventory. Remember always check your local policies for proper tool documentation and requirements.

Tool room operations and security

Security of tools and equipment starts at the point of issue. Procedures are established to ensure custodial control. The tool room custodian has certain responsibilities when issuing tools to dispatch work-teams. Set up tool rooms to ensure positive accountability. The following guidelines help to ensure positive accountability:

- Establish procedures to ensure accountability. You have to have a way to account for every tool located in the tool room. (i.e., signing items out in TCMax or another form of tracking who has what when deployed to a location without a computer tracking system).
- Do not issue tools located in a dispatchable CTK individually. However, the entire box may be signed out.
- Designated tool rooms must be capable of being secured. If CTKs or tools have to be located outside of the tool room, the NCOIC/section chief will design a process to prevent unauthorized use or access to the tools and/or equipment. For example, an oversized support equipment bin may be too large to fit in the room due to facility limitations.
- Use tool kit locks to provide a physical barrier to opening the container lid, drawer or door, thereby preventing unauthorized removal of the tools/equipment.

- If the tool room is secured, then locks are not required. However, the tool room has to be locked when left unattended, preventing unauthorized access.
- Lock and/or secure to an immovable object, dispatchable tools, equipment, eTools, and CTKs when left unattended. (**NOTE:** NEVER leave a tool box secured to the exterior of an aircraft or AGE.)

If after all measures taken to ensure positive tool control fail and a tool is lost, every effort to locate and secure the lost tool and must be made in a timely manner. Supervisors ensure that all assigned personnel are familiar with lost tool procedures. If an item/tool or a portion of a broken tool is discovered missing, consult [AFI 21-101](#) and local policies for proper lost tool procedures. Be prepared to do an extensive search until it is accounted for; if the possibility of the lost tool is somewhere in an aircraft, and not found after an initial search, an expeditor, production super, or equivalent must be notified.

A final note about tool and equipment control—it is very important to remember that personal tools not controlled through CTK procedures, are *not* authorized on the flight line, or in any maintenance area (e.g., mini flashlights, multi-tools, buck knives, and so forth). If you think a Leatherman or some other tool would be beneficial, you should ask your section CTK custodian and/or NCOIC to add it to the MIL.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

025. Using common hand tools

1. What are the four most common types of screwdrivers?
2. What type of screwdriver is used to reach a screw that is located in a recessed position where a straight screwdriver cannot be used?
3. What items with square, hex, or notched shanks can be used with ratcheting screwdrivers, speed handles, and socket wrenches?
4. What is the danger of using a poor fitting screwdriver?
5. What is the proper way to hold a hammer?
6. What is the proper way to strike an object with a hammer?
7. Which hammers are used as chisels for removing rivet heads and for stretching or bending metal?

8. Periodically, what should you rub into wooden hammer handles to prevent the wood from drying out and shrinking?
9. What type of tool is used when hand grip alone is not sufficient to do the job?
10. What is the danger of using pliers in place of a wrench?
11. What type of flat-nosed pliers are very good for holding objects in tight places, crimping or bending thin metal, and forming loops in wire?
12. When can you use pliers for removing nuts or bolts?
13. Pushing on a wrench is dangerous, but if you do have to push a wrench, what method should you use?
14. Match the tool in column B with its description in column A by writing the correct letter in the blank space provided. Descriptions in column B may be used once, more than once, or not at all.

a. Column A

- ____ (1) Has one box end and one open end.
- ____ (2) Box-end wrench that does not have to be lifted up and repositioned each time you turn it.
- ____ (3) Includes a switch on the back of the head which controls direction of the drive.
- ____ (4) Used with any socket/handle combination to gain clearance above a nut or bolt.
- ____ (5) Changes the drive size between the socket and the handle.
- ____ (6) Has a knurled worm gear.
- ____ (7) Openings are closed.
- ____ (8) Provides increased leverage for loosening nuts or bolts.
- ____ (9) A brace type shaft with a revolving grip on the top.
- ____ (10) Opening on one or both ends.
- ____ (11) Round hardened metal sleeve with a drive on one end and a splined opening in the other.

Column B

- a. Adjustable open-end wrench.
- b. Open-end wrench.
- c. Box wrench.
- d. Ratchet-box wrench.
- e. Combination wrench.
- f. Socket wrench.
- g. Ratchet handle.
- h. Speed handle.
- i. Hinged handle.
- j. Extension.
- k. Socket wrench adapter.

15. What tool cuts, smooths off, or removes small amounts of metal, wood, plastic, or other material?

16. What type of punch removes straight or tapered pins?
17. If you cannot recondition a punch with a mushroomed end, what should you do?

026. Using composite tool kits

1. What does the tool and equipment management program include?
2. What is the objective of the tool and equipment management program?
3. Who is responsible for the tool and equipment management program?
4. What Air Force publication outlines the tool and equipment management program?
5. What provides a quick and simple inventory method for accountability of tools through tool shadowing?
6. Who designates CTK custodians?
7. What is the computerized system the Air Force uses to control and account for tools and equipment in each flightline maintenance shop?
8. What is the maximum number of digits that can be assigned to each individually dispatchable tool or CTK as a WWID?
9. If a CTK is dispatchable to the flight line, what must be attached to it?
10. Besides tools in the CTK, what else is must be included on the MIL?
11. What alternatives can be used, if tool accountability software is not available at your deployed location?

12. When are CTKs, tools, and equipment accounted for?
13. When must a comprehensive inventory of all tools, equipment, and CTKs be accomplished?
14. What must be done if only one tool in a dispatchable CTK is needed?
15. When may you use a personal box cutter on the flight line?

4-2. Special Tools and Test Equipment

Common hand tools are not the only tools you will use as an egress journeyman. Torque wrenches and gauges are a few of the special tools you will need to accomplish the mission. Also, depending on the MDS you are working, you will use some different types of test equipment. It's important to know how to use these items properly because we are an aircrew member's last chance for survival.

027. Using special tools

Have you ever tried to measure a spark plug gap on your car with a damaged or rusted feeler gauge? It probably still worked. But what if your life depended on it being correct? The same lessons you learned about properly maintaining your tools at home apply to Air Force tools. In the lesson about common hand tools you learned that you must take pride in your work and use your hand tools correctly. Well, the same applies here, and even more so as special tools are used to apply a measurement of some sort, or to perform some special maintenance function on egress system components. If they are not maintained with the utmost care and attention to detail, they cannot properly perform the function for which they were designed. And someone else's life may depend on it.

Torque wrenches

Torque wrenches are one of the most important tools you will use as an egress journeyman. You may have heard some of your trainers or coworkers say that they have a "calibrated elbow" and have no need of torque wrenches. This statement exhibits a lack of integrity and excellence. In egress, we use torque wrenches to torque nuts and bolts, but more importantly we use them to torque ballistic hose "B" nuts. "Torque" is defined as the product of a weight times the perpendicular distance to a center of rotation. Imagine if someone used their calibrated elbow during the installation of an F-16's JAU-8 initiators and the gas pressure from their firing during an ejection caused the "B" nuts to come undone. The results would not be pretty; this example illustrates why torque wrenches are so important and must be used every time they are called for in the technical order.

Torque wrenches measure torque (twisting force) applied to bolts and nuts. Some wrenches measure torque in inch-pounds, others in foot-pounds. Much of the hardware installed on an aircraft must be tightened to specified torque values. Tables of general torque values are listed in aircraft general ground servicing maintenance manuals. These tables provide standard (hardware) torque values for the aircraft system on which you work. General torque values are used when a maintenance procedure does not specify torque values. For example, the maintenance procedure may call for the ballistic hose on an aircraft ejection seat to be tightened to 90 to 100 inch-pounds. Had the maintenance procedure not specified the torque value, you would refer to the appropriate general ground servicing

technical manual to find the correct torque value. The most common torque wrench used in the Air Force is the “breakaway” type, sometimes called the automatic-release torque wrench. This is the only torque wrench authorized for use on common aircraft hardware. The torque wrenches common in egress are either mechanical or digital. The digital ones are especially nice, because they are more precise, and are due PMEL calibration less frequently. Digital torque wrenches also take less than half the time for routine calibration (meaning less time out of the shop). One of the best features of the digital torque wrench is the automatic shut off feature. The automatic shut off feature lowers itself to the lowest setting, which helps to keep the calibration accurate and avoid those pesky QA write ups.

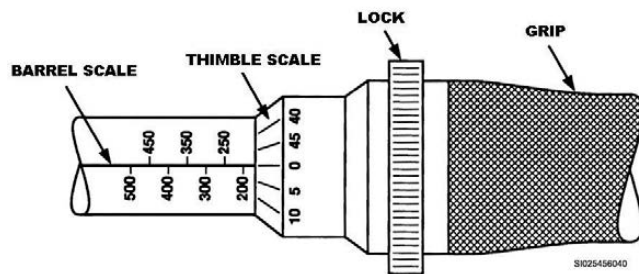


Figure 4-9. Torque wrench scale.

Mechanical breakaway torque wrenches are adjustable; and a desired torque value can be set (within limits of the torque wrench), by turning the handle or grip. The torque scale consists of the barrel scale and the thimble scale. Notice that the barrel scale is graduated in 50 inch-pounds (fig. 4-9). The thimble scale is graduated from 0 to 50 inch-pounds

To increase the torque setting, turn the handle or grip clockwise. To reduce the torque setting, turn the handle or grip

counterclockwise. Always approach the desired torque setting by moving from the lower to the upper end of the scale. To set the torque value on a digital wrench, you simply press the up or down button to the desired value seen on the display screen.

The mechanical breakaway torque wrench has a lock to ensure that the torque value does not change while the wrench is being used. Some torque wrench handles are pushed inward to engage the locking mechanism and outward to set the torque. In other wrenches, turning a lock ring on the handle locks the wrench. In either case, the grip should not turn when the wrench is in use. The lock must be “unlocked” before the handle (grip) can be turned. The lock can be “locked” only when a number on the grip (thimble) scale (0, 5, 10, etc.) is in line with the barrel index line.

Torque wrenches should be checked and calibrated when they are issued from supply or stock. This should also be accomplished at the specified intervals listed in the torque wrench’s applicable technical order. A torque wrench’s calibration should also be verified if you suspect it is out of adjustment because the wrench was dropped, mishandled, or any other reason.

NOTE: *Verification* is a checking operation to determine accuracy or inaccuracy of a torque wrench by a tester. *Calibration* is the actual adjustment necessary to bring the torque wrench into acceptable tolerance.

Prevailing (running) torque

To obtain the correct recommended torque value on a nut, the nut must be run down until it is one turn from the beginning of seating. At this point; the prevailing torque should be noted. If the prevailing torque is less than one-third of the recommended torque, it should be disregarded and the nut tightened to the recommended torque value. If the prevailing torque is one-third or more than one-third of the recommended torque, it should be added to the recommended torque.

Example: The recommended torque is 50 to 70 inch-pounds. The prevailing torque at one turn from the beginning of seating is 30 inch-pounds. The correct torque wrench reading would be 80 to 100 inch-pounds. If the prevailing torque had been 10 inch-pounds, it would have been disregarded and the correct torque wrench reading would have been 50 to 70 inch-pounds.

NOTE: Prevailing torque is usually associated with self-locking screws and nuts. It is not always necessary to account for prevailing torque. If the appropriate technical order specifies using a self-locking screw or nut and does not state that prevailing should be compensated for, it must be assumed that the manufacturer of the item has already taken it into consideration. As a result, prevailing torque will be compensated for only if required by specific technical data.

Precautions

Torque wrenches are precision measuring instruments and should be handled and treated as such. Observe these precautions when using torque wrenches:

- NEVER use a torque wrench that is overdue for verification or has been dropped. This could result in over-torque or under-torque of aircraft hardware, which could have disastrous consequences.
- NEVER use a torque wrench to loosen bolts. The ratchet mechanism could be damaged and its verification would become untrustworthy. (*Remember the breaker bar in the last lesson.*)
- NEVER use an extension on the handle. This would exceed the wrench's capacity and most likely damage the ratchet mechanism.
- NEVER exert a fast or jerky pulling force when tightening with a torque wrench. This can cause over-torque when the breakaway occurs.
- NEVER apply torque after the breakaway occurs. If you do, you will over-torque the fastener and you might damage the wrench.
- NEVER use the torque wrench without first applying the lock. This allows you to torque to the desired tightness without the setting mechanism accidentally moving to another position.
- NEVER use a torque wrench without first cycling it according to the manufacturer's guidelines. If guidelines are not available, set the torque wrench to the maximum setting and allow breakaway to occur six times. This is required prior to the torque wrench's first use and is good for an eight-hour period. This ensures the wrench is lubricated properly prior to use.

Fixed gauges

Gauges measure distances or dimensions, often within 1/1000 of an inch or less. There are both adjustable and fixed types. We only discuss fixed gauges because that is what you will mostly use as an egress journeyman. A fixed gauge is made with extreme accuracy to a fixed standard of measurement or shape, so that when it is applied to a piece of work, the work is measured directly against extreme accuracy, and not a human estimation of the standard. For example, to fix two surfaces, say six-thousandths of an inch apart, you adjust them until a piece of metal *known* to be six-thousandths of an inch thick—a fixed gauge—just fits between them. There is no need to “eyeball” it. Fixed gauges are generally made, either individually or in sets of two or more, for some specific operation or measurement. We mainly deal with two fixed gauges: the thickness gauge and the go/no-go gauge (fig. 4-10).

Thickness gauge

Thickness gauges are also known as gap-setting, feeler, or clearance gauges. They are used to determine the exact gap, or clearance, between two surfaces. You may have previously used one to measure the gap of automobile spark plugs. A typical thickness gauge has 22 blades, although some may have fewer or more. In your job you use thickness gauges to measure the clearance when adjusting such items as canopy hooks, rollers, and canopy seals. Be careful to insert the blades perpendicular to the gap being measured. If the blades are inserted at an odd angle, you may get an erroneous measurement or kink and ruin the blades. When used correctly, the gauge blade has a distinct “drag” on it as it is slipped in or out. Never force the blade into the gap; you may damage the blade if you do. As you become more proficient, you will be able to tell if the “drag” is too great or too little, if a thicker or thinner blade would fit better, and if an adjustment is necessary.

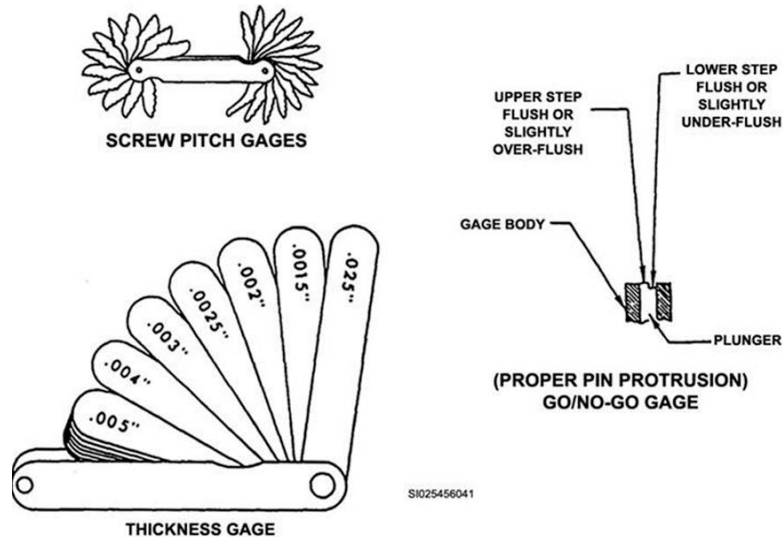


Figure 4-10. Types of gauges.

Go/no-go gauge

Go/no-go gauges are usually made in pairs in one unit. They, like other fixed gauges, compare a precise standard to the component you are inspecting. When the component is checked against a fixed standard, the component is easily identified as serviceable or unserviceable. For example, the firing pin protrusion gauge is used to determine the serviceability of firing pins. If you place this gauge over a firing pin and get a reading on the upper step of flush or slightly over flush and a reading on the lower step of flush or slightly under flush, then the firing pin is the proper length and serviceable. Any other indication is considered a “no-go” or unserviceable condition.

Egress journeymen use many different types of go/no-go gauges, and to list them all would take a volume in itself. Go/no-go gauges simplify work and eliminate the need for taking complicated measurements and making complicated calculations.

Using fixed gauges

All fixed gauges are made to measure some specific dimension. Handle them carefully. Any strains imposed on them by forcing them over or into a piece of work, or by dropping them, can distort them enough to spoil their accuracy, rendering them unusable. See that their measuring surfaces, as well as the surfaces of the work, are clean and smooth. Remember, these are instruments of extreme precision!

Prior to storage, coat metal parts with a film of oil light enough so that it will not leave a visible fingerprint. This prevents rust and keeps gauge markings legible. Store gauges in separate containers and return blades of leaf-type gauges to their case after use. Check them periodically against their respective standard to make sure they have not changed in size due to wear or damage. Gauges that have been worn or damaged beyond repair must be replaced.

Force gauges

A force gauge is used to check or adjust specific forces required to operate mechanisms. For example, a force gauge is used to check the amount of force required to actuate the ejection seat initiator firing mechanisms and components. Force gauges are available in various capacities. The 0 to 30-pound and the 0 to 200-pound sizes are commonly used (fig. 4-11). In using a force gauge to adjust tension, be sure that the pull of the gauge is perpendicular to the center of the lever being checked (fig. 4-12); otherwise, you will get an erroneous reading. Force gauges should be checked and calibrated by PMEL periodically to ensure accuracy of the tension mechanism.



Figure 4-11. Force gauges.

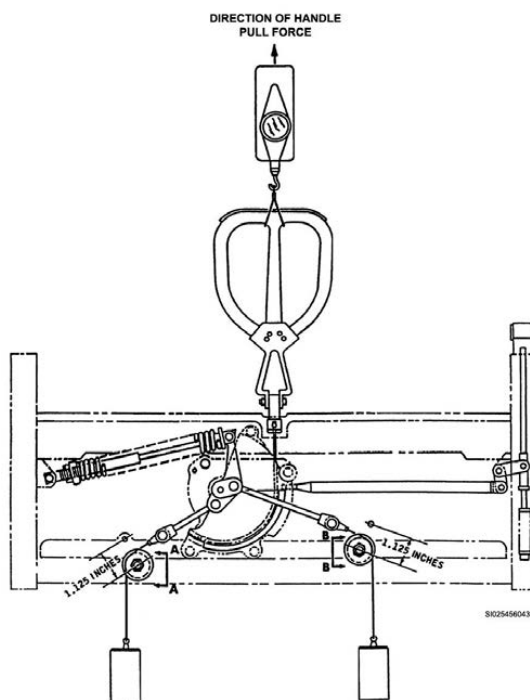


Figure 4-12. Force gauge check.

Other measuring tools

We use many devices to measure clearances and surfaces. Fixed gauges provide the easiest method because a predetermined standard is used. Often you cannot use these types of gauges and must rely on more conventional measurement devices such as rules, micrometers, and vernier scales. Some of the most common measurement checks that call for using these tools include checking firing linkage

travel, adjusting thruster and canopy actuator, verifying rocket motor alignment, and determining the proper length of disconnect lanyards.

It might seem very complicated to measure in thousandths of an inch or less—as a journeyman must—but taking these measurements simply requires the use of a more accurate tool. And you must be more exact in reading their scales. But those are the only differences between these and other measuring jobs.

Rulers

Rulers are graduated measuring instruments usually made of metal or wood. You have probably used wooden rulers since your childhood school days. However, flexible steel rulers are the type most commonly used in aircraft maintenance. The graduations indicate inches and fractions of an inch (or centimeters and millimeters).

Because a journeyman must use rulers of various kinds so frequently, it is important that you become thoroughly familiar with the usual graduations and be able to read them quickly and accurately. Once you know how to use the 6-inch ruler, using other types becomes merely a question of applying them to the work at hand. Ordinarily, the four edges of a 6-inch ruler are graduated in 8ths and 16ths of an inch on one side and in 32nds and 64ths on the other. Practice in reading measurements will enable you to obtain accurate measurements very quickly with any type of ruler.

The best way to learn to read a ruler is to first, learn the 8ths and 16ths, then the 32nds and 64ths. Practice by reading measurements similar to the examples in figure 4-13 and soon you will be able to measure accurately and quickly with any type of ruler. One frustrating but common problem you will encounter is that the rule gives measurements in fractions, while the technical order gives measurements in decimals. This problem is overcome easily by converting decimals to fractions and *vice versa*. To change a fraction to a decimal, simply divide the numerator by the denominator. For example, if you need the decimal equivalent of $\frac{3}{8}$ of an inch, you would divide 3 by 8 which equals 0.375 thousandths of an inch.

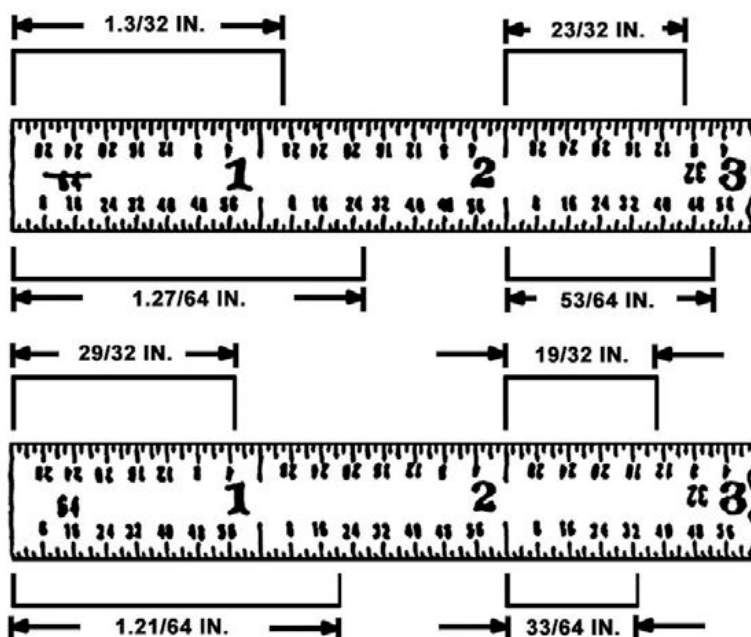


Figure 4-13. Practice measurements for 6-inch ruler.

To convert a decimal to a fraction, remember that decimals are written in powers of 10. The first digit to the right of the decimal point is tenths; the second is hundredths; the third is thousandths. So in our preceding example 0.375 can be written as $\frac{375}{1000}$. However, as you recall, the most common

fractions on the ruler are 8ths, 16ths, 32nds, and 64ths; so, the fraction $375/1000$ is of little use to you. Your problem is to convert $375/1000$ into a fraction you can use. What ratio of $375/1000$ will fit your ruler scales (8ths, 16ths, 32nds, or 64ths)? The formula for figuring a ratio is $a/b = c/d$. You already know “a/b” is $375/1000$. You also know “d” will be one of the scales on your ruler. Let’s select 8ths of an inch. Your formula should now look like this $375/1000 = c/8$. The next step is to cross multiply (8 times 375 and 1000 times c). The answer is $3000 = 1000c$. Now divide 1000 into 3000 and you find “c” = 3. You now know that $375/1000 = 3/8$ of an inch. Using this principle, you can convert a decimal into a usable fraction.

NOTE: The technical order almost always gives plus and minus tolerances (e.g., 0.75 ± 0.10). Use these tolerances to make your fractions come out even. This requires trial and error.

Micrometers

The micrometer is a precision measuring tool used to take measurements accurate to one ten-thousandth (0.0001) of an inch. Examples of micrometers are shown in figure 4-14. Also shown are extension rods that come with the inside and the depth micrometers. They extend the range of measurement for these two types of micrometers. The outside micrometers are made in various sizes to measure differently sized objects. They come with interchangeable anvils to adapt one frame to measure various sizes.

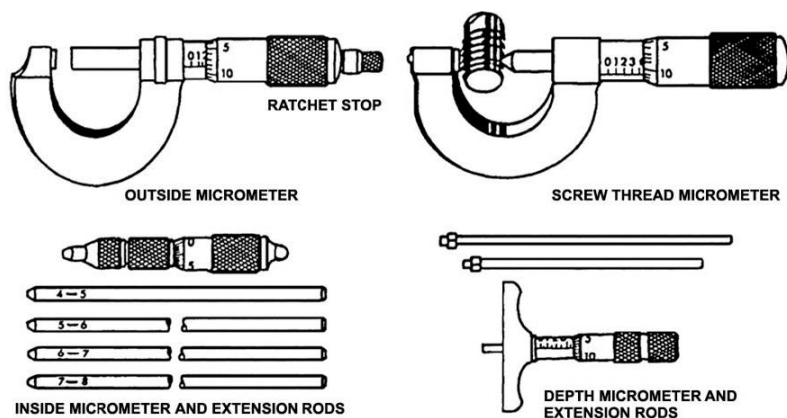


Figure 4-14. Types of micrometers.

The outside-micrometer, shown in the previous figure, measures objects up to 1-inch. Commonly, it is called the 0- to 1-inch micrometer, because those are its limits. The next larger size—the 1- to 2-inch micrometer—is used to measure objects that are larger than 1 inch, yet smaller than 2 inches. While outside micrometers range up to 24 inches, each can measure only a 1-inch range within its size. Thus, before you can measure something with a micrometer you must first find the approximate size to the nearest inch and then select accordingly. All micrometers are similar in use. The following paragraphs explain micrometer use in general terms. This information applies to any micrometer.

First, position the tool so the object to be measured is between the anvil and the spindle (fig. 4-15 shows the parts of a micrometer.) The spindle is threaded where it extends through the barrel to the thimble. As the thimble is turned clockwise or counterclockwise, the spindle moves in or out, thus decreasing or increasing the distance between the end of the spindle and the anvil. The thimble and barrel have very accurately graduated scales. You read the scales to determine the distance the spindle moves in or out, or the distance between the spindle and the anvil.

These scale graduations are illustrated in figure 4-15. When the spindle is turned clockwise all the way in (against the anvil if the micrometer is a 0- to 1-inch size), the zero line on the thimble should line up with the revolution line on the barrel, and the edge of the thimble should line up with the zero line on the barrel. As the thimble is turned counterclockwise, one revolution moves the spindle

twenty-five thousandths (0.025) of an inch away from the anvil. This one revolution of the thimble moves its edge outward one mark on the micrometer barrel, thus indicating that there is 0.025 of an inch clearance between the spindle and the anvil. When the thimble is turned four revolutions counterclockwise, its edge moves outward to the number 1 on the barrel to indicate 0.100 of an inch ($4 \times 0.025 = 0.100$). In other words, each mark on the barrel represents 0.025 of an inch. Also, each mark on the thimble represents 0.001 of an inch. There are 25 marks on the thimble.

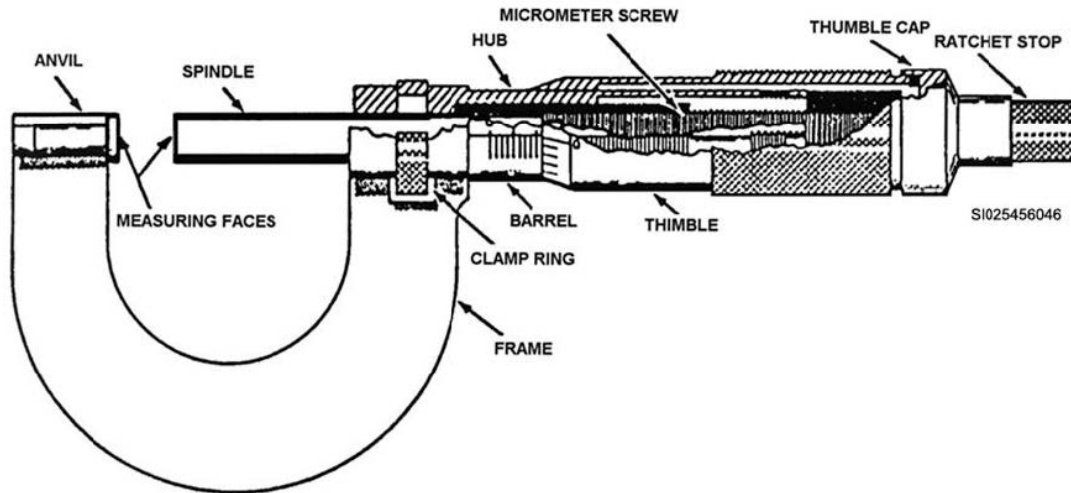


Figure 4-15. Parts of a micrometer.

To practice reading the micrometer scale, refer to the upper drawing in figure 4-16. Here, the edge of the thimble is slightly past the number 3 on the barrel. This indicates the reading is slightly over three hundred thousandths (0.300). Note that the thimble has been turned four-thousandths (0.004) past the zero mark. Adding this 0.004 to the 0.300, gives a reading of 0.304 inch. For another example, look at the lower drawing in figure 4-16. Here the thimble is almost to the first line, which would indicate 0.225, but as indicated by the reading on the thimble, it lacks 0.001 of being to the line. Therefore, the correct reading is 0.224 inch.

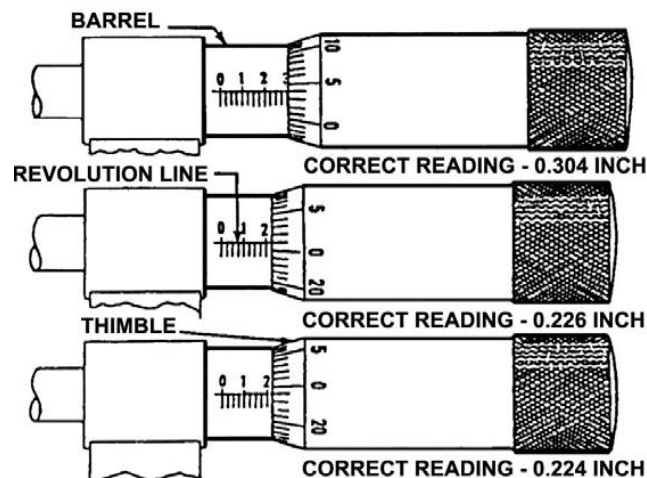


Figure 4-16. Graduations on a micrometer.

With practice, you can read a micrometer correctly at a glance; however, until you learn, use this procedure: find the largest number on the revolution line between zero and the edge of the thimble. Use the middle reading in figure 4-16 as an example; this largest number is 2. Write it down as 0.200 inch.

Then add to it the number of unmarked graduations between this figure and the edge of the thimble, which in the example is 1, or 0.025 inch. Jot this down under the 0.200. At this point, if the zero graduation on the thimble coincided with the revolution line, the reading would be complete.

0.200 inch
0.025 inch
 0.225 inch, final reading

However, the zero graduation on the thimble and the revolution line do not coincide, so you must add the number of graduations *between* zero on the thimble and the revolution line to the 0.225-inch reading. In the example, there is one such graduation. Write this as 0.001 inch, and the complete addition is:

0.200 inch
 0.025 inch
0.001 inch
 0.226 inch, final reading

028. Using test equipment

As aircraft technology has advanced throughout the years, so has the technology for escape systems. Today's ejection seats carry many electrical components (e.g., environmental sensors and recovery sequencers) to tell ejection seat components when to fire. The F-22 even has an internal sequencer that tells components when to fire throughout the whole system. This lesson covers the tools you will use to test those components.

Multimeter

Multimeters are used with the ACES II to check for proper continuity between Recovery Sequencer P-lead connector shells and their respective receptacles. This is called a shell receptacle test. Testing must be accomplished each time a Recovery Sequencer P-lead is connected to its corresponding component receptacle.

As the name implies, the multimeter is a combination meter that measures voltage, current, resistance or continuity (fig. 4-17). We will focus on the two functions you will use most: resistance and continuity.

For resistance, turn the switch to the omega (Ω) symbol. Since the meter powers up in the auto-ranging scale mode, if you leave it in auto-ranging, it will simply select the best range in which to display the resulting reading. But if you require a particular result, such as *must not exceed* a particular limit given by technical data, select manual ranging by pushing the ranging button in the top left corner. Keep pushing the button until the proper range appears in the window. For example, if you need to find out if your circuit has no more than 0.010 ohms resistance, select ohms (Ω) and look for a reading of 0.010 or less. After selecting the range, hold the test leads together to zero the meter. If the meter does not completely zero, whatever resistance is registered on the scale may be subtracted from the circuit's reading to get the true resistance of the circuit. For example, if the meter's test leads have 0.3 ohms resistance, and the scale measures 1.8 ohms resistance when you measure the circuit, it stands to reason that the circuit actually has about 1.5 ohms resistance. See the manual for further instructions.

For a continuity reading, you can use the same scale if you want to, but a function is available that provides an audible tone as well as a resistance reading. This function is represented on the multimeter as a series of increasing sound waves. Move the switch to the continuity symbol and test the meter by touching the leads together. If your leads are working properly, you have continuity and the meter will emit a high-pitched tone. Now, use the meter to test the continuity of your circuit. If

there is a power supply in the circuitry, make sure you disconnect the power supply first. If your circuit has continuity, the meter will emit the same high-pitched tone. If the circuit has a poor or intermittent connection, the meter will produce erratic beeps.

This can be a valuable trouble-shooting aid in identifying broken wires or poor connection in electrical firing circuits and may come in handy when troubleshooting various systems.

To perform a shell receptacle resistance check on the ACES, using your multimeter, measure resistance between connector shell and receptacle to which it is connected. Resistance must be 0.010 ohms or less, excluding lead resistance.

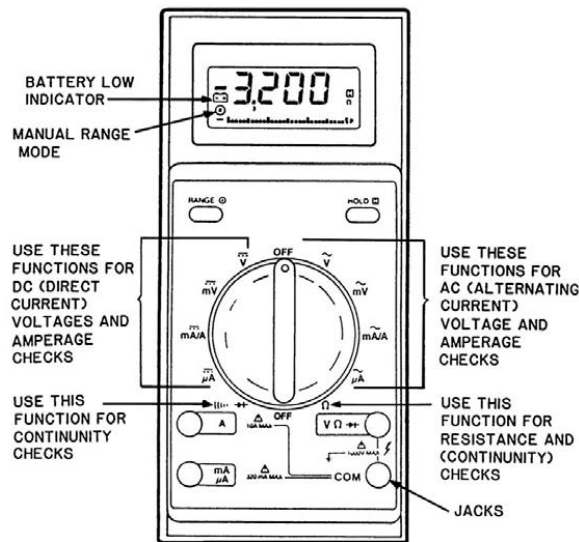


Figure 4-17. Digital multimeter.

The digital multimeter has a battery-low indicator. When you see a picture of a battery displayed in the window, you know the battery needs to be replaced. Remember the following points when using meters:

- Inspect test leads for insulation damage or exposed metal.
- Replace a damaged lead.
- Use shroud connectors or finger guards to avoid the risk of accidental contact with the metal probe during testing.
- Check continuity of test leads by touching them together before you start testing.
- Ensure you have selected the proper function for your test or the meter may be damaged.
- Disconnect the red (positive) test lead electrically before disconnecting the black (negative) test lead during your checks.

TTU-415/E tester

ACES environmental sensors are precision instruments inside the seats which measure airspeed and altitude. This information is used by the recovery sequencer to determine the mode of ejection, so the environmental sensors must work properly. The mechanism for testing environmental sensors is the TTU-415/E environmental sensor test set (fig. 4-18).

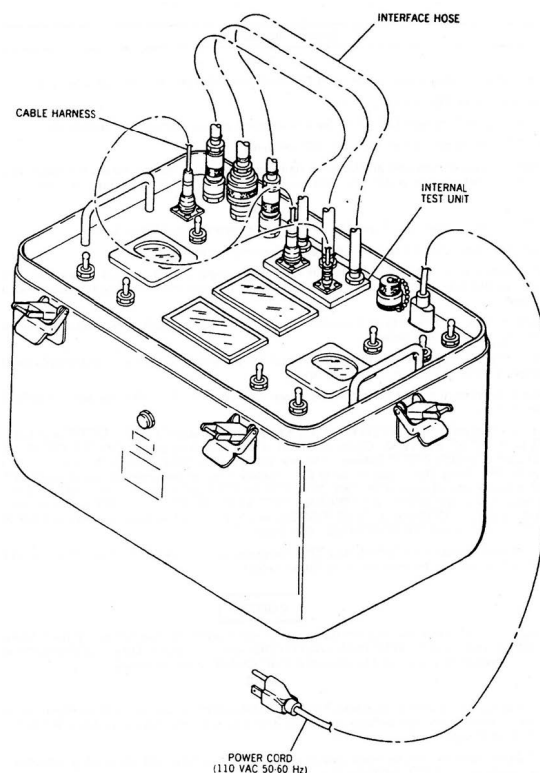
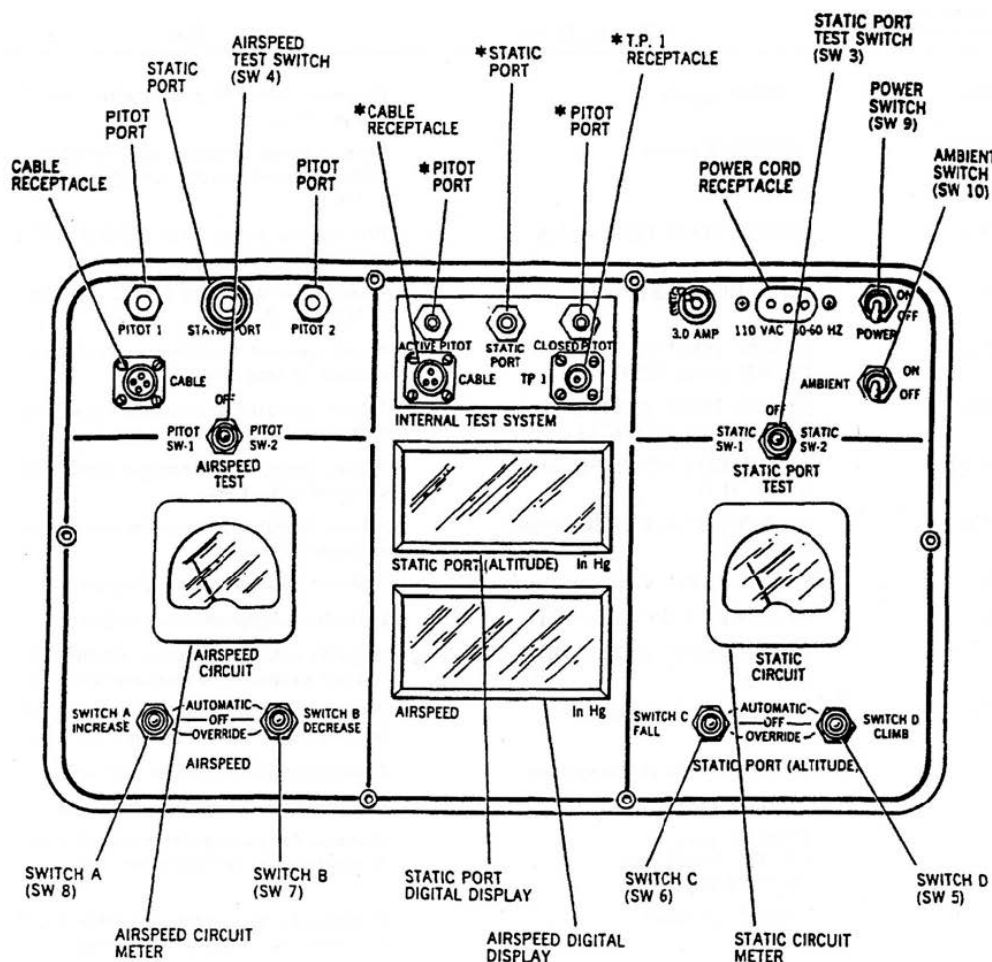


Figure 4-18. Environmental sensor test set TTU-415/E checkout set-up.

Testing of the environmental sensor includes a connector shell and resistance check as discussed earlier and a functional test using the TTU-415/E test set and altitude chamber. The procedures for testing an environmental sensor are within the appropriate 13A5 seat technical order for the ACES system you are using. Figure 3-18 shows controls and indicators for the test set. Always follow step-by-step checkout procedures within the technical order. To ensure that it is well taken care of, the following are some important things to inspect prior to using your test set:

- Inspect exterior of case and markings on panel for corrosion damage, nicks, scratches, illegible markings or other obvious defects.
- Inspect interface hose for external damage. Hose must not leak.
- Inspect power cord and cable harness for external damage, frayed or cracked insulation, loose pins, or evidence of electrical arcing or overheating.
- Inspect power cord and cable harness for damage.
- Inspect meters, instruments and switches for signs of damage, broken face lens, bent or broken toggles, or other obvious defects (fig. 4-19).
- Inspect altitude chamber for scratches. Inspect markings, packing and fittings for signs of damage or deterioration.

If you do find discrepancies, consult TO 33D2-39-26-1, *Operation and Maintenance Instructions with IPB-Environmental Sensor Test Set, Model TTU-415/E*, for procedures on fixing the issues. If your TTU-415/E is out of service, then a continuity check of the environmental sensor is an authorized deviation. However, a TTU-415/E functional check must be scheduled for the next seat removal. If an environmental sensor is new from supply, it may not be checked this way. You will have to contact another base to obtain a test set.



NOTES

1. INTERFACE HOSE AND CABLE HARNESS NOT SHOWN FOR CLARITY.
2. * INTERNAL TEST UNIT CONNECTIONS.

Figure 4-19. Environmental sensor test set TTU-415/E controls and indicators.

If you are at a B-1 base, you will also use the TTU-415/E to perform functional checks on the seat's velocity sensor in accordance with TO 13A5-66-1, *Operation and Maintenance Instructions with IPB, Intermediate Level, Escape System Assembly (B-1)*. The velocity sensor must be tested prior to installation also.

F-22 Emergency Escape Sequencing System tester

Where the ACES series of seats have a "brain" inside in the form of the recovery sequencer to sequence the firing of egress components, the F-22s also have a "brain" inside in the form of the Emergency Escape Sequencer or Emergency Escape Sequencing System (EESS). It is an electronic assembly that uses redundant electronic microcontrollers to provide sequenced firing signals for the electronic explosive devices in the emergency escape system.

The EESS receives power from the thermal batteries on the seat, or the internal or external canopy jettison handle assemblies. The microcontrollers sequence the power to generate redundant fire signals to each independent circuit that initiates the canopy thruster, inertia reel gas generator electronic explosive device, canopy rocket, seat catapult, and the central integrated processor guillotine. As important as the EESS is, it must be tested every time the integrity of the system is

broken such as during seat or canopy removal. This test is accomplished with the EESS tester, which can be used quickly on the flight line or as a tool to troubleshoot problems in the EESS wire harness. The procedures for using the EESS tester can be found in the F-22's Integrated Maintenance Information System (IMIS).

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

027. Using special tools

1. What is the definition of torque?
2. Where can you find tables of general torque values?
3. What type of torque wrench is adjustable and allows a desired torque value to be set (within the limits of the torque wrench) by turning the handle or grip?
4. How do you reduce the torque setting on a mechanical breakaway torque wrench?
5. How do you adjust the torque setting on a digital breakaway torque wrench?
6. When should a torque wrench be checked and calibrated?
7. How far must a nut be run down to obtain the correct recommended torque value?
8. If a torque wrench's guidelines are not available, how should you cycle it to ensure proper lubrication?
9. What tool is made with extreme accuracy to a fixed standard of measurement or shape, so that when it is applied to a piece of work, the work is measured directly against extreme accuracy?
10. How should you insert the blades of a thickness gauge in relation to the gap being measured?
11. Usually, what type of gauge is made in pairs in a single unit?

12. What type of gauge is used to check or adjust specific forces required to operate mechanisms?
13. When using a force gauge to adjust tension, why should you be sure that the pull of the gauge is perpendicular to the center of the lever being checked?
14. Which graduated measuring instruments are usually made of metal or wood?
15. You are performing a measurement where you need to record the results in decimals. However, your steel rule only measures in fractions. If your steel rule measured the object to be $\frac{3}{32}$ " long, how many inches would that be if expressed in decimals?
16. What should you do before measuring with a micrometer?
17. On a 0- to 1-inch micrometer, how many inches is each turn of the micrometer thimble counterclockwise away from the anvil?

028. Using test equipment

1. What does a multimeter measure?
2. If you use a multimeter to determine a reading specified by the technical order, what ranging should you use?
3. If a multimeter's test leads read 0.5 ohms resistance, and the scale reads 1.5 ohms resistance when you measure the circuit, what is the actual resistance of the circuit?
4. How do you check continuity of test leads on a multimeter?
5. How do you disconnect a multimeter's test leads during checks?

6. What test equipment is used as the primary means of testing ACES environmental sensors and velocity sensors?
7. When inspecting the TTU/415/E environmental sensor test set, for what do you inspect the meters, instruments, and switches?
8. Your TTU-415/E environmental sensor test set is out of service and you need to check a new environmental sensor you received from supply. How can you check it?
9. What tool would you use to troubleshoot the escape system wiring on an F-22?

4-3. Support Equipment and Aerospace Ground Equipment

Our career field has many unique pieces of support equipment that we use to care for aircrew egress systems. They vary depending on the type of airframe your shop supports. In this section, we talk about two types of slings: seat slings and one particular type of canopy sling.

In addition, you should be familiar with ground equipment that supports the aircraft assigned to your unit. The term aerospace ground equipment covers many pieces of equipment; however, we'll study only the equipment used by egress personnel.

029. Using slings

Slings are designed to move aircraft components that are either too bulky or too heavy to be removed and installed by hand. Slings are made mostly of straps, cables, and bars, and in the case of egress, are used with a hoist to handle seats, canopies, and hatches. Each aircraft has a -2 TO that contains removal and installation procedures. This technical order also illustrates how to use each sling.

Safety

Slings have the potential to cause injury, death, and property damage. Mishaps often occur when loads are dropped or slip because the sling or its attachments break or otherwise fail. The usual causes are inadequate design, improper selection, poor inspection, failure to make sure that loads are properly attached and secured, or improper storage and care.

Human error contributes to most sling mishaps. The most common is that supervisors allow untrained and unqualified people to use and maintain slings. Additional causes are listed here:

- Overloaded slings.
- Improperly rigged loads.
- Loads hitting obstructions.
- Damaged or defective slings.
- Unauthorized modifications to slings.
- Kinks in supporting ropes and cables.
- Loads not securely attached to the slings.
- Sling failure caused by not using edge padding.

- Improperly balanced loads which allow them to slip.
- Personnel standing or walking under suspended loads.
- Unauthorized equipment such as cargo straps as slings.
- Sling failure caused by damage when slings are pulled incorrectly from under a load.
- Personnel placing their hands between the sling and load before the sling is tightened around the load.

As you can imagine, the fact that the loads we are removing and installing are filled with explosives further amplifies the inherent danger in using slings, so exercise extreme caution.

Seat slings

As we mentioned above, most support equipment, such as slings, are designed specifically to fit certain airframes and airframe components. We use slings for all of our airframes, but the procedures for inspection are similar across all MDSs. Figure 4-20 shows the sling designed to support the ACES II ejection seat. The sling is constructed of two steel cables, cloth webbing, and a metal hoist attachment. It attaches to the seat structure by four bolts, which are screwed into nut-plates permanently built into the side-caps and the head support structure. This sling is used for one purpose, and one purpose only—to remove and install the ACES II seat. It should not be used for any other purpose whatsoever. If the sling is used for purposes other than its intended use, it could be damaged and rendered useless for removing and installing ejection seats. Like all other lifting equipment, the sling must be weight tested periodically to ensure sound construction and design. There is a pre-use inspection, which is a visual inspection of the following parts:

Pre-use Visual Inspection of Seat Slings	
Area	What to Look For
Cable assemblies	Inspect for broken wires, excessive rust, or corrosion.
Hoisting plates and upper attachment plate	Check for distortion, strain, and cracks.
Lower attachment fittings	Inspect for security of attachments and evidence of strain.
Cloth webbing and/or strap	Inspect for mildew and broken strands or stitching.

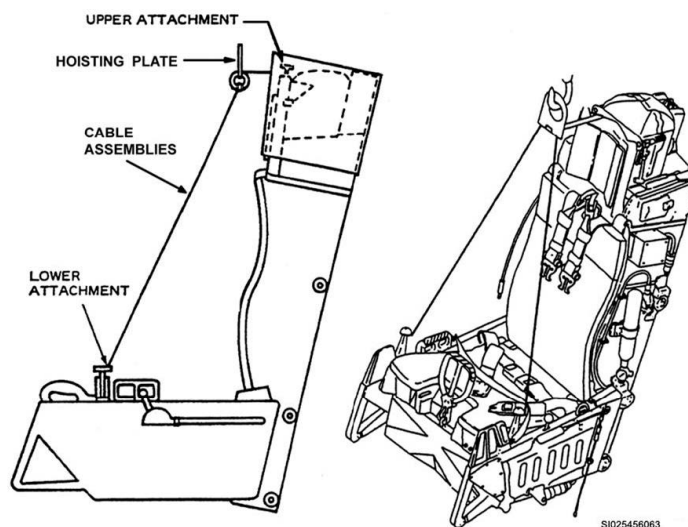


Figure 4-20. Seat sling.

An in-depth annual inspection is done which involves solvent cleaning and NDI using dye-penetrant. For the ACES sling, consult TO 35D8-14-3-1, *Operation and Service Instructions with Illustrated Parts Breakdown for Sling, Ejection Seat Lifting (KETCO) and Shroud Assembly*, for detailed instructions on the seat sling inspections, proof load test, and repair and replacement. If your shop supports a different MDS, use the appropriate technical order for your airframe.

Document all inspections on AFTO Form 244, Industrial/Support Equipment Record, or other approved method.

F-16 canopy sling

The F-16 canopy sling is designed somewhat similar to the ACES II seat sling, in that it is constructed using cables and a hoist attachment, but this is where the similarities end. Because it supports a heavier load, the canopy sling is constructed with a larger gauge cable assembly and an I-Beam support. The four cables are different lengths. The two cables that attach to the front of the canopy are shorter than the two that attach to the rear of the canopy. The sling is designed this way to obtain the proper angle when engaging and disengaging the canopy hinge and the hinge brackets. If the proper angles are not maintained when mating the canopy to the airframe, severe damage to the aircraft and personnel may occur. The sling is attached to the canopy by four sling adapters (fig. 4-21), which are bolted to the canopy frame. A ball lock pin secures the cable assembly to the adapter.

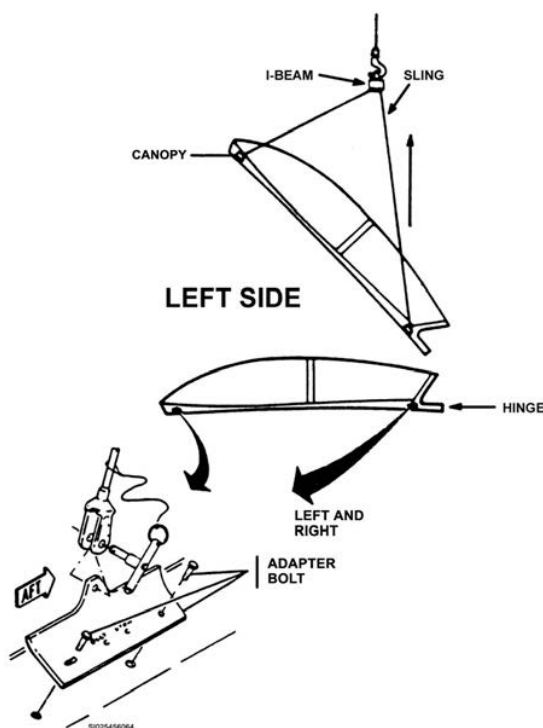


Figure 4-21. F-16 canopy sling.

Inspecting the F-16 canopy sling

Perform a pre-use inspection before each use to ensure the sling is in good repair. This inspection is a “look-over” of the parts that make up the sling (just as was done for the seat sling). Here are some specific items to look for in accordance with TO 35-1-246WC-1, *Periodic Inspection Non-powered Aerospace Ground Equipment, Aircraft Ground Servicing Equipment and Airfield Specialized Trucks and Trailers*:

- Check equipment forms for discrepancies and required special inspections.

- Perform monthly lubrications including:
 - Cleaning and lubricating all beam, rail, and link mating areas subject to wear.
 - Fully extending screws (clean and lubricate).
 - Cleaning and lightly oiling cables.

Annually, perform these inspections:

- Inspect cable assemblies for security of fittings and presence of broken wires in strands. The presence of more than six broken wires in any 1-inch length of cable is cause for replacement.
- If corrosion or rust is present, replace cables regardless of the number of broken wires.
- Remove all dirt and foreign matter from the cables by cleaning with solvent. Remove stubborn accumulations with a wire brush and dry thoroughly.
- Inspect all bolts, pins, and hardware for evidence of wear, strain, and distortion.
- Inspect all bolt holes subject to strain for elongation and stripped threads.
- Send the sling to the NDI shop for inspection.

Using the F-16 canopy sling

The canopy sling is used with both single- and two-seat F-16 models. It is used in conjunction with four adapters that connect the sling to the canopy. The steps are similar for both the C and D models.

CAUTION: Do NOT use CDCs as a supplement for actual technical data! Always follow applicable technical orders when performing maintenance.

Canopy removal

The steps for removal of a canopy also include other maintenance procedures. The following procedures are *only for hoisting the canopy*:

Canopy Removal Steps using the F-16 Canopy Sling	
Step	Action
1	Preread and follow all of the cautions, warnings, and notes included in the technical order.
2	Remove eight bolts from the canopy frame. These bolts are held in place by nutplates instead of ¼-inch nuts so they are easy to find. Install two bolts in each of the bolt stow holes in the four adapters.
3	Attach forward and aft adapters using the two bolts supplied with each adapter.
4	Install two canopy maintenance supports.
5	Perform required maintenance to disconnect the canopy from the aircraft.
6	Position the canopy sling over the canopy and attach sling to the forward adapter with the pins supplied with each sling on each side of the aircraft.
7	Attach the sling to the aft adapters with the pins supplied with the sling on each side of the aircraft.
8	Remove the canopy support struts.
9	Slowly and carefully remove the canopy from the fuselage, guiding the aft end of the canopy until the hinged area clears aircraft.
10	Position canopy on canopy transport or maintenance fixture.
11	Remove sling pin, two bolts, and adapter. Then, reinstall the eight stowed bolts on each side of the canopy frame.

Canopy installation

The steps for installation of a canopy also include other maintenance procedures. The following procedures are *only for hoisting the canopy*:

Canopy Hoisting/Install Steps using the F-16 Canopy Sling	
Step	
1	Preread and follow all of the cautions, warnings, and notes included in the technical order.
2	Remove eight bolts from the canopy frame. These bolts are held in place by nutplates instead of ¼-inch nuts so they are easy to find. Install two bolts in each of the bolt stow holes in the four adapters.
3	Attach forward and aft adapters using the two bolts supplied with each adapter.
4	Position the canopy sling over the canopy and attach sling to the adapters with the pins supplied with each sling. <div>WARNING: Take care to properly position the hoist directly over the aircraft centerline to minimize canopy misalignment with aircraft. Failure to comply may result in injury to personnel and/or damage to equipment.</div>
5	Position canopy over aircraft.
6	Lower canopy until upper concave surface of track engages upper roller bearing on each side of aircraft. <div>WARNING: Ensure both sides engage before proceeding. Failure to comply may result in injury to personnel and/or damage equipment.</div>
7	Lower canopy by allowing it to rotate about upper roller bearing until lower convex surface of the track contacts lower roller bearing. Continue to lower canopy until its angle with longeron is approximately 27 degrees, using protractor for measurement.
8	Perform maintenance required to install the canopy on the airframe.
9	Lower canopy enough to install two maintenance supports and finish maintenance required to install canopy on airframe.
10	Disconnect sling from four adapters by removing four pins.
11	Remove two bolts from each adapter and install in bolt stow holes in four places.
12	Reinstall the removed canopy bolts back in the canopy frame.

030. Cranes

Obviously, we cannot use slings without cranes. As an egress journeyman, depending on the MDS you are working at, you should be familiar with at least one of the types of cranes available in the Air Force inventory. Some of the more common ones are the East/West Industries Inc. Crane (used on F-22s and F-35s and shown in fig. 4-22), Lorain Crane (a drivable crane used on various airframes), SkyHook Crane (also used on various airframes), and overhead cranes (installed in some hangars).

Parts

With the exception of overhead cranes, cranes usually consist of the following parts:

- Chassis or frame.
- Tow bar.
- Caster and wheels.
- Brakes.

- Cable.
- Hoist.

Most cranes we use in egress are telescopic cranes; this means they include a boom with fitted tubes inside each other. This boom “telescopes” out and is adjustable, enabling the user to position the hoist exactly where it needs to go to lift the aircraft components. Some cranes also have an adjustable base, which allows maintainers even more flexibility in reaching around the aircraft. Your airframe’s technical order will specify the requirements for the exact crane placement in order to remove egress components.



Figure 4-22. East/West Industries Inc. crane.

Safety

One of the greatest hazards associated with mobile crane operations is electrocution that results from the equipment coming into contact with energized electric lines. Other potential hazards to personnel and property include the following:

- Overloading.
- 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.
- Failure to use outriggers when operating on a surface which is not level.
- Slipping or falling from equipment.
- Failure to detect or correct equipment deficiencies or malfunctions.
- Ignoring inspection and maintenance requirements including installing safety pins.

Where feasible, safeguards have been built-in to minimize the probability for human error, but hazards that cannot be abated by mechanical means still exist. It is important that you select individuals who are physically and mentally fit to operate cranes, especially since you are working

with explosives. Another important requirement is to *always* check the AFTO Form 244 for discrepancies and perform a pre-use inspection on the crane using applicable technical data.

Prior to the start of any task involving a crane, you and your team should decide who will be the “designated signal person,” that is, the team member who tells the crane operator what to do. The designated signal person may speak directions to the crane operator or may use hand signals. Anyone on the team may ask for an emergency stop if they see a hazardous condition. At that time, the crane operator immediately stops crane operation until the situation is corrected. Whenever there is any doubt about safety, the operator has the authority to stop and refuse to handle loads until safety has been ensured.

Always wear the proper PPE when using cranes. PPE for cranes includes head protection and steel-toed shoes.

031. Using maintenance stands

We would have a difficult time performing maintenance on any airframe without the use of maintenance stands. Maintenance stands are essentially “beefed up” ladders. By using them we can gain access into cockpits or other areas of the airframes that cannot be reached with just the crew entry ladder. The most common types of maintenance stands we use are the B-1, B-4A, and C-1 stands. There is not much to a C-1 stand, so this lesson focuses on the B-1 and B-4A stands only.

As discussed in the unit on safety, with any stand, you must ensure handrails are installed and secured with bolts or quick release pins prior to use. Maintenance stands are deemed unserviceable if handrails are not secured by bolts or quick release pins and will be immediately removed from service until repairs are made. Using stands with damaged rails or with removable handrails installed, but not secured with a bolt or quick release pin, can result in serious injury or death.

Remember to do a prior-to-use inspection on any stand you use, including checking the AFTO Form 244 for discrepancies. Depending on your base’s policy, you may document the prior to use inspection each time it is accomplished or only once for an entire day or shift of usage.

B-1 maintenance stand

This maintenance stand is designed to provide a variable height work platform for aircraft maintenance personnel (fig. 4-23). The base structure is a fixed height, while the upper structure assembly can be varied up to a height of 10 feet. Suction and pressure lines connect the hydraulic reservoir, located in the base structure, to the hydraulic cylinder and hand hydraulic pump, mounted at the base of the maintenance platform. The hydraulic cylinder’s function is similar to any hand-lever operated piston type pump. Wheels, casters, and a towbar attached to the frame of the base assembly enables the unit to be moved as necessary.

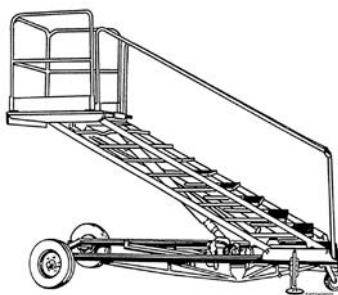


Figure 4-23. Platform, adjustable aircraft maintenance, USAF Type B-1.

The maintenance platform is operated by means of hydraulic pressure supplied to a hydraulic actuating cylinder through a hand-operated pump. Height variations of upper structure assembly are controlled by the extension or retraction of the hydraulic cylinder assembly. Handrails are fitted with

hinge joints that allow handrail uprights to remain vertical and handrails to assume a position parallel to the stair support assembly. The stair supports, including step assemblies, make up a parallelogram linkage allowing the work platform and steps to remain parallel to the base at any desired platform height.

The hydraulic cylinder barrel lock assembly is a safety-locking device and must be inserted manually. It must be rotated to lock the fingers of the hydraulic cylinder barrel lock assembly into the proper slot of the hydraulic cylinder barrel. Make sure that all four locking fingers positively engage the barrel slot. Also, make sure that all four safety locks are in good condition and that the red reflector tape is installed between the finger locks to indicate the unlocked position. The *maximum platform load* for the B-1 stand is 500 pounds.

Safety

Besides the warning about handrails—which applies to all maintenance stands—the following warnings are specific to the B-1 maintenance stand:

- Failure to make sure that the ram is locked and in proper working order could result in an unexpected lowering of the stand causing damage to equipment and serious injury to personnel.
- Operator will not raise the platform level higher than the red colored area of the ram cylinder. Over-extension of the ram can cause instability of the platform, resulting in injury to personnel.
- Do not place hands, arms, or other body parts between stand components such as entrance steps and other moving frame members, which may become pinch points while stand is being raised or lowered. Doing so may cause serious injury up to and including death.

Raising and lowering the upper structure assembly

The following table provides a concise overview of the steps involved in raising and lowering the upper structure assembly of the B-1 maintenance stand.

B-1 Maintenance Stand Upper Structure Assembly Operation	
Raising the Upper Structure Assembly	
Step	Action
1	Place maintenance platform in desired position and ensure that caster locks are engaged and wheel brakes locked.
2	Close bypass valve by turning handle clockwise.
3	Rotate barrel lock to unlock position prior to raising the platform to prevent unnecessary wear to the actuator cylinder barrel locking grooves.
4	<ul style="list-style-type: none"> • Operate hydraulic hand pump until maintenance platform attains desired height. • Manually rotate barrel assembly into proper position to allow fingers to lock. • Release hydraulic pressure and ease platform down until fingers engage the proper slot and platform travel stops.
5	Close hydraulic valve then open valve to ¼ turn to ensure ram lock does not unseat due to thermal expansion.
6	If handrails are removed to perform maintenance or gain access to aircraft, reinstall bolts or pins in handrail to ensure accountability.
Lowering the Upper Structure Assembly	
Step	Action
1	Assure bypass valve is closed and raise platform slightly by operating the hand pump until pressure is released from hydraulic cylinder barrel lock.

B-1 Maintenance Stand Upper Structure Assembly Operation	
Raising the Upper Structure Assembly	
Step	Action
2	Rotate hydraulic cylinder barrel lock assembly to unlock fingers from hydraulic cylinder assembly.
3	To lower platform, open bypass valve by turning handle counterclockwise.
4	Disengage caster locks to maneuver maintenance platform.

B-4A maintenance stand

The B-4A aircraft maintenance platform is a hydraulically operated adjustable platform and ladder assembly mounted on a caster equipped base (fig. 4-24). The B-4A allows personnel to work safely at heights varying from a minimum of 3 feet to a maximum of 7 feet. The maximum platform load for the B-4A stand is 500 pounds. You need to also consider the tools and equipment on the platform and not just weight of personnel.

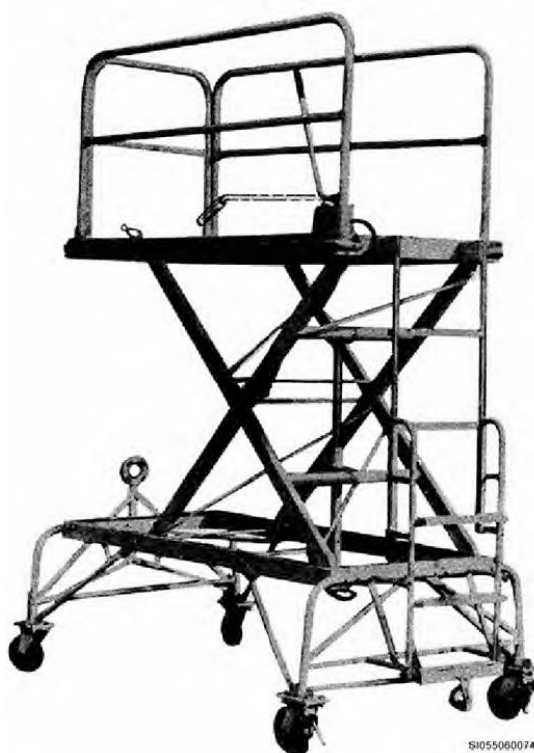


Figure 4-24. Platform, adjustable aircraft maintenance, USAF Type B-4A.

Safety

Again, the standard warning about handrails mentioned earlier applies to working with the B-4A maintenance stand. The following warnings are specific to the B-4A:

- Do not use stowed tow bar or upright lunette (the circular portion of the tow bar) as a handle to position the stand near an aircraft.
- The platform is equipped with two safety lock pins, which must be engaged when the platform has attained the desired height.
- While personnel are on the platform, the safety gate must be closed and latched at all times.
- Do not operate the pump handle or release valve while standing on the ladder.

- Do not stand on the ladder without safety pins engaged.
- Use extreme care when on the areas of the maintenance stand platform near the access ladder and/or near any removed railings. Stepping backwards and/or making other steps without looking in the intended direction of travel can cause a fall from the platform. Always be aware of your location on the platform and do not make these movements. Failure to heed this warning may cause personal injury or death.
- The operator must control the platform's rate of descent in order to prevent damage to the stand and/or personal injury.
- If binding occurs while platform is being lowered, insert safety lock pins before performing any maintenance.
- Do not place arms through scissors area.

Raising and lowering the B-4A platform

The following table outlines the steps you take when raising and lowering the B-4A platform.

B-4A Platform Operation	
Raising the Platform	
Step	Action
1	<p>Immobilize the platform prior to use by inserting the swivel lock pins and locking the caster brakes.</p> <p>To prevent interference between the swivel lock and brake handle, the swivel will be locked with the brake handle 90 or 180 degrees from the swivel locking pin.</p> <p>When setting the brakes, pull the handle up with sufficient force to make sure the brakes will remain in the locked position and lock wheel brakes.</p>
2	Remove both lock pins from the platform holes and secure in last hole of channel located in center of platform toward ladder.
3	Close the release valve lever by turning in a clockwise direction to its stop.
4	Open vent plug. Operate the pump handle until the platform reaches the desired height.
5	<ul style="list-style-type: none"> • Install the lock pins in the appropriate holes on the platform. • Lower platform by opening release valve lever counterclockwise, until platform eases down on the lock pins. • Close hydraulic release valve lever and close vent plug.
6	If handrails are removed to perform maintenance or gain access to aircraft, reinstall bolts or pins in handrail to ensure accountability.
Lowering the Platform	
Step	Action
1	Open vent plug and raise the platform slightly to remove any load on the lock pins.
2	Remove safety pins from side channels and secure in last hole of channel located in center of platform toward ladder.
3	<p>Open valve spindle.</p> <p>The rate of descent is controlled by the opening between the spindle and the spindle seat.</p>
4	<p>Once the platform has completely lowered, release caster brakes on casters so that the stand is maneuverable.</p> <p>Move the stand away from the aircraft and re-engage brakes.</p>

032. Using power units

AGE power units are self-contained power sources used to supply power to the jet when the engine is turned off. They provide a safer means of performing maintenance and operations checks than running the engine. This lesson covers the types of power units you may use.

A/M32A-60 gas turbine generator set

This generator set consists of a gas turbine engine, aircraft-type alternating current (AC) generator, generator voltage regulator, rectification system for the direct current (DC) power supply, engine fuel system, batteries, and engine electrical system for starting and control functions (fig. 4-25). The generator set is mounted on wheels and enclosed in a sheet-metal housing.



Figure 4-25. A/M32A-60 gas turbine generator set.

You often hear this generator referred to as just the “-60.” It is used mostly when working on fighter and attack aircraft. You may use the A/M32A-60 to perform seat not-armed light checks and seat height adjustment checks on the F-16.

A/M32A-86 and 5359C/90G20

The A/M32A-86 and the 5359C/90G20 are diesel engine driven, 72KW, 3- phase, 4-wire, 115/200 volts generator sets used when working on bombers. Depending on your base, you will use one or the other, but they look exactly alike and perform the same job. The A/M32A-86 is made by the John R. Hollingsworth Company and is commonly referred to as the “-86.” The 5359C/90G20 is made by the Hobart Brothers Company and is nicknamed the “Hobart.”

The purpose of these generator sets is to generate and deliver regulated, 400 hertz (Hz), 115/200 volts (V), 3-phase power to an aircraft for operating the aircraft’s electrical equipment when the on-board generators are not running. In order to operate, the unit requires fuel and 12V DC power (supplied by the batteries). The engine, generator, and controls are designed into a compact unit which is easily removable from a tow trailer. A superstructure, attached to the main frame, provides mounting facilities for the canopy, control box and electrical equipment and controls.

B809A

The B809A generator set is used on bombers and F-22s (fig. 4-26). It is slowly replacing the -86 and the Hobart because it has a cleaner running diesel engine which is safer for the environment. The B809A basically consists of a diesel engine driving a 400 cycle brushless generator. The generator supplies 400 cycle power for servicing aircraft. All the necessary electrical controls and instruments are furnished on a control panel. The diesel engine and generator, along with all necessary components, are enclosed within a sheet metal housing that allows for operation in inclement environments. The enclosure has all the necessary panels and doors to provide for proper ease of maintenance, servicing, and/or repair. The entire unit is mounted on a four-wheel steerable trailer.



Figure 4-26. B809A generator set.

Frequency convertors

Frequency convertors provide a method for converting electricity directly from the power grid to a voltage acceptable for aircraft. You will find frequency convertors inside some hangars hooked right up to the wall. If they are available, choose them over generators because they are noiseless and eliminate the need for hearing protection. There are two types of frequency convertors: the EPU-5/E and the EPU-6/E.

Frequency Converters	
Type	Description
EPU-5/E	<p>The EPU-5/E is a cabinet enclosed, skid-mounted unit configured with forklift guides to facilitate moving and is air transportable. This means you can send these frequency convertors to deployed locations.</p> <p>The unit converts 240/380/480 volts alternating current (VAC), 3-phase, 50/60 Hz input voltage to 120/208, 230/400V revolutions per minute (rpm), 3-phase, 400 Hz output voltage. The 3-phase output rating of the unit is 100 kilowatt (KW).</p> <p>The design incorporates a maintenance safety panel and door interlock microswitches to enhance personnel safety.</p>
EPU-6/E	<p>The EPU-6/E is a cabinet enclosed, skid-mounted unit configured with forklift guides to facilitate moving and is air transportable, making it, like the EPU-5/E, deployable.</p> <p>The unit converts 240/380/480 VAC, 3-phase, 50/60 Hz input voltage to 120/208 VAC, 3-phase, 400 Hz output voltage. The 3-phase output rating of the unit is 50KW.</p> <p>The design of the unit incorporates a maintenance safety panel and door interlock microswitches to enhance personnel safety.</p>

Usage and safety

Never operate a power unit without first being trained and signed off in the Training Business Area. Most power units include instructions printed on the unit itself; but again, do not operate these units without being fully trained first.

Power units will not be positioned within a 10-foot radius of an aircraft fuel system vent. *Never refuel power units inside hangars or inside maintenance shops.*

The turbine wheel of an operating power unit may disintegrate. If this happens while you are standing in the plane of rotation, you may be killed or severely injured by flying parts traveling at speeds greater than the muzzle velocity of a rifle. For this reason, *never stand in the plane of rotation when turbine engines are being operated.* To make this danger area easy to locate, a painted stripe, most of the time is

red and similar to that used on the aircraft, marks the danger area(s) on AGE. **NOTE:** If your base requires a pre-use inspection on AGE or any other type of support equipment, remember to document it on the AFTO Form 244 in accordance with your base's policy.

033. Using light carts

Let there be light! You may find yourself working on a swing shift or mid shift where you will be called to the flight line to work on aircraft. The work cannot stop just because there is no daylight. The Air Force's solution when artificial light is required for maintenance or other operations is to use light carts to shed some light on the situation.

As an egress journeyman, it is important that you know how to operate light carts in case you have to set them up on the job site. There are two light carts that you will likely encounter: the NF-2D portable floodlight set and the FL-1D trailer-mounted floodlight. We'll take a look at both of these, along with their safety requirements.

NF-2D portable floodlight set

The NF-2D is a completely mobile unit, equipped with two floodlights mounted on a hoist (retractable tower) (fig. 4-27). The unit is intended for use in night maintenance on aircraft, loading and unloading aircraft cargo and for emergency lighting. Besides providing light, the NF-2D can also provide electricity through its engine/generator set. The engine/generator set is mounted to the base assembly of the unit subassembly and provides single phase, 120V, 60 Hz electrical power for the floodlights. In addition, power is supplied to the receptacle box located adjacent to the rear door for operating portable electrical equipment.

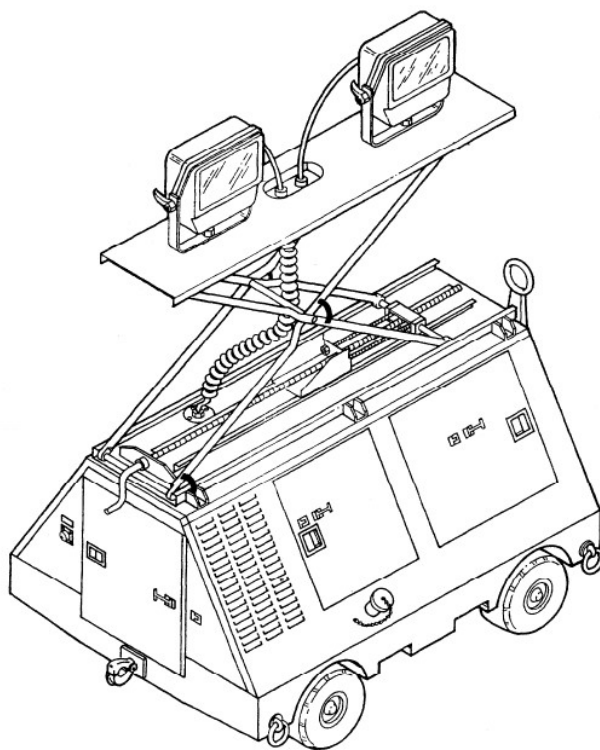


Figure 4-27. NF-2D portable floodlight.

FL-1D trailer mounted floodlight

The FL-1D consists of a three-cylinder diesel engine-driven generator mounted on a four-wheel trailer with steerable front wheels and parking brake equipped rear wheels (fig. 4-28). Two floodlight assemblies are attached to a telescopic mast which is raised for operation and lowered for transportation between work sites. Like the NF-2D, the FL-1D can also provide electricity through a generator. The FL-1D has two receptacles for 240V and three receptacles for 120V.

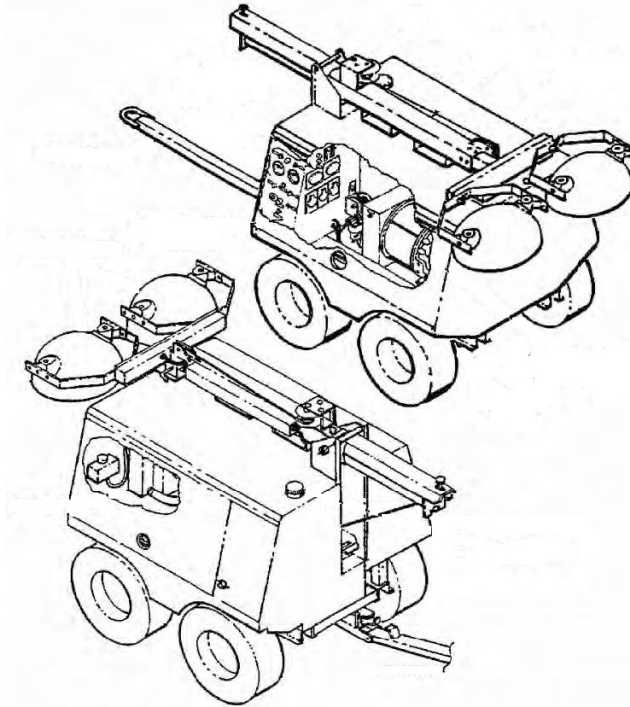


Figure 4-28. FL-1D trailer mounted floodlight

Safety

Always perform a pre-inspection of floodlights before using them, even if a pre-inspection was already documented on the AFTO Form 244. Document your inspections on AFTO Form 244 according to your base local policy.

You may have heard stories about Airmen climbing into floodlights during the winter to keep warm. Don't do this! The floodlights produce carbon monoxide and can poison, severely injure, or even kill you.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

029. Using slings

1. What is the most common cause of sling mishaps?
2. When performing a pre-use inspection on an ACES seat sling, what should you visually inspect?

3. What technical order would you use to find instructions for repairing the ACES seat sling?
4. How is the F-16 canopy sling attached to the canopy?
5. How do you perform monthly lubrication of the F-16 canopy sling?
6. When removing an F-16 canopy, what step do you take before performing the required maintenance to disconnect the canopy from the aircraft?
7. When installing an F-16 canopy, how do you find the bolts on the canopy frame where you attach the forward and aft adapters?

030. Cranes

1. What type of crane has an adjustable boom that can position the hoist exactly where it needs to go in order to lift components?
2. What team member tells the crane operator what to do during crane operations?
3. During crane operations, what team member can tell the crane operator to stop if a hazardous condition is observed?

031. Using maintenance stands

1. What should you do before using any maintenance stand?
2. What is the maximum height of a B-1 maintenance stand?
3. How is the B-1 maintenance stand operated?
4. Why should the B-1 maintenance stand's platform level not be raised higher than the red colored area of the ram cylinder?

5. What actions do you take with the hydraulic valve after easing the B-1 maintenance stand's platform down until the fingers engage the proper slot and platform travel stops?
6. When lowering the B-1 maintenance stand, how do you release pressure from the hydraulic cylinder barrel lock?
7. What is the *maximum* platform load for the B-4A maintenance stand?
8. When a B-4A maintenance stand's handrails are removed in order to perform maintenance or to gain access to the aircraft, what should you do with the bolts or pins?
9. When lowering a B-4A maintenance stand's platform, where do you put the safety pins after removing them from the side channels?

032. Using power units

1. What type of generator does the A/M32A-60 gas turbine generator have?
2. What is the purpose of the A/M32A-86 and the 5359C/90G20 generator sets?
3. What type of engine does a B809A generator set have?
4. What is the 3-phase output rating of the EPU-6/E?
5. How can you locate the plane of rotation for a power unit's turbine engine?

033. Light carts

1. How many floodlights does an NF-2D portable floodlight set include?
2. What type of engine does an FL-1D trailer mounted floodlight have?

Answers to Self-TEST Questions

025

1. Common, cross-point, cross-tip, and offset.
2. Offset screwdriver.
3. Screwdriver bits/screwdriver blades.
4. It will damage the screw head, slip off the screw, and cause personal injury.
5. Hold any hammer is near the end of the handle.
6. Strike the object fully with the face of the hammer parallel to the work.
7. Cross peen hammer.
8. A small amount of linseed oil.
9. Pliers.
10. They will unquestionably damage the material and may, if they slip, injure you or others.
11. Flat-nosed plier, needle-nose plier.
12. Never.
13. Use the base or palm of your hand and hold your hand open; this may save your knuckles from cuts and bruises.
14. (1) E; (2) D; (3) G; (4) J; (5) K; (6) A; (7) C; (8) I; (9) H; (10) B; (11) F.
15. Files.
16. Drive pin punches.
17. Replace.

026

1. CTK management, special tool procedures, and tool storage and facility requirements.
2. To prevent and eliminate FOD to aircraft, engines, missiles, training and support equipment, and to reduce costs through strict, effective control and accountability of assets.
3. MXG/CC.
4. AFI 21-101.
5. Each tool in the kit is shadowed; its shape cut out so that it is obvious if the tool is not present.
6. The flight commander/chief.
7. TCMax.
8. Nine characters (numbers and letters).
9. A hard copy of the MIL.
10. Everything; even spools of safety wire, rolls of tape, and the FOD bag.
11. AF Form 1297 or a MAJCOM or locally approved form.
12. At the beginning and end of each shift.
13. At least annually or when the CTK custodian changes.
14. The entire box may be signed out.
15. When added to the MIL.

027

1. The product of a weight times the perpendicular distance to a center of rotation.
2. Aircraft general ground servicing maintenance manuals.
3. Mechanical breakaway torque wrenches.
4. Turn the handle or grip counterclockwise.
5. Press the up or down button to the desired value seen on the LCD screen.
6. Specified intervals; also be verified if you suspect it is out of adjustment because the wrench was dropped, mishandled, or any other reason.

7. Until it is one turn from the beginning of seating.
8. Set the torque wrench to the maximum setting and allow breakaway to occur six times.
9. Fixed gauge.
10. Perpendicular to the gap being measured.
11. Go/no-go gauges.
12. Force gauge.
13. You will get an erroneous reading.
14. Rulers.
15. 0.09.
16. First find the approximate size to the nearest inch and then select accordingly.
17. One revolution moves the spindle twenty-five thousandths (0.025) of an inch away from the anvil.

028

1. Voltage, current, resistance, or continuity.
2. Manual ranging.
3. 1.0 ohms resistance.
4. Touch them together.
5. Electrically disconnect the red (positive) test lead before disconnecting the black (negative) test lead during your checks.
6. TTU-415/E environmental sensor test set.
7. Signs of damage, broken face lens, bent or broken toggles, or other obvious defects.
8. Normally, you would do a continuity check, but not if the environmental sensor is new from supply. You will have to contact another base to obtain a test set.
9. The EESS tester.

029

1. Supervisors allowing untrained and unqualified people to use and maintain slings.
2. Cable assemblies—inspect for broken wires, excessive rust or corrosion. Hoisting plates and upper attachment plate—check for distortion, strain, and cracks. Lower attachment fittings—inspect for security of attachments and evidence of strain. Cloth webbing and/or strap—inspect for mildew and broken strands or stitching.
3. TO 35D8-14-3-1.
4. By four sling adapters which are bolted to the canopy frame.
5. Clean and lubricate all beam, rail and link mating areas subject to wear. Fully extend screws, clean and lubricate. Clean and lightly oil cables.
6. Install two canopy maintenance supports.
7. They are held in place by nutplates instead of ¼-inch nuts.

030

1. Telescopic crane.
2. The designated signal person.
3. Anyone on the team.

031

1. Perform a prior to use inspection, including checking the AFTO Form 244 for discrepancies.
2. Ten feet.
3. Hydraulic pressure supplied to a hydraulic actuating cylinder through a hand-operated pump.
4. Over extension of the ram can cause instability of the platform, resulting in injury to personnel.
5. Close hydraulic valve, then open valve to ¼ turn to ensure ram lock does not unseat due to thermal expansion.

6. Raise platform slightly by operating the hand pump.
7. 500 pounds.
8. Reinstall bolts or pins in the handrail to ensure accountability.
9. The last hole of channel located in center of platform toward ladder.

032

1. Aircraft type AC generator.
2. To generate and deliver regulated, 400 Hz, 115/200V, 3-phase power to an aircraft for operating the aircraft's electrical equipment when the on-board generators are not running.
3. A diesel engine.
4. 50KW.
5. A painted stripe, sometimes red, marks the danger area.

033

1. Two floodlights.
2. A three-cylinder diesel engine.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to AFCDA.

75. (025) Which publication gives instructions on how to care for hand tools?
- a. Technical Order (TO) 00-25-259 *Standard Maintenance Practices*.
 - b. Air Force Instruction (AFI) 21-123 *Air Force Repair Enhancement Program*.
 - c. TO 32-1-101 *Use and Care of Hand Tools and Measuring Tools*.
 - d. AFI 21-101 *Aircraft and Equipment Maintenance Management*.
76. (025) What type of screwdriver will you use most often on airframes?
- a. Offset.
 - b. Torq-set.
 - c. Cross-tip.
 - d. Cross-point.
77. (025) Which type of hammers are color coded in order to allow you to select the proper face hardness for a task?
- a. Ball peen.
 - b. Soft-faced.
 - c. Cross peen.
 - d. Straight peen.
78. (025) When breaking the torque on a nut/bolt, which socket wrench accessory is the *best* to use?
- a. Speed handle.
 - b. Hinged handle.
 - c. Ratchet handle.
 - d. Torque wrench.
79. (025) Which type of punch is used to remove straight or tapered pins?
- a. Prick.
 - b. Center.
 - c. Starting.
 - d. Drive pin.
80. (026) Who is responsible for the tool and equipment management program?
- a. Vice-wing commander.
 - b. Squadron maintenance officer.
 - c. Maintenance group commander.
 - d. Maintenance squadron commander.
81. (026) Which method of tool accountability is *not* acceptable for deployed locations if a software database is not available?
- a. Chit system.
 - b. AF Form 1297.
 - c. MAJCOM form.
 - d. Base specific form.

-
-
82. (026) If you have to leave a composite tool kit (CTK) unattended on the flight line, which is an appropriate method to secure it?
- a. Locked with a key lock to an aircraft.
 - b. Locked to a secure and unmoveable object.
 - c. Locked with a cable to aerospace ground equipment (AGE).
 - d. Hidden in a low traffic location as long as it is on the secured flight line.
83. (027) If your technical order's maintenance procedure did *not* specify the torque value for a "B" nut you would refer to
- a. the appropriate ground servicing technical manual.
 - b. TO 32-1-101, *Use and Care of Hand tools and Measuring Tools*.
 - c. AFI 21-101, *Aircraft and Equipment Maintenance Management*.
 - d. TO 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures*.
84. (027) Which two types of torque wrenches are common in egress sections?
- a. Stabilized and level.
 - b. Standardized and static.
 - c. Mechanical and digital.
 - d. Industrious and dynamical.
85. (027) When torquing a nut, the prevailing torque would be added to recommended torque if the prevailing torque is
- a. one-third or more than one-third of the recommended torque value.
 - b. less than one-third of the recommended torque value.
 - c. one-fourth or more than one-fourth of the recommended torque value.
 - d. less than one-fourth of the recommended torque value.
86. (027) What type of gauge typically has 22 blades?
- a. Rule gauge.
 - b. Force gauge.
 - c. Thickness gauge.
 - d. Go/no-go gauge.
87. (028) How will you know if your multimeter has a low battery?
- a. The multimeter emits an audible continuous tone.
 - b. A picture of a battery is displayed in the window.
 - c. The omega Ω symbol is displayed in the window.
 - d. The multimeter emits an audible intermittent tone.
88. (028) Which test does the TTU-415/E tester perform?
- a. Velocity sensor.
 - b. Shell receptacle.
 - c. Recovery sequencer.
 - d. Emergency Escape Sequencing System (EESS).
89. (028) What sequences the F-22 escape system, including the canopy thruster, inertia reel gas generator electronic explosive device, canopy rocket, seat catapult and the central integrated processor guillotine?
- a. Ejection sequencer.
 - b. Recovery sequencer.
 - c. Auto-escape sequencer.
 - d. Emergency escape sequencer.

90. (029) Which is a *common cause* of sling mishaps?
- a. Using edge padding.
 - b. Properly balanced loads.
 - c. Kinks in ropes and/or cables.
 - d. Hard hats obstructing the crane operator's view.
91. (029) Seat sling inspections are documented on
- a. AFTO Form 244, Industrial/Support Equipment Record.
 - b. AFTO Form 781A, Maintenance Discrepancy and Work Document.
 - c. AF Form 1670, Value Property Record.
 - d. AF Form 1800, Operator's Inspection Guide and Trouble Report.
92. (030) Which item is a component of a crane?
- a. Sling.
 - b. Hoist.
 - c. Guide lines.
 - d. Pin bolt adapter.
93. (031) After performing a prior-to-use inspection on a B-1 maintenance stand, what is the *first step* in *raising* the stand?
- a. Close the bypass valve by turning handle clockwise.
 - b. Place the maintenance platform in desired position and ensure that caster locks are engaged and wheel brakes are locked.
 - c. If handrails were removed to perform maintenance or gain access to aircraft, reinstall bolts or pins in the handrail to ensure accountability.
 - d. Operate the hydraulic hand pump until the maintenance platform attains the desired height, then manually rotate the barrel assembly into the proper position to allow fingers to lock.
94. (031) What must be engaged once a B-4A maintenance stand's platform has attained the desired height?
- a. The release valve.
 - b. The bypass valve.
 - c. The pump handle.
 - d. Two safety lock pins.
95. (031) Which controls the rate of descent when lowering the B-4A maintenance stand's platform?
- a. Bypass valve.
 - b. Valve spindle.
 - c. Release valve.
 - d. Pump handle.
96. (032) Which aerospace ground equipment (AGE) power unit consists of a gas turbine engine, aircraft type alternating current (AC) generator, generator voltage regulator, rectification system for direct current (DC) power supply, engine fuel system, batteries and engine electrical system for starting and control functions and is used mostly on fighter and attack aircraft?
- a. B809A.
 - b. A/M32A-60.
 - c. A/M32A-86.
 - d. 5359C/90G20.

97. (032) Which generator set is replacing the “Hobart” because it has a diesel engine that runs cleaner and is safer for the environment?
- a. B809A.
 - b. A/M32A-60.
 - c. A/M32A-86.
 - d. 5359C/90G20.
98. (032) Power units should *never* be positioned within which distance of an aircraft fuel system vent?
- a. 5 feet.
 - b. 10 feet.
 - c. 15 feet.
 - d. 20 feet.
99. (033) Which floodlight set includes two receptacles for 240 volt (V) and three receptacles for 120V?
- a. FL-1D.
 - b. B809A.
 - c. NF-2D.
 - d. EPU-5/E.
100. (033) Which statement about floodlight sets is *true*?
- a. You cannot use them to power other equipment.
 - b. Never climb into a floodlight’s compartment to keep warm.
 - c. It is safe to climb into a floodlight’s compartment to keep warm.
 - d. Light carts are similar to any other appliance and you do not need to pre-inspect them.

Student Notes

Glossary of Abbreviations and Acronyms

Ω	ohms, omega
ABU	Airman battle uniform
AC	alternating current
ACES	advanced concept ejection seat
AF	Air Force
AFE	aircrew flight equipment
AFI	Air Force instruction
AFMAN	Air Force manual
AFOSH	Air Force Occupational Safety and Health
AFPAM	Air Force pamphlet
AFPD	Air Force policy directive
AFREP	Air Force repair and enhancement program
AFRIMS	Air Force Records Information Management System
AFSC	Air Force specialty code
AFTO	Air Force technical order
AFVA	Air Force visual aid
AGE	aerospace ground equipment
AMU	aircraft maintenance unit
AMXS	aircraft maintenance squadron
ANG	Air National Guard
API	Airmen Powered by Innovation
BE	bioenvironmental engineering
CAD/PAD	cartridge actuated device/propellant actuated device
CBRN	chemical, biological, radiological, nuclear
CD-ROM	compact disc read-only memory
CDB	computer database
CDC	career development course
CDL	commercial driver's license

CMA	competent medical authority
CMS	component maintenance squadron
CPR	cardiopulmonary resuscitation
CTK	composite tool kit
dBA	decibels A (acoustic) -weighted
DC	direct current
DIT	data integrity team
DOD	Department of Defense
DODD	Department of Defense directive
DODIC	Department of Defense identification code
DODM	Department of Defense manual
ECC	emergency communication center
EDD	estimated delivery date
E&E	electrical and environmental
EESS	Emergency Escape Sequencing System
EID	electrically initiated device
EMS	equipment maintenance squadron
EPR	enlisted performance report
ESOH-MIS	Environmental, Safety and Occupational Health Management Information System
eTO	electronic technical order
eTools	electronic tools
ETIMS	Enhanced Technical Information Management System
FASTCAL	field assistance support team for calibration
FCF	functional check flight
FI	fault isolation
FO	foreign object
FOD	foreign object damage
GHz	gigahertz
GS	general system
GV	general vehicle
HAZCOM	hazard communication

HAZMAT	hazardous material
HC	hexachlorethane
Hz	hertz
HMIRS	Hazardous Materials Information Resource System
IAW	in accordance with
IDEA	Innovative Development through Employee Awareness
IMDS	Integrated Maintenance Data System
IMIS	Integrated Maintenance Information System
IPB	illustrated parts breakdown
IPI	in-process inspection
ITCTO	interim time compliance technical order
JCALs	Joint Computer Aided Acquisition and Logistics Support
JG	job guide
JHCS	Joint Hazard Classification System
JSTO	job safety training outline
kHz	kilohertz
kV	kilovolt
KW	kilowatt
LIMFAC	limiting factor
LOAP	list of applicable publications
MAJCOM	major command
MDS	mission design series
MHz	megahertz
MI	management inspection
MIDAS	Maintenance Integrated Data Access System
MIL	master inventory listing
MOC	maintenance operations center
MPTO	methods and procedures technical order
MSEP	maintenance standardization and evaluation program
MSL	maintenance supply liaison
MTF	medical treatment facility

MUNS	munitions squadron
MXG	maintenance group
MXG/CC	maintenance group commander
MXS	maintenance squadron
NAF	numbered Air Force
NCO	noncommissioned officer
NCOIC	noncommissioned officer in charge
NDI	nondestructive inspection
NEW	net explosive weight
NEWQD	net explosive weight for quality distance
NIOSH	National Institute for Occupational Safety and Health
NSN	national stock number
O&M	operations and maintenance
OG	operations group
OSHA	Occupational Safety and Health Administration
PA	Public Affairs
PAS	personnel accounting symbol
PASS	pull, aim, squeeze, sweep
PDI	potentially disqualifying information
PE	personnel evaluation
PIM	product improvement manager
PIP	product improvement program
PMEL	precision measurement equipment laboratory
PPE	personal protective equipment
PRDA	personnel records display application
PRP	personnel reliability program
PRS	performance requirements statement
PS&D	plans, scheduling and documentation
psi	pounds per square inch
PWS	performance work statement
QA	quality assurance

QVI	quality verification inspection
R&R	repair and reclamation
RAC	risk assessment code
RC	recommended change
RF	radio frequency
RFA	request for assistance
RM	Risk Management
rpm	revolutions per minute
SCR	special certification roster
SDS	safety data sheet
SI	special inspection
SORTS	status of resources and training
SOW	statement of work
SPEED	Sound the alarm, Phone the fire department, Evacuate the building, Extinguish the fire if possible, Direct the fire fighter to the fire.
SrA	senior Airman
TAS	tool accountability system
TCM	technical content manager
TCTO	time compliance technical order
TDY	temporary duty
TM	technical manual
TMDE	test, measurement, and diagnostic equipment
TO	technical order
TODO	technical order distribution office
UL	Underwriters Laboratory
U.S.C.	United States Code
USR	unit safety representative
V	volt
VAC	volts alternating current

W&B	weight and balance
WP	white phosphorus
WS3	Weapons Storage & Security System
WSSR	weapons system safety rules
WWID	worldwide identification

Student Notes

AFSC 2A653
2A653 01 1902
Edit Code 06