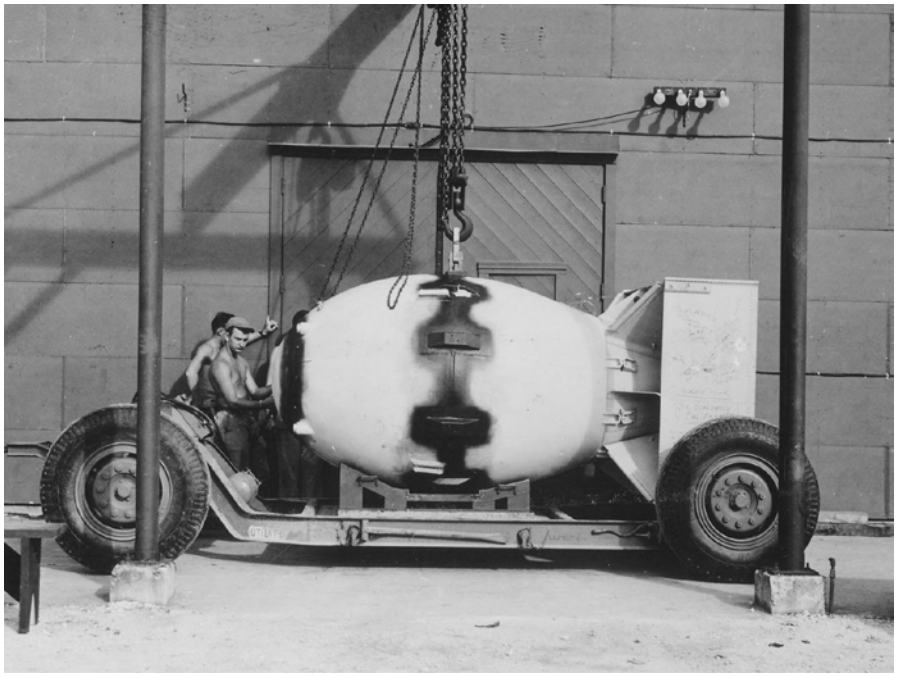
# CDC 2W251A

# Nuclear Weapons Journeyman

## Volume 3. Standard Procedures



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THERE ARE MANY tasks within our career field that are common to all nuclear weapons systems. In this volume, we will cover many of them. The first unit discusses general procedures that encompass tasks and tools used in support of weapon operations and test and handling equipment. Unit 2 discusses general and special cleaning procedures, surface preservation, and repair. The final unit deals with torque wrenches, safety-wire methods, and adhesives, and explains some of the ways to join and seal components and parts. It also discusses some packaging and marking methods. This volume is about standard procedures that you will use daily during maintenance operations. Always refer to the applicable technical orders (TO) during maintenance.

A glossary is included for your use.

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**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.

*Page*

# Unit 1. General Procedures



GENERAL MAINTENANCE is a term you will hear throughout your career. It refers to a broad range of general, vitally important servicing, repair, and care of materiel or equipment to keep it in operating condition. Since so many maintenance tasks are similar from weapon to weapon, or system to system, Sandia National Laboratories (SNL) along with the Air Force (AF) compiled a single publication that has become the number one manual for the nuclear weapons workers across the Department of Defense (DOD). This publication, called Technical Order (TO) 11N–35–51, *General Instructions Applicable to Nuclear Weapons*, is your primary source of general maintenance information for nuclear weapons.

Please remember, even though the material here is extracted from the most up-to-date TOs, don't use this career development course (CDC) on the job—refer to the current TO.

## 1–1. Standards, Specifications, and Procedures

Before discussing maintenance and other procedures, let's introduce a few standard specifications and procedures you must be familiar with in your duties. This section covers common maintenance procedures that apply to most nuclear weapons material. General specifications and procedures are not always incorporated into the –1 or –1A manuals; you'll find them in TO 11N–35–51, which eliminates repetition in other TOs. You should become very familiar with TO 11N–35–51.

### 401. General standards and procedures

Because TO 11N–35–51 provides such a broad coverage of general maintenance procedures, not all of its guidance applies in every case. You will use procedures in TO 11N–35–51 only as they apply to what you are doing. When other manuals refer you to procedures in TO 11N–35–51, they will give the title of the procedure exactly as it is in the table of contents.

#### Definitions

You will see the following terms in numerous places throughout your 2W2 career and in TO 11N–35–51. This list of terms is not all-inclusive, and you will encounter many more.

| Term | Definition |
|---|---|
| ***Interior package*** | An interior package may be tied or wrapped components or may be a container that provides complete environmental protection and preservation. It is not suitable for shipment unless placed in an outer package. |
| **Unit package** | An interior package that contains a single item or a group of items of the same part number. |
| **Intermediate package** | An interior package that encloses two or more identical unit packages. |
| ***Parcel*** | An interior tie, wrap, or container that lacks some element of environmental protection or preservation. |
| ***Unit parcel*** | A parcel that contains a single item or group of items of the same part number. |
| **Intermediate parcel** | A parcel enclosing two or more identical unit parcels. |
| ***Assorted parcel*** | A parcel enclosing two or more unit parcels of unlike items. |
| ***Impervious gloves*** | Gloves that will not allow chemicals to come in contact with the skin when using chemicals. |
| ***Room temperature*** | When used by TO 11N–35–51, refers to a temperature of approximately 72 degrees Fahrenheit (°F). |

## Commercial equipment

Commercial equipment is any equipment procured from a commercial vendor for military use. Some examples of this include, but are not limited to, pallet jacks, pallet stackers, and pry bars since these equipment items (normally) do not have a specific TO assigned to them. Therefore, personnel may use a general service directive or manufacturer's instructions (if present) for *prior to use inspections and usage*. If neither exists, inspect equipment with good shop practices.

## Expendable materials

These materials are required to perform certain procedures. TO 11N–35–51A, *General Instructions Applicable to Nuclear Weapons (Supplement),* lists all applicable expendable materials (hazardous or nonhazardous) and alternates that are utilized throughout the manual.

### *Alternates for expendable materials*

When a weapon maintenance TO instructs the use of a particular expendable material, refer to the expendable materials table in TO 11N–35–51A for an alternate material unless prohibited by the weapons- and/or equipment-specific TO.

### *Maintenance*

Maintenance of weapons and Department of Energy (DOE) equipment requires the use of expendable materials that may be hazardous to personnel. Hazardous materials are identified in the TO by the symbol (HM). Hazardous materials that are flammable are identified in the text of the TO by the symbol (HM)(F). Additionally, flammable products with a flash point below 20 °F will have a warning statement preceding occurrences in the referenced publication.

## Reject

The word "reject" in most cases means that you cannot use a particular item unless the appropriate authority returns it to a serviceable condition according to approved maintenance procedures. It has different meanings in the following circumstances:

a. *Weapons* – The weapon is not operational and no further electrical operations, including permissive action link (PAL) operations, are to be performed unless directed by weapon-specific TO or until the weapon is returned to operational status or when authorized through unsatisfactory report (UR) response process.

b. *Individual components or hardware* – The subject item is not acceptable and must be replaced or accepted in accordance with (IAW) approved maintenance procedures or when authorized

through the UR response process. The rejection of individual components may or may not lead to the rejection of the weapon (turning the weapon non-operational).

c. *Equipment* – The subject item is not to be used for any operation unless it is returned to a serviceable condition IAW approved maintenance procedures or when authorized through UR response process.

## Location

The nuclear weapons field uses the airframe practice of locating components and features by station number. All station numbers are measured in inches (in.) or millimeters, starting at the nose or most forward point of the weapon (station 0) and looking to the rear following the centerline of the weapon. For example, stations at 8.5 in. and 20.1 in. indicate the distance from the nose where you can locate components, markings, and so forth. In some cases, where the weapon has an alternate nose section there may not be a station 0 for the shorter alternate version. Exceptions may arise for other reasons.

In addition, use the following guidelines to establish the left or right side of a weapon or test equipment:

- The left or right side of a major assembly is the side to the left or right of the centerline when *the observer is at the rear looking forward, and the top of the unit is the uppermost*.
- The left or right side of a test set is the side to the left or right of an *observer facing the panel when the panel is in operating position.*

## General procedures

As you might expect, inspection, test, and maintenance procedures on nuclear weapons are much more critical and exacting than they are on other nonnuclear systems and components. Therefore, there are certain criteria you must keep in mind whenever you work with nuclear weapons or components.

### *Sequence of procedures*

It is not always feasible or convenient to follow procedures in the sequence provided in a specific TO. For instance, maintenance may require disassembly for access to only one component, its replacement, and reassembly, although the manual provides a more extensive sequence. However, for electrical test procedures, the sequence must not change. The following rules apply unless the maintenance manual or a service directive instructs differently:

- No required test may be omitted.
- No tests or inspections may be invalidated.
- No safety features may be violated.

### *Test set indications*

Test set indications in TOs provide the operator with an expected normal result on weapon system or component procedural tests. When you encounter an abnormal result during a test and other specific procedures are not given, stop the test and reject the system or component. However, you may repeat continuity and/or monitor tests when an abnormal result occurs before the system or components are rejected.

### *Corrosion*

Always check hardware removed from major assemblies and the hardware issued as spares for corrosion. Replace a screw, nut, washer, or similar piece of hardware with corrosion to the extent that enough base material is lost to create doubt about its structural integrity or ability to function. If the corrosion appears only to be surface discoloration, the item is structurally acceptable and you do not need to replace it.

## Inspection limitations

Perform visual inspections using normal vision only. If you discover a suspected defect while inspecting a weapons surface, component, equipment, or part, you may use a magnifying glass. However, the use of the magnification shall be limited to establishing the validity of the suspected defect only. Simply put, do not continue your inspection using the magnifying glass for the rest of the inspection. Use the magnifying glass to evaluate the defect, and then continue with the inspection using normal vision only.

### *War reserve materiel*

The only inspections you will perform on war reserve (WR) weapons are those procedures listed in TOs. Do not disassemble or perform operations past the point specified in the TO. For example, do not disconnect cable connectors for the sole purpose of inspecting them unless the TO directs it. Inspection requirements in TOs are made to fit the operation you are performing and in many cases restrict inspections to a specific time or event. If you notice a defect in a cable or component not mentioned in the procedures, notify the team chief who will then decide the next course of action.

### *Nuclear weapons*

Inspect interior areas of nuclear weapons and remove any loose dirt, dust, or other foreign material using a clean dry cloth. Do not use water or solvents for cleaning unless specifically authorized, and avoid damaging wires or cables when cleaning. If cleaning interior with an electrically powered vacuum cleaner, use a nonconductive wand or extension (plastic, rubber, or similar material) attached to the hose. When cleaning up toxic material or low-level radioactive material, dispose of contaminated cleaning materials accordingly. In addition, a nonelectrical powered vacuum cleaner may be used.

### *Damage*

You may come across a defect or damage while inspecting weapons or equipment. It is important to identify the type of damage correctly to decide whether the condition is acceptable or rejectable. Structural damage is damage that results in functional impairment and requires repair or rejection. It is indicated by, but not limited to:

- Punctures or cracks.
- Warped flanges.
- Obvious permanent deformities.
- Loose rivets or elongated rivet holes.
- Breaks in lugs or hardware.
- Loss of sealant or ablative material.

The weapon or equipment-specific TOs may provide criteria for a dent, gouge, nick, or scratch; therefore, the following definitions apply upon discovery of any of these defects:

- Dent involves no removal of material, but may be structural.
- Gouge removes material and is indicated by exposure of bare metal or metal oxide.
- Nick is a shallow notch, cut, or indentation on an edge, flat, or curved surface.
- Scratches do not involve structural damage and may or may not remove material, but they are relatively shallow and are much longer than they are wide. This type of damage may expose bare metal or metal oxide.

Acceptable defects or differences include identical components (manufactured at different times) that vary in surface appearance. Minor manufacturing defects in surfaces, such as minor surface irregularities, discoloration due to welding heat, and tooling marks, are also acceptable.

## 402. Maintenance procedures and protecting against moisture

In this lesson, we examine some basic maintenance and storage procedures to follow. We also discuss the importance of weapon stabilization to prevent condensation and desiccating open weapons and components to reduce relative humidity to acceptable levels.

### Basic maintenance procedures

You will need to follow some basic maintenance procedures, even when they are not spelled out exactly in the weapon-specific TO.

#### *Stockpile samples*

Anytime a weapon is scheduled to be returned to a DOE facility for repair, or selected for a stockpile laboratory test or flight test, it must be maintained in normal WR condition unless a higher authority directs you otherwise.

#### *Retirement units*

You must maintain retirement units according to the following guidelines:

- Cleaning and surface preservation are not required to be performed, documented, or reported.
- No parachutes or limited-life component exchanges will be performed.
- All other inspections and/or maintenance actions required by TOs will be performed with the exception of the maintenance actions above.

#### *Association of weapon components*

When you reassemble a weapon, use the components that you previously removed from that weapon (provided they are still serviceable). Do not interchange components between weapons unless authorized by the DOE to do so. Report any replacement of serial-numbered components on a weapon IAW TOs and AF procedures.

#### *Handling equipment*

Use DOE and National Nuclear Security Agency (NNSA) designated handling equipment (H-equipment) only for approved nuclear weapons maintenance and for which Joint Nuclear Weapons Publication System/Service procedures are provided. If required, you can refer to TO 11N–H–61, *Operations and Maintenance Instructions with Illustrated Parts Breakdown, Active Systems Special Handling Equipment*, for approval to use H-gear outside of normal procedures. Otherwise, usage will result in disqualification of the item for WR use. H-equipment listed in the special equipment tables at the beginning of each weapon or equipment specific TO is the preferred equipment to use. This does not preclude the use of DOD-designed specialized H-equipment that has been properly certified by the DOD for nuclear weapons use.

#### *Critical markings*

Critical markings are those markings where the exact location is very important, or critical. The three critical markings you will need to concern yourself with are chock bands, center of gravity (fig. 1–1), and match marks. You do not need to measure critical markings for accuracy each time you perform a surface inspection unless there is reason to believe that the markings were applied improperly. For instance, during a general maintenance operation, you notice an unequal weight distribution while lifting a weapon with a H1004 lifting device or you needed to apply a new marking. In these situations, you will need to measure the critical marking to ensure it matches the specifications listed in the weapon-specific TO.

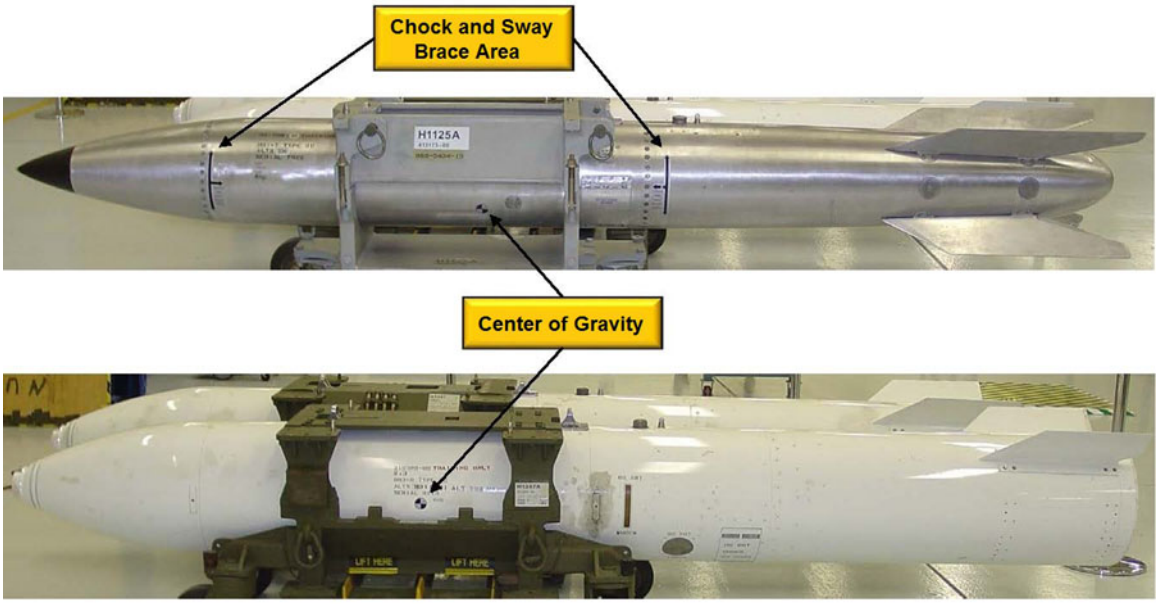


**Figure 1–1. Critical marking.**

## Weapon temperature

We take weapons from an uncontrolled climate in a storage structure into a facility that has a controlled climate for maintenance on a regular basis. The temperature and humidity difference can cause condensation to form and expose sensitive components to an unwanted environment. To prevent condensation from forming on connectors and internal weapon components, do not open the sealed volume of cold weapons until they have reached the maintenance facility temperature. Observe the following precautions:

- Do not open sealed volume of weapon until the internal temperature of weapon is higher than the dew point or ambient temperature of the work area. The dew point of work area may be determined by using commercially available measuring equipment (and accompanying documentation) such as a sling psychrometer, wet-and-dry bulb hygrometer, and electronic hygrometer.
- If dew point measurement capability is not available, allow one hour for weapon to stabilize for each 4 °F increase in temperature. For example, if a storage structure was 53 °F when you opened it and your work area is 73 °F, there is a 20 °F difference between the two. Remember that every 4 °F is a 1-hour wait, which means you take the difference (20 °F) and divide by 4 °F. The answer is 5; the team cannot perform any maintenance until at the end of the 5 hours wait period.
- Assume the weapon transported from an unheated ordnance igloo or weapons storage vault into a heated work area is stabilized to the internal temperature of the igloo or weapon storage vault (e.g., if igloo temperature is 60 °F, assume internal warhead temperature, at time igloo or vault was opened is 60 °F).
- Assume that a weapon transported from an unheated rudimentary structure is stabilized to the coldest temperature experienced in the last 24-hour period (e.g., if structure temperature ranged from 30 °F to 45 °F, assume internal warhead temperature is 30 °F).
- Any components and major assemblies outside a weapon’s sealed case can be serviced at any time without regard to weapon’s internal temperature.

### Protection against moisture

Many internal weapon components are fabricated from materials that can absorb relative humidity or moisture quite rapidly if they are left undesiccated and exposed to the atmosphere. If you reseal a weapon with moisture-saturated components, they can release the moisture into the weapon's internal atmosphere, raising the internal humidity to levels conducive to producing corrosion. Various TOs specify maximum time periods you can leave a weapon open or unpressurized. You must provide moisture and humidity protection if you stop work for an extended period, a substantial part of the workday, or if you must leave the weapon disassembled overnight.

Use these moisture protection procedures when a specific maintenance manual does not give instructions:

1. Enclose removed components back inside the weapon or place in separate packages.
2. Place enough desiccant inside the weapon to reduce the relative humidity to 10 percent or less. To determine the amount required follow guidelines in TO 11N–35–51.
3. Place a humidity indicator card in the weapon and each separate package (if applicable) as far as possible from the desiccant.
4. Seal weapon openings using item 632, heat-sealable electrically conductive film. Secure sealing material over case using any of several devices such as twine, textile tape, elastic cord, or discarded preformed packing. If you use pressure-sensitive adhesive tape, apply directly to the sealing material only, not to the weapon surface.
5. Seal each separate package.

### Unseal weapons

When maintenance is ready to resume on a weapon and components, ensure that you follow one of the following guidelines before opening sealed weapon cases or packages:

- When the weapon and components remain sealed and desiccated for a minimum of 8 consecutive hours and the humidity indicator card indicates that the relative humidity is 10 percent or less, you may start a new period of maximum allowable open time. If the relative humidity is greater than 10 percent, do not proceed with work until the card reads 10 percent or less. It may be necessary to replace the desiccant and reseal to bring the humidity back down to acceptable levels.
- However, if the weapon and components remain sealed for less than 8 consecutive hours, ignore the readings of the humidity indicators and resume the operation as if you had not interrupted the weapon open time (i. e., if the maintenance team took 2 hours to disassemble a weapon and then decided to take a short break). Before taking the break, the team sealed and desiccated the weapon. Unknowingly to the team, two hours had passed since the weapon was sealed. In this situation, the total open time is 4 hours since we have to consider the original open time to disassemble a weapon (2 hours) and the duration of the break time (2 hours).

### Storage procedures

You need to follow some basic storage procedures even when they are not spelled out exactly in the weapon-specific TO.

#### *Empty weapon storage containers*

You need to store empty shipping and storage containers and associated equipment when not in use. Follow these necessary steps:

1. Desiccate interior of the container to protect internal cushioning material and hardware.
2. Close storage containers as if a weapon was inside.
3. Close any container breather holes or unsealed joints with tape.

4. Mark the containers accordingly.
5. Store any supporting hardware furnished with weapon on a one-to-one basis.
6. Ensure the containers are stored in appropriate place and given environmental protection, if required.
7. Inspect material condition of the container annually.
8. Perform necessary maintenance IAW weapon or equipment-specific TOs.
9. Remove tape (step 3) once container is placed back into service.

#### *Bomb and warhead hand trucks*

You need to store empty bomb and warhead hand trucks and associated equipment when not in use also. Follow these necessary steps:

1. Store equipment in an appropriate place with adequate environmental protection.
2. Inspect material condition annually.
3. Perform any necessary maintenance IAW weapon- or equipment-specific TOs.

#### *Immobilization*

You need to perform any or all of the following procedures, as necessary, to ensure immobilization of hand trucks or castered weapons containers when such procedures are not specified in maintenance manuals:

1. Turn any one caster wheel 90° from the other three castered wheels of hand truck or castered container and lock all casters. Turn the casters using a castering tool or by momentum.
2. When the floor or deck is uneven, sloping, or in motion, use chocks, sandbags, tie downs, or a different caster alignment, as necessary, to ensure adequate immobilization.

## 403. Handle and protect electrical connectors

Weapon systems and associated equipment have several types of electrical connectors, and they are easily damaged if you handle them improperly. They can be contaminated with dirt, moisture, and so forth, if you leave them unprotected. Both damage and deterioration reduce weapon reliability and can even lead to unsafe conditions. Now, let us learn how to engage, disengage, and protect electrical connectors. If the weapon-specific manual does not contain information for connecting, disconnecting, and protecting electrical connectors, use instructions provided in TO 11N–35–51.

### Equalization of body potential

First, before handling an electrical connector, you need to equalize your body potential. This means your bare skin must touch bare metal in order to equalize the electrical potential between you and a component or weapon. This prevents an electrostatic discharge happening near the connector itself. Follow the weapon system specific procedures in the weapon-specific TO.

### Connection, disconnection, and protection of electrical connectors

Always use extreme care when you connect or disconnect an electrical connector. Avoid skin contact with connector pins and connector sockets. Touching unprotected pins or sockets can cause them to physically deteriorate due to your skin’s oils and contaminates. This can ultimately lead to unsafe or unreliable conditions. Additionally, *always* inspect the connectors for damage immediately before connecting cables or immediately after disconnecting cables.

#### *Tri-loc connectors*

First, remove the metal connector cover using pliers that have nylon, rubber, or similar soft materials. (**NOTE:** the use of pliers is *only* applicable on protective covers only.) Tri-loc connectors have three bayonet pins (usually on the receptacle part of the connector) and three grooved slots in the coupling ring that the bayonet pins slide into during connector engagement. When you engage tri-loc connectors, make sure you couple the coupling ring completely. Ensure, by feel, that connector is fully coupled while connector is being connected; or ensure, by visual inspection of locking pins, that

locking pins (bayonet or coupling pins) on receptacle are visible through inspection holes in mating plug coupling ring. When you disconnect, do not use pliers or wrenches unless specifically authorized by the TO. When the use of pliers or wrenches is authorized, the same pliers authorized to remove connector cover applies (pliers with jaws having nylon, rubber, or similar soft material) in this situation. Once disengaged, pull on the connector or pull wire (bail) and do not pull on the cable or the pigtail.

#### *Threaded coaxial connectors*

When you connect threaded coaxial connectors, align the male and female connectors. Hold the barrel of the connector shell stationary and connect the connector by turning the coupling nut to ensure that the entire cable end does not twist. If you don't hold it stationary, the cable end can twist and ruin the cable. When you disconnect, you need to hold the connector barrel again while turning the coupling nut.

#### *Screw or nut connectors*

Screws or studs and nuts are used to hold some connectors in place (after securing them). If possible, observe pins as they enter the component to avoid bending connector pins and unseating any preformed packing. First, align the male and female electrical connectors. Once aligned, connect and fully seat the electrical connector by hand and ensure that the connector face is parallel with the surface of component. Once connected, secure the connection with screws or studs and nuts.

#### *Protection of electrical connectors*

When dealing with electrical connectors, their protection is very important since they are considered the nervous system of any weapon, component, or equipment. A severed connection can lead to an unreliable or unsafe condition. There are certain guidelines for protecting electrical connectors:

- Keep electrical connectors covered until immediately before electrical connector inspection and connection.
- As soon as practical after disconnecting the electrical connector, protect the connector with a suitable cover. When not specified by the TO, use an available metal or plastic protective cover. If metal or plastic covers are not available, use item 627 (opaque, heat-sealable, conductive plastic bags) and secure using any suitable method.
- Use pin protectors, connector covers, cap plugs, shorting plugs, or other devices when specified by the TO.
- When a connector is not covered, avoid exposing electrical connectors to electrolytes, solvents, and conductive or corrosive agents. These agents can remove the lubricants on the pin contacts making it difficult to disconnect electrical connectors. You may need to use extreme force to disconnect connectors. Because of the extreme force, it produces metallic slivers, chips, and short circuits, which could cause shorting or leakage of current around receptacle inserts.
- Clean connectors only as specified in TO 11N–35–51.

### Inspection criteria for electrical connectors

Always visually inspect connectors immediately before you connect them and immediately after you disconnect them. Once disconnected, use the following guidelines to inspect electrical connectors:

- A missing, damaged, bent, or splayed pin is unacceptable unless repair is authorized in a weapon- and/or equipment-specific TO.
- A resilient insert that is punctured is unacceptable. Additionally, if a resilient insert has a tear or gouge extending more than 25 percent of the distance from contact to the nearest adjacent contact (or to the insert edge), it, too, is unacceptable.

- A nonresilient insert that is broken or cracked or has a chip that extends in depth to the top of any metal contact, is unacceptable. A chip extending to a maximum of three contacts, but not extending in depth to the top of any metal contact, is acceptable.
- Do not make a connection if repair is not authorized or acceptable on a bent pin, deformed key, or keyway that makes a connection doubtful.
- Damage affecting the function of keys, keyways, locking pins, or socket contacts is unacceptable.
- A missing or deformed socket contact is unacceptable.
- Inspect connector with locking (bayonet) pins for movement by using finger pressure. If movement is detected, attempt to remove pin using fingers only. If pin is removable or missing, connector is unacceptable.
- A connector with coupling rings that have damage threads or does not move freely is unacceptable.
- Inspect connector with coupling rings and/or spring fingers for damage to the connector shell. Damage to the connector shell that prevents proper connection or affects more than two spring fingers is unacceptable and shall be replaced. A connector with damage to the spring fingers is unacceptable.
- Kinks, broken strands, or other mechanical damage that affects lanyard operation (if present) is unacceptable.
- An abraded, scratched, nicked, dimpled, or rough insert and normal wear of the protective finish on connector components is acceptable.
- Clean corrosion, moisture, fungus, metal particles, and other foreign matter on a connector IAW procedures in 11N–35–51.

### Cleaning electrical connectors

Electrical connectors must be cleaned in a manner that avoids damage to mating surfaces or coupling mechanisms and reduces risk of creating static electricity. Remember, always equalize before handling electrostatic-sensitive components and *do not* use a vacuum cleaner to clean electrical connectors. When cleaning, exercise care to prevent damage to pins and contacts and *do not* clean miniature connector sockets by inserting any tools. Clean electrical connectors using one or more of the following guidelines:

- Clean foreign matter from electrical connectors whenever possible by dry brushing, dry wiping, or scraping with a wood or plastic tool.
- A suction bulb or bulb-type hand blower may be used to remove foreign matter from, in, or around electrical connectors.
- Attempt to blow out metal particles imbedded in inaccessible preformed packings. Those metal particles that cannot be blown out, and are electrically isolated, are acceptable.
- If foreign matter is present on electrical connectors, remove it by wiping with a clean cloth moistened (damp, not dripping) with item 42, isopropyl alcohol.

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## Self-Test Questions

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

### 401. General standards and procedures

1. What are impervious gloves?

2. What TO lists all applicable expendable materials (hazardous or nonhazardous) and alternates?

3. What does the word “reject” mean?

4. Where would station 10.2 of a nuclear weapon be?

5. Unless you are directed otherwise in the weapon TO, how should you identify a weapon’s left side?

6. Can you change the sequence of procedures for an operation?

7. What do you do if you do not get the required indication on a test set during a test on a nuclear weapon (not a continuity test)?

8. You remove a screw from a weapon that has surface discoloration from corrosion. Under what condition may you reuse it?

9. How far do you disassemble during the inspection process on a nuclear weapon?

10. When you are inspecting a weapon or equipment, what conditions would indicate structural damage?

11. What type of defect is a shallow notch, cut, or indentation on an edge, flat, or curved surface?

### 402. Maintenance procedures and protecting against moisture

1. What actions are allowed on retirement units?

2. What are the three critical markings?

3. What would happen if a sealed volume of a cold weapon is *not* equilibrated to the maintenance facility temperature?

4. If a storage structure is 67 °F and your work area is 75 °F, how long must you wait before you can begin disassembly procedures?

5. Assuming that a weapon was transported from an unheated rudimentary structure, what is the weapon temperature stabilized to?

6. Why is it important to protect weapon components from moisture?

7. If a weapon is sealed and desiccated for 9 consecutive hours, and the humidity indicator card indicates 10 percent, can you start a new open time? Explain.

8. How often are empty weapon storage containers inspected, if required?

9. How is the bomb hand truck immobilized on an uneven floor in the maintenance bay?

### 403. Handle and protect electrical connectors

1. What is the first action before handling an electrical connector?

2. When you engage tri-loc connectors, what indicates that they are coupled?

3. What *must* you remember to do when engaging or disengaging threaded coaxial connectors?

4. When should a technician protect electrical connectors?

5. A resilient connector insert has a tear extending one-third of the distance between two contacts. Is it acceptable? Why or why not?

6. A nonresilient connector insert has a chip that extends to the top of the metal contact. Is it acceptable? Why or why not?

7. A connector has a loose bayonet pin, but finger pressure won't make it come out. What do you do?

8. What type of solvent is authorized to clean electrical connectors?

## 1–2. Common Hand Tools and Measuring Devices

On your job, you will use many different types of tools—some common hand tools and some special tools, such as measuring devices. Most of us think we know how to use hand tools properly, but sometimes we are guilty of using tools improperly or unsafely. In this section, we discuss the proper use of common hand tools. We also discuss different types of measuring devices and how they are used to measure a wide range of defects in weapons, components, and equipment.

### 404. Common hand tools

We maintain nuclear weapons with all kinds of different tools and every tool is designed for a specific job. Do we always use the right tool? If we do, are we using it correctly? Bear in mind that your work as a nuclear weapons technician will also be judged by the way you handle and care for your tools. Therefore, we will cover the types, inspection, and use of a few select hand tools.

#### Tool safety

Tools are necessary to any maintenance task, but they can be a source of injury if they are not used right. You will need to follow some general safety rules, regardless of the tool you use:

1. Select the right tool for the job.
2. Inspect tools and equipment to ensure they are safe before starting work.
3. Wear safety glasses when there is a danger of flying particles, such as when soldering, using power tools, or cutting safety wire.
4. Keep tools in a safe place. Never carry tools in your pockets or leave them lying on the floor.
5. Use only authorized maintenance techniques and materials.
6. Clean your work area when the job is complete.
7. Know the location of all safety equipment and be familiar with its operation.
8. Report all accidents, no matter how slight.
9. Never use tools that are damaged.

#### Hand tools

TO 32–1–101, *Use and Care of Hand Tools and Measuring Tools*, will give you an increased understanding of the common hand tools you may encounter throughout your career. You'll use many different types of hand tools for nuclear weapons maintenance, but we'll stick to general inspection and use of the more common ones.

##### *Hammers*

Never use an unsafe hammer. Before using, check for a loose head or a cracked handle. Replace a cracked handle; never tape it. Do not use the handle as a pry bar or to knock sharp edges together. Do

not etch on fiberglass handles as this process may weaken the handle. Etch information on the hammer head.

Inspect steel hammer faces for wear, dents, or chips. Replace the hammer if you find any of these conditions. They can be dangerous if chips fly off. Inspect copper, lead, or plastic mallets for "mushrooming." If you find this condition, file the edges down to the original shape. Make sure the striking face on the hammer is free from oil. The right way to hold any hammer is near the end of the handle (fig. 1–2). Strike the nail or tool squarely and on center to keep the hammer from glancing off.

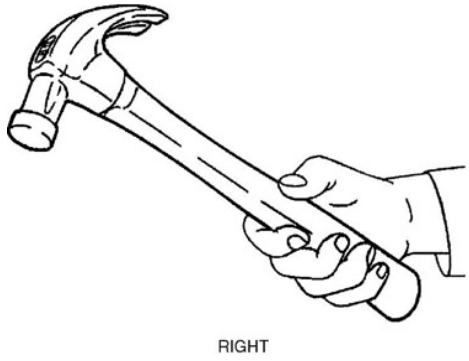


**Figure 1–2. Holding a hammer properly.**

### *Screwdrivers*

Handle screwdrivers carefully. A greasy handle could cause an accident. Never use a screwdriver for prying, punching, chiseling, scoring, or scraping. Never pound on a screwdriver with a hammer. Never use a screwdriver near a live wire, to check a storage battery, or to determine if an electrical circuit is live. Never hold the work in one hand while using the screwdriver with the other. If the screwdriver slips out of the slot, you will most likely injure yourself.

Before using a screwdriver, inspect the tip of it for nicks, rounded edges, or other damage that could cause it to not fit properly in the screw slot. You can file or grind the tip if you find damage. The sides must be parallel and the tip must be square at right angles to the sides and to the blade. Replace the screwdriver if it has a worn or damaged handle, if the tip is round or damaged, and you cannot repair it. The right way to select and use a screwdriver is to match the size of the screwdriver to the size of the screw slot so that the tip fits *exactly* into the slot (fig. 1–3). Always match the type of screwdriver to the head of the screw. When you use a screwdriver, keep it in direct line with the screw while turning the screwdriver. Never use other tools to turn a screwdriver unless the screwdriver is designed for use with other tools.

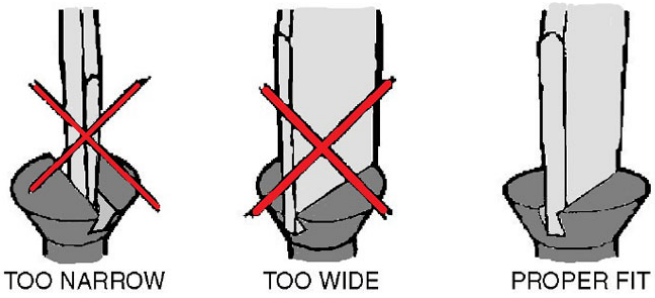


**Figure 1–3. Selecting the proper size screwdriver.**

### *Pliers*

Never use pliers for prying or for removing nuts or bolts. When you use pliers for cutting, always wear eye protection and keep your fingers away from the jaws and cutting edges. Use diagonal cutting pliers for cutting only. Before you use pliers, inspect them for broken jaws, handles, or cutting edges and replace them if necessary.

### *Wrenches and sockets*

Before you use a wrench or socket, inspect the jaws and openings for damage. If it is rounded, flared, or has any other type of damage that would cause it to fit improperly, replace it. Otherwise it may slip, causing serious injury to you or your coworkers or damaging the weapon or equipment. Wrenches and sockets should fit snugly on the nuts or bolts you need to tighten or loosen. Never turn an adjustable wrench so that you apply the pulling force to the adjustable jaw. Do not extend the handle in any way to increase the leverage on the wrench. Do not strike wrenches with hammers while you are trying to tighten or loosen nuts or bolts. Always pull on wrenches, when possible, to protect your knuckles and hands in case the wrench slips.

## 405. Devices used for measuring surface defects

There are various techniques for measuring and checking surface irregularities such as dents, protrusions, chips, and scratches as well as measuring equipment for particular measurements and evaluations. When the equipment is not specified, you may use any feasible method, depending on the equipment available (depth gauges, feeler gauges, and so forth.).

### Straightedge

Use a straightedge to check depressions or protrusions in a flat or cylindrical-shaped surface. You can also use it with a gap-setting gauge to determine whether the depth of a depression is more or less than a specified maximum. Lay the straightedge on the surface and compare the contour of the surface with the straightedge. In the case of a cylindrical surface, lay the straightedge parallel to the longitudinal axis of the cylinder. To check the depression depth, select a gap-setting gauge of the same thickness as the specified maximum depression depth and insert the gauge into the depression. If the gauge can be routed beneath the straightedge without lifting the straightedge, the depression is deeper than the specified maximum.

### Contour template

Use the contour template to check depressions or protrusions in an irregularly shaped or nonlinear tapered surface, such as a tail or nose section. You can also use it with a gap-setting gauge to determine whether the depth of a depression in a surface is greater or less than a given maximum. Position the template on the surface to be checked and compare the contour of the surface to the contour of the template. Make depth measurements with the gap-setting gauge.

### Machinist’s steel rule

This rule has several methods of measuring length with graduations on the top and bottom of each side. You can use the machinist’s steel rule to measure lengths and to check surface irregularities in a flat or cylindrical surface in the same way as a straightedge. The flexibility of the rule allows making length or width measurements in the direction of a cylindrical contour. Take depth measurements with a gap-setting gauge.

### Gap-setting gauge

These come in many sizes much like a feeler gauge and you can use these to measure certain clearances. Use the gap-setting gauge with the straightedge, contour template, or steel rule to check the depth of surface depressions. This can also be described as a pin gauge or pin type feeler gauge.

### Dial-indicating depth gauge

Use the dial-indicating depth gauge (fig. 1–4) to measure the depth of surface depressions in flat and cylindrical surfaces. The gauge consists of a knife-edge base, 2.5 in. long; a needlepoint plunger; and

a dial indicator. For accurate measurements, hold the gauge perpendicular to the surface you are measuring. On cylindrical surfaces, orient the gauge parallel and perpendicular to the longitudinal axis of the cylinder.

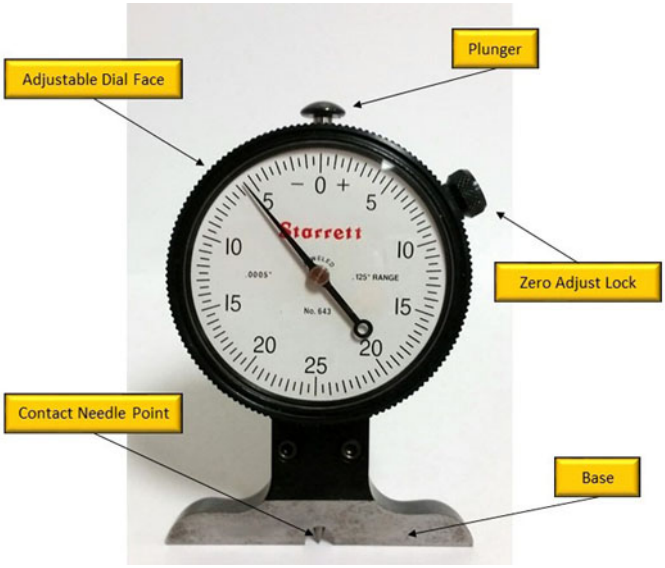


**Figure 1–4. Dial-indicating depth gauge.**

Unless otherwise specified, the depth limitations given for surface defects apply only to the base material (e.g., metal, ablative material) and not to any coatings applied over the base material. Therefore, when measuring the depth of a defect in a coated surface, the depth gauge must either be zero-adjusted relative to the bare uncoated surface or the actual depth measurement with the gauge resting on an uncoated area of the surface. This requirement does not apply to anodic coatings and other types of chemical films that are not thick enough to affect the depth measurements. Also make sure the scratch or dent is not over $^{1}/_{8}$ in. wide and the depth gauge is zero-adjusted on the surface before making the measurement.

To zero-adjust using the dial-indicating depth gauge (fig. 1–4), perform the following steps:

1. Set the knife-edge on a smooth, hard surface and verify that the depth feeler is not fixed beyond the knife-edge by lightly pressing down plunger. Ensure you notice definite needle deflection before proceeding.
2. Depress the plunger and hold. Next loosen the zero adjust lock and adjust the dial face so that the needle points to zero. Now tighten the zero adjust lock and release the plunger.
3. Place the gauge on the surface to be measured so that the point of the needle is centered over the depression, and then press down the plunger. Finally, compute the depth from zero on the dial. It may be necessary to capture additional measurements around the suspected defect to ensure the deepest depth is obtained.

There are digital versions of these gauges in the field utilized in the same way. The only difference is you do not have to adjust the dial or complete any computations. When step 3 is completed, the measurement displays on the digital readout on the face of the gauge.

### Depth micrometers

These are utilized to take precise measurements down to thousandths of an in. Most depth micrometers utilize a fixed barrel and rotating thimble marked with graduations of measurements. These measurements adjust with the movement of the thimble, which moves the measurement rod or lens towards and away from the item to be measured. The two main types of depth micrometers commonly used in the field are the standard depth micrometer utilizing a mechanical rod and the optical depth micrometer.

### *Standard depth micrometer*

This micrometer uses an interchangeable measurement rod for various depths. These interchangeable rods extend out from the base of the micrometer. When the thimble is rotated, the rod extends outward from the base to contact the surface to be measured below. This ends up giving you the distance from the surface below to the base of the micrometer. Figure 1–5 shows a standard depth micrometer and rods.

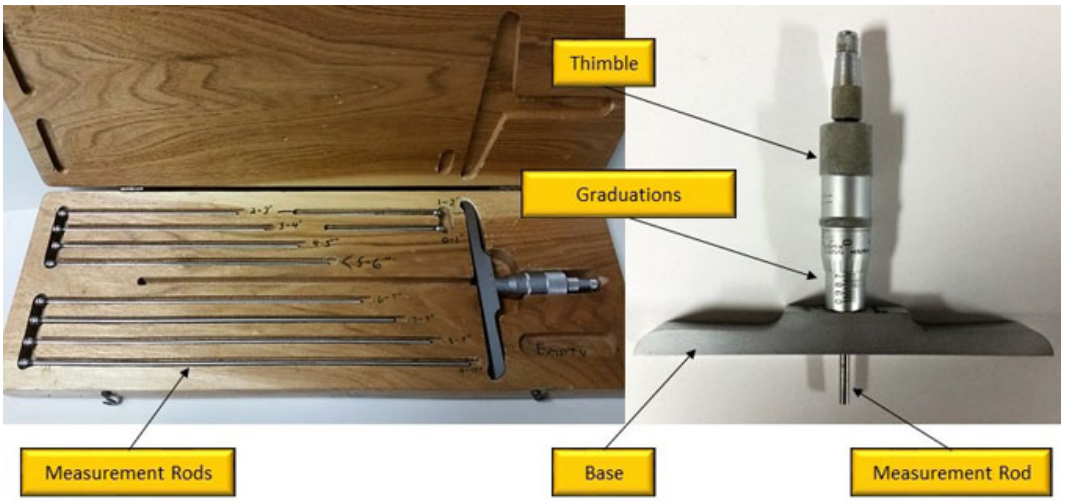


**Figure 1–5. Depth micrometer.**

One turn of the thimble moves the spindle $^{1}/_{40}$ of an in. (0.025) and graduations on the barrel show the number of turns made by the thimble. Since each graduation on the barrel is 0.025 of an in., every fourth graduation represents 0.100 of an in. and is marked 1, 2, 3, and so on. The thimble has a beveled edge divided into 25 parts, each line indicates 0.001 in. and every fifth line on the thimble is numbered 0, 5, 10, 15, 20, and returns back to 0.

There are four steps when computing the measurement from a micrometer. The first step is to start with the rod length that is being used. If you were using a rod that is 2 in., extends 2 in. from the bottom of the base of the micrometer when placed at zero, then you would begin with 2.000. If you are not using a rod that extends past the base when placed at zero, you will be measuring things that are less than an in. Thus, you would begin with a decimal and the three tailing zeros (0.000). The next step is to take the measurement from the micrometer barrel by locating the number the thimble's edge has completely past. The number should be partially or completely covered. In example 3 from figure 1–6, it is a 4; therefore, our measurement so far is (0.400). Now we look at the lines that are showing past that number. Each line represents 0.025 and in the example, there are no lines showing. Therefore, it has past 0.075 and our measurement is now (0.475). We are not done yet. The thimble will now provide the last part of our measurement. These graduations are in thousandths of an in. The final part of the measurement can be identified by the line closest to the long central line. This happens to be (0.004) in the example. Now add the last number we had (0.475) with the (0.004) to get our final measurement (0.479). The computation should be:

0.400 in. + 0.075 in. + 0.004 in. = 0.479 in.

This computation reveals that the micrometer rod is extending 0.479 in. from the base of the micrometer. Look at the other examples (fig. 1–6) and find out their readings.

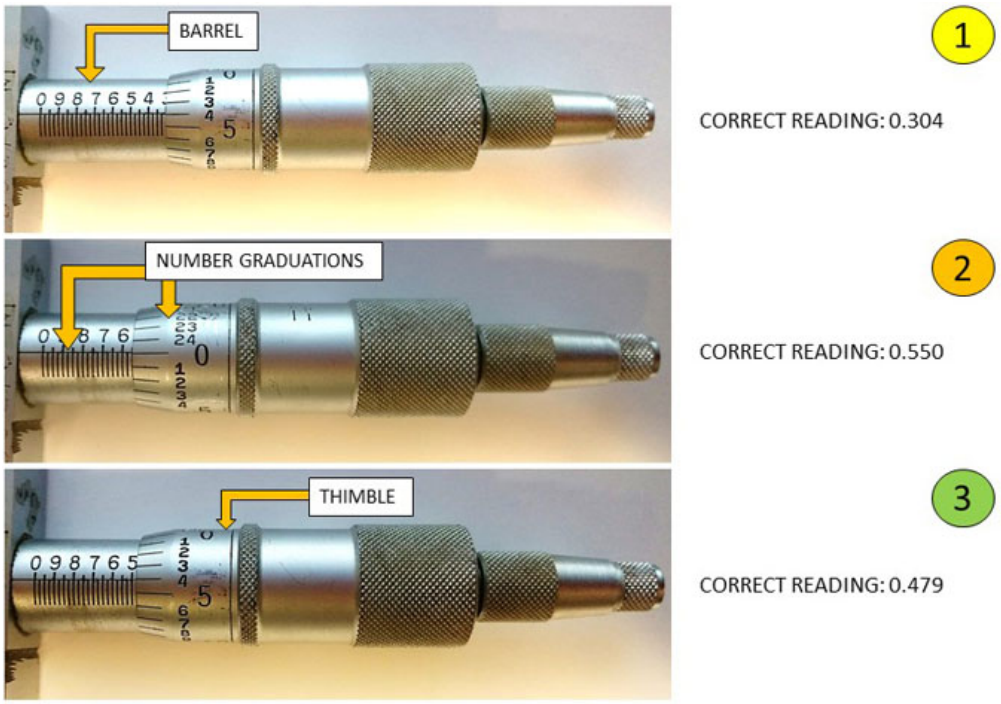


**Figure 1–6. Depth micrometer examples.**

Digital versions of this micrometer are in the field, which are easier to utilize. When turning the thimble, the reading will be indicated on the display removing the need for computation except for when extension rods are used. If they are used, then you simply add the length of the rod to the final measurement.

### Optical depth micrometer

The optical depth micrometer is extremely accurate if you use it correctly (fig. 1–7). This device uses your eyesight to perform the measurement. Most optical micrometers come with interchangeable bases designed for specific applications on all types of material. These bases provide greater flexibility and ease of operation. Typical bases you will use with the optical micrometer are shown in the following table:

| Typical Bases Used with the Optical Micrometer | |
|---|---|
| **Base** | **Used for** |
| Tripod | Flat surfaces. |
| Quadpod | Simple curved surfaces. |
| Wedge bipod | Measuring defects on inside angles. |
| Offset tripod | Flat and curved surfaces next to a protruding item. |
| Large tripod | Flat surfaces and parts. |
| Translucent V-block | Round surfaces, outside angles, flat surfaces near recess. |


1) Optical Micrometer Model 966A (200 Power)
2) 20X Eyepiece Cell (P/N 989)
3) 15X Reticle Eyepiece Cell (P/N 966AR)
4) 10X Objective Optic Cell (P/N 966AC)
5) 5X Objective Optic Cell (P/N 966C)
6) LED Micrometer Light (P/N 961)
7) Micrometer Light Adapter (P/N 962)
8) Standard Tripod Base (P/N 970)
9) Quadpod Base (P/N 971)
10) Offset Tripod Base (P/N 972)
11) Wedge Bipod Base (P/N 973)
12) Translucent V-Block Base (P/N 974)
13) Large Tripod Base (P/N 975)
14) Allen Wrench (P/N 984)
15) Instrument Kit Case (P/N 977)

**Figure 1–7. Optical depth micrometer kit.**

The base is secured to the micrometer with an Allen screw. To change the base, loosen the Allen screw and unthread the base. Select the desired base and thread it onto the barrel in a clockwise direction as far as it will go without forcing. Rotate the base counterclockwise about one turn until you align the index line on the base with the index line on the barrel. Finally, tighten the Allen screw.

After installing the correct base, place the micrometer over the object with the lens directly over the damaged area. You will be taking two measurements. Your first measurement should be of the undamaged surface directly next to the damage you wish to measure. It's recommended that readings be made without eyeglasses. Shine the flashlight through the micrometer lens. This will provide a pinpoint of light that will represent exactly where the focusing point of the micrometer will be. Once you are ready to take a reading, rotate the thimble on the micrometer barrel until the primary undamaged surface area comes into sharp focus. Take your first reading on the undamaged surface by performing the following:

1. The first part of the measurement will be taken from the fixed barrel of the micrometer, which has a value in tenths. The number that has been passed up and potentially no longer visible will be the first part of the measurement. In the example, it is (0.1000).
2. The second portion of the measurement will come from the rotating portion of the thimble, which has a value in the thousandths. This number will be the closest to the zero line on the vernier scale, which is the fixed measurement on the thimble. In the example, it is (0.0520).
3. The third portion is read from the vernier scale, which is the fixed measurement on the thimble. Below the zero, these numbers are in the ten thousandths. Find the fixed number that

lines up exactly with a corresponding line above it from the rotating portion of the thimble. In the example, it is (0.0003).

4. Add all three of these measurements together and this will be your final measurement for the undamaged portion. Make a note of this measurement for later.

0.1000 in. + 0.0520 in. + 0.0003 in. = 0.1523 in.

Now that you have completed the undamaged area measurement, you now need to move the optical micrometer over the damaged area carefully. You can utilize the same methods above and perform the measurement of the deepest damaged area. Once you have this measurement, let's say it is 0.1568 in., you need to subtract the first measurement from the second. The difference will be your final depth measurement of the damaged area. Figure 1–8 is the visual example of the reading.

0.1568 in. – 0.1523 in. = 0.0045 in.

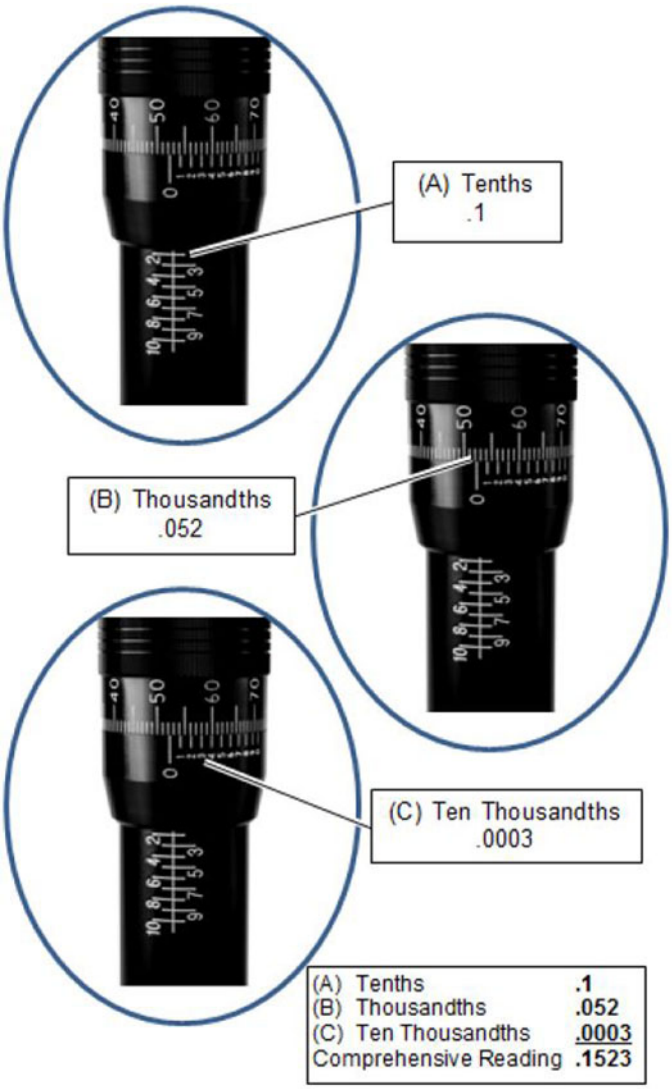


**Figure 1–8. Reading the optical depth micrometer.**

A digital version of the optical micrometer is available and in the field as well. They are utilized more often since they are virtually the same, but it is easier to obtain readings. You perform the same steps to set up the digital micrometer as you would the manual one. When you are ready to take a reading, you rotate the thimble until the primary undamaged surface comes into sharp focus. Then you press

the “zero” button on the side of the display. Move the micrometer over the damaged surface and bring the deepest portion of the damaged area into sharp focus. Some versions of the equipment may have a “hold” button on the display, which allows you to freeze the reading so it is not affected by further thimble movement. Either way, the measurement indicated on the display is the depth of the damaged area.

## Self-Test Questions

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

### 404. Common hand tools

1. When are you required to wear safety glasses?

2. What are the inspection criteria for steel hammers?

3. If the head of a plastic mallet has “mushroomed,” can you repair it? If so, how?

4. List five ways that you must never use screwdrivers.

5. What are the inspection criteria for screwdrivers?

6. What is the right way to select a screwdriver?

7. When, if ever, can you use other tools to turn a screwdriver?

8. What do you look for when you inspect pliers?

9. What do you look for when you inspect a wrench or socket?

10. Which way do you turn an adjustable wrench?

## 405. Devices used for measuring surface defects

1. Match the type of measuring devices in column B with the list of jobs in column A.

| *Column A* | *Column B* |
|---|---|
| ____ (1) Used with other measuring devices to check the depth of surface depressions. | a. Straightedge. |
| ____ (2) Used to check depressions or protrusions in a flat or cylindrical-shaped surface. | b. Contour template. |
| ____ (3) Is extremely accurate and uses eyesight to perform a depth measurement. | c. Machinist's steel rule. |
| ____ (4) Contains a graduated barrel and thimble to accurately provide depth measurements via a rod which contacts the measured surface. | d. Gap-setting gauge. |
| ____ (5) Its flexibility allows making length or width measurements in the direction of a cylindrical contour or flat surface. | e. Dial-indicating depth gauge. |
| ____ (6) Used to check depressions or protrusions in an irregularly shaped or nonlinear tapered surface. | f. Depth micrometer. |
| ____ (7) Contains a knife-edge base and needlepoint plunger to measure surface depressions in flat or cylindrical surfaces. | g. Optical depth micrometer. |

2. How do you check the maximum depth of a depression using a straight edge?

3. What is a machinist steel rule used to measure?

4. How should you position a dial-indicating depth gauge to measure defects on cylindrical surfaces?

5. How do you zero-adjust a dial-indicating depth gauge?

6. How far does one turn of the thimble move the spindle on a depth micrometer?

7. How much does each mark on the depth micrometer bevel indicate?

8. Using the following graphic (fig. 1–9), what is the reading on the depth micrometer?


**Figure 1–9. Depth micrometer example.**

9. How is a base installed on the optical micrometer?

10. How do you measure a defect using an optical micrometer?

## Answers to Self-Test Questions

**401**

1. Gloves that will not allow chemicals to come in contact with the skin when using chemicals.
2. TO 11N–35–51A.
3. You cannot use a particular item unless the appropriate authority returns it to a serviceable condition according to approved maintenance procedures.
4. 10.2 in. aft of the tip of the nose.
5. It is the side to the left of the centerline when you are at the rear, looking forward, and the top of the unit is uppermost.
6. Yes, unless the referencing manual specifically states differently. You may change the sequence of an operation as long as you do not omit any required tests, invalidate any tests or inspections, or violate any safety features. This does not apply to electrical test procedures—they cannot be changed.
7. Stop the test and reject the system or component.
8. If the corrosion appears only to be surface discoloration and the item is structurally acceptable, you do not need to replace it.
9. Don’t disassemble or perform operations past the point specified in TO procedures just to inspect.
10. Punctures or cracks, warped flanges, obvious permanent deformities, loose rivets or elongated rivet holes, breaks in lugs or hardware, and loss of sealant or ablative material.
11. Nick.

**402**

1. Inspections and/or maintenance actions required by TOs will be performed except any cleaning, surface preservations, or parachute or limited-life components exchanges
2. Chock bands, center of gravity, and match marks.
3. Condensation will form on connectors and internal components.
4. Two hours.
5. Coldest temperature experienced in the last 24 hours.
6. If you reseal a weapon with moisture-saturated components, they can release the moisture into the weapon’s internal atmosphere, raising the internal humidity to levels conducive to producing corrosion.
7. Yes. If the weapon and components stay sealed and desiccated for at least 8 consecutive hours and the humidity indicator card indicates the relative humidity is 10 percent or less, you may start a new period of maximum allowable open time.

8. Annually.
9. Use chocks, sandbags, tie downs, or different caster alignment.

**403**

1. Equalize body potential.
2. By feel or by visual inspection of locking pins ensuring pins are visible through inspection holes.
3. Hold barrel of connector shell stationary while connecting or disconnecting.
4. As soon as practical after disconnecting the electrical connector.
5. No. Reject a resilient (stretchable or flexible) insert that's punctured or has tears or gouges extending more than 25 percent of the distance from a contact to the nearest adjacent contact or to the insert edge.
6. No, a chip extending in depth to the top of any metal contact is unacceptable.
7. Nothing; it is acceptable.
8. A clean cloth moistened with isopropyl alcohol.

**404**

1. When there is a danger of flying particles.
2. Loose head or a cracked handle; inspect the face for wear, dents, or chips.
3. Yes. File the edges down to the original shape.
4. Prying, punching, chiseling, scoring, or scraping.
5. Inspect the tip for nicks, rounded edges, or other damage that could make it fit improperly, and check for damage to the handle.
6. Match the size of the screwdriver to the size of the screw slot so the tip fits exactly.
7. Never, unless it's designed to be used with other tools.
8. Broken jaws, handles, or cutting edges.
9. Inspect jaws and openings to see if they are rounded, flared, or have any other damage that would make them to fit improperly.
10. Always turn the wrench so that you do not apply the pulling force to the adjustable jaw.

**405**

1. (1) d.
   (2) a.
   (3) g.
   (4) f.
   (5) c.
   (6) b.
   (7) e.
2. To check the depression depth, select a gap-setting gauge of the same thickness as the specified maximum depression depth and insert the gauge into the depression. If the gauge can be routed beneath the straightedge without lifting the straightedge, the depression is deeper than the specified maximum.
3. Used to measure lengths and to check surface irregularities in a flat or cylindrical surface in the same way as a straightedge.
4. Orient the gauge parallel and perpendicular to the longitudinal axis of the cylinder.
5. Set the knife-edge on a smooth, hard surface and verify the depth feeler is not fixed beyond the knife-edge by lightly pressing down the plunger ensuring a definite needle deflection. Next, depress the plunger and hold; loosen the zero-adjust lock and adjust the dial so that the needle points to zero; now lock the zero-adjust lock and release the plunger.
6. $^{1}/_{40}$ of an in. (0.025).
7. 0.001 in.
8. 0.643 in.

9. Thread the base onto the barrel clockwise as far as possible, and then rotate it counterclockwise about a turn until the index line on base aligns with index line on barrel. Tighten the Allen screw.
10. Rotate the thimble on the micrometer barrel until the primary undamaged surface area comes into sharp focus. Record the first reading. Take the second reading of the lowest damaged surface in the specific area. Get the final measurement by subtracting the first reading from the second reading.

**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.

1. (401) What type of package may be a container that provides complete environmental protection and preservation?
   a. Classified package.
   b. First class package.
   c. Interior package.
   d. Unit package.

2. (401) What type of package contains a single item or a group of items of the same part number?
   a. Classified package.
   b. First class package.
   c. Interior package.
   d. Unit package.

3. (401) What should you use to inspect commercial equipment if the manufacturer's instructions are *not* available?
   a. Procedures in manufacturer's instruction similar to commercial equipment.
   b. Procedures in tech data similar to commercial equipment.
   c. Procedures listed in the Air Force (AF) Form 1800.
   d. Good shop practices.

4. (401) What type of damage involves *no* removal of material but may be structural?
   a. Dent.
   b. Gouge.
   c. Nick.
   d. Scratch.

5. (402) You bring a weapon in from the storage igloo where the temperature is 23 degrees Fahrenheit (°F); the bay temperature is 63 °F. How many hours *must* you wait to ensure internal weapon temperature stabilization?
   a. 5.
   b. 10.
   c. 15.
   d. 20.

6. (402) When you bring a weapon into a heated work area from an unheated ordnance igloo, assume that the weapon has stabilized to the
   a. outside temperature of the igloo at the time of the weapons movement.
   b. warmest temperature of the past 24 hours.
   c. coldest temperature of the past 24 hours.
   d. inside temperature of the igloo.

7. (402) When you transport a weapon from an unheated rudimentary structure, assume the weapon has stabilized to the
   a. outside temperature of the igloo at the time of the weapons movement.
   b. warmest temperature of the past 24 hours.
   c. coldest temperature of the past 24 hours.
   d. inside temperature of the igloo.

8. (402) How often are empty bomb and warhead hand trucks in storage inspected?
   a. Monthly.
   b. Quarterly.
   c. Annually.
   d. Biannually.

9. (402) How do you immobilize a hand truck or castered container?
   a. Turn any one caster wheel 90 degrees (°) from the other three castered wheels and lock all casters.
   b. There is no such thing as immobilization of hand trucks or castered containers.
   c. Turn all caster wheels 90° from each other and unlock all casters.
   d. Turn any caster wheel in the direction you are going.

10. (403) How many bayonet pins does a tri-lock connector have?
    a. 1.
    b. 2.
    c. 3.
    d. 5.

11. (403) Whenever you connect or disconnect threaded coaxial connectors, you should
    a. align the grooved slots in the mating halves.
    b. hold the barrel of the connector shell stationary while you turn the coupling nut.
    c. apply steady pressure on the wire bail as you gently press the connector halves together.
    d. ensure the large keyway of the female connector is in line with the large keyway of the male connector.

12. (403) You should place a suitable cover on electrical connectors
    a. prior to performing the next step.
    b. as soon as practical after you disconnect them.
    c. when the referencing technical order (TO) instructs you to do so.
    d. after the component is removed from the weapons assembly.

13. (403) You should reject any connector that has missing, damaged, bent, or splayed pins *unless* the repair is authorized by
    a. a weapon-specific technical order (TO).
    b. maintenance assistance personnel.
    c. a technical assistance request.
    d. the system design engineers.

14. (403) How many metal contacts can be affected in an electrical connector if a chip does *not* extend to the top of any of the metal contact(s)?
    a. One.
    b. Two.
    c. Three.
    d. Four.

15. (403) Which action is *not* an authorized method of cleaning electrical connectors?
    a. Dry wiping.
    b. Brushing.
    c. Vacuuming.
    d. Scraping.

16. (404) When should you wear safety glasses?
    a. Anytime you perform any type of maintenance.
    b. When there is a danger of flying particles.
    c. Whenever you use solvents.
    d. When using adhesives.

17. (404) Before using a steel hammer, inspect the face of the hammer
    a. to ensure it is painted.
    b. for chips, dents, and wear.
    c. for the proper toolbox etching.
    d. to ensure it is made of the proper metal.

18. (404) To protect your hands in case a wrench slips,
    a. orient the wrench to apply a pulling force.
    b. orient the wrench to apply a pushing force.
    c. extend the handle to increase leverage on the wrench.
    d. strike the wrench with a hammer to loosen nuts or bolts.

19. (405) You use a straightedge to check
    a. clearance between two parts.
    b. distances on curved surfaces.
    c. protrusions in a nonlinear tapered surface.
    d. depressions in a flat or cylindrical surface.

20. (405) Which item is *not* used with a gap-setting gauge?
    a. Steel rule.
    b. Straightedge.
    c. Contour template.
    d. Optical micrometer.

21. (405) When using a dial-indicating depth gauge to measure depressions on a cylindrical surface, how should you orient the gauge?
    a. Diagonal to the surface's longitudinal axis.
    b. Parallel and horizontal to the surface's longitudinal axis.
    c. Perpendicular and vertical to the surface's longitudinal axis.
    d. Parallel and perpendicular to the surface's longitudinal axis.

22. (405) Each graduation on the barrel of a depth micrometer shows an increment of
    a. 0.050 inch (in.).
    b. 0.033 in.
    c. 0.025 in.
    d. 0.015 in.

23. (405) Each of the marks on the bevel of a depth micrometer indicates
    a. 0.0001 inch (in.).
    b. 0.001 in.
    c. 0.01 in.
    d. 0.1 in.

24. (405) When using an optical micrometer, you get the actual measurement by
    a. subtracting the first reading from the second reading.
    b. adding the first reading to the second reading.
    c. rounding off the scale.
    d. taking the average.

**Please read the unit menu for unit 2 and continue ➔**

# Unit 2. Cleaning, Repairing, and Preserving



IN THIS UNIT, we'll discuss general and special cleaning and repair procedures during daily maintenance. You will be working with hazardous materials, so you need to pay attention to the manufacturer's precautions and to specific guidance for protective equipment stated in TOs. You need to understand the various cleaning methods and know about surface preservation and repair. Proper surface preparation and correct application of pretreatment and finishes will prevent additional repairs later.

## 2–1. Cleaning Procedures

Cleaning a weapon or component is a process of removing any foreign material from the item. This foreign material could be dust, dirt, grease, or anything that is generally not supposed to be there. The type of material and the surface to be cleaned determines the cleaning materials you use and the way you clean it. In some cases, you may have to use a variety of cleaning agents or methods to remove the foreign material. Many cleaning agents are hazardous because they are toxic and/or present a fire hazard.

### 406. General cleaning procedures

This lesson includes a list of cleaning materials and procedures for cleaning and drying any component or major assembly related to nuclear weapons. These procedures may be changed or combined depending on the availability of cleaning materials and equipment, degree of disassembly requirements, or length of time required to perform the procedures. Observe the following guidelines when you perform a cleaning procedure:

1. Ensure the item is not damaged during cleaning.
2. Ensure you remove fingerprints from critical surfaces of items.
3. Ensure you accomplish all cleaning procedures that could invalidate inspection or test results before the inspection or test.
4. Ensure you remove all fibers, lint, and other residue from cleaning and drying materials from the item.
5. Do not disassemble weapon beyond the level of required maintenance for cleaning.

#### Cleaning materials

The list of cleaning materials in TO 11N–35–51A is a guide in selecting a suitable cleaning agent. Observe the following guidelines when selecting a cleaning agent:

- The list of cleaning materials in TO 11N–35–51A is not all-inclusive.
- Alternate cleaning agents must be at least equivalent to those listed in TO 11N–35–51A.
- Disposable paper wipes may be substituted for a clean cloth when cleaning and drying.
- Unless otherwise specified by the weapon and/or equipment specific TO, a cleaning procedure requiring a particular solvent may allow an alternate solvent as noted in TO 11N–35–51A.

- Certain materials that are merely suggested for use in these procedures or the weapon- and/or equipment-specific TO and are considered to have a wide range of substitutes, are not listed in TO 11N–35–51A (e.g., cotton swabs, tongue depressors, paper wipes, etc.).

## Practices for component or assembly cleaning

When you clean a weapon or part, be careful not to obliterate or smear any identification markings. Such "erasing" is particularly easy to do when you clean something with solvents. If you cannot avoid removing a marking, make a note of it and re-mark it after you finish cleaning the item. For this discussion, we group cleaning into four methods: mechanical, vacuum, solvents, and abrasion.

### *Mechanical cleaning*

When the TO specifies the mechanical method of cleaning, use a knife, scraper, or other suitable tool that will not damage the component and carefully scrape or peel off the foreign material. A situation where you might use this method is in cleaning layers of dirt, grease, paint, or sealant from an item. Wooden items like tongue depressors usually make good tools for scraping since the wood is less likely to damage metal surfaces.

### *Vacuum*

Two types of vacuum cleaners are authorized for cleaning nuclear weapons components: an electrically powered vacuum cleaner with a nonconductive wand or extension (plastic, rubber, or similar material) attached to the hose, or a nonelectrical powered vacuum cleaner. Use these cleaners to clean loose dirt, dust, or other foreign matter from assemblies. When you clean up toxic and/or low-level radioactive materials, dispose of contaminated cleaning materials IAW appropriate service directives. Normally, you use vacuum cleaners to clean hard-to-get-to areas of weapon assemblies. You can clean dust or dirt from hoses or other tubing by drawing air through the tube with a vacuum cleaner. When you clean tubes by this method, you can check the air intake by placing your fingertip over the end of the tube.

### *Solvents*

Cleaning with solvents simply involves using some type of liquid, including water. TO 11N–35–51 lists different types of contamination and indicates the solvents and methods to use in cleaning various component materials. When you apply cleaning materials, use a clean cloth, disposable paper wipe, cotton swab, or bristle brush moistened (damp, but not dripping) with the cleaning solvent. Actually, it's better to use paper wipes instead of cloth because the cloth normally creates a lot of lint that would cause you to clean even more of the surface. Paper wipes also reduce the amount of hazardous waste created.

When you use solvent in a closed or sealed area, let the solvent dry completely before you close or seal the space. When you use detergent and hot water, make sure the detergent is equal to an aerospace equipment-cleaning compound and at least conforms to specification MIL–C–87937A, *Cleaning Compound, Aerospace Equipment*, Type II. After you use detergent and hot water, rinse or wipe the area with clean water and dry the area completely. Clean off the excess of newly applied synthetic rubber sealing compounds with toluene (technical) before they cure.

### *Abrasion*

Abrading is also classified as a cleaning method. You abrade surfaces to remove corrosion and to repair finished and unfinished surfaces. When the TO authorizes you to abrade an item, the TO usually states the type of abrasive material you should use. Examples of abrading instruments are files, abrasive cloth or paper (sandpaper), hard Arkansas stone, pumice (a powdered volcanic rock), steel wool, or steel brushes (wire brushes). Many abrasives, particularly abrasive cloths and papers, are graded according to the degree of surface roughness. Their classification is usually grouped according to a grit number (no.), such as no. 80 grit, no. 220 grit, and so forth, with the *higher* numbers representing the *finer* surfaces. The grit number refers to the number of abrasive particles

per square in. on the abrasive surface (an increase in the number of particles on a surface equals a decrease in size of the particles on a surface).

When you sand an item, always take care that particles caused by abrasion don't enter or fall into the item. If they do, they may get between moving parts and wear them out quickly or cause electrical shorts. Because of the danger of electrical shorts, *never use* emery cloth or steel wool around electrical equipment because both are electrically conductive. If you have to abrade around equipment or other weapons, use a drop cloth. When you must file or abrade parts and assemblies that are machined to close tolerances, do so only to the extent necessary. Never wire-brush or abrade corroded structural and other parts unless they can safely serve their original function. Use a fine-cut file or hard Arkansas stone to remove burrs and sharp edges from metal surfaces. Choose the abrasive for a particular job by determining how hard the material is and how smooth you want it. After you finish abrading, clean all abrasive metal or other particles from all areas.

## 407. Cleaning surfaces

Now that you understand the many different ways of cleaning, you can put these to use. Corrosion control and fungus growth are a constant battle because of the environments in which our weapons and equipment reside. Knowing the proper way to remove and protect surfaces will improve their lifespan and reduce further weapon or equipment damage.

### Clean corrosion from coated areas

Abrade the corroded area to clean the metal. If the corrosion covers a large area or is deep, remove most of the corrosion with a wire brush or stiff-bristle brush, and then abrade the surface. Wipe off the abraded surfaces with a clean, dry cloth and refinish the surface as necessary.

### Clean corrosion from uncoated areas

First, clean the corroded areas thoroughly with isopropyl alcohol or aerospace equipment cleaning compound. If this removes all signs of the corrosion, you can use the part without further cleaning. However, if any evidence of corrosion, such as pits, stains, and so forth still remains, remove most of the corrosion with a wire or stiff-bristle brush and then abrade the surface. Wipe off the abraded surface with a clean, dry cloth.

### Clean fungus growth

In a high-humidity area, you will probably have problems with fungus growing on surfaces. The next paragraphs cover how to clean fungus from various surfaces.

#### *Rubber surfaces*

To clean fungus growth from rubber surfaces on nonelectrical components, use a bristle brush, warm water, and a mild detergent to clean the contaminated surfaces. Rinse with clear water and then thoroughly dry the clean surfaces.

For rubber surfaces on electrical components, use the same procedures, but use isopropyl alcohol and a stiff-bristle brush to remove the detergent residue. Then, rinse thoroughly with isopropyl alcohol and allow to air dry or dry with pressurized gas.

#### *Unpainted metal surfaces*

Wipe the fungus from the affected area with a clean cloth moistened with aerospace equipment cleaning compound and water. Wipe the surface dry or let it air dry.

#### *Painted metal surfaces*

Visually check for damage to the paint. If there are streaks that you cannot remove or if you find pits, abrade the affected area with emery cloth. Abrade only enough to clean the metal surface. If the area of contamination is large, first brush the surface with a stiff-bristle brush and then abrade it with the emery cloth. Wipe off the abraded surface with a clean cloth moistened with isopropyl alcohol or other approved solvent. Refinish the sanded surface in accordance with TO 11N–35–51 or as the item's TO specifies.

### *Coated cloth*

To clean fungus growth from coated cloth, wipe the fungus from the affected area with a clean cloth moistened with aerospace equipment-cleaning compound and water. Wipe the surface dry or let it air dry.

### Cleaning preformed packings (O-rings)

When you clean O-rings, be careful not to stretch them. If the TO you are using tells you to clean a new preformed packing, briefly immerse it in item 42, isopropyl alcohol. Next, allow the excess alcohol to evaporate from the packing; then let the O-ring air-dry for at least 10 minutes before use. If you are cleaning a removed O-ring or a new one that has become contaminated following lubrication, wipe off the foreign material with a clean cloth moistened (damp, but not dripping) with toluene. Let it air-dry for at least 10 minutes before use. While cleaning some O-rings, they may leave a black residue; this is normal and you should not try to remove it further.

Besides cleaning O-rings, you must lubricate them properly before installation. Lubricate O-rings and elastomeric seals with a type of polyglycol grease, electrical insulating compound, or other material specified in the applicable weapon or item TOs. When you apply the lubricant, use care not to stretch the O-ring, and do not apply excessive amounts of lubricant. Apply a sufficient amount of lubricant to coat the seal completely with a thin film and give enough lubrication to the entire seal surface. Do not allow excess lubricant to contaminate other surfaces, and wipe off any excess when finished.

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## Self-Test Questions

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

### 406. General cleaning procedures

1. List the five guidelines that you must observe when you perform a cleaning procedure.

2. How do you clean something using the mechanical method?

3. When you clean with an electrically powered vacuum cleaner, what must you attach to the hose?

4. What items can you use to apply cleaning solvents?

5. When you clean with solvents in an area that will be sealed, what must you do?

6. What must you do after cleaning with detergent and hot water?

7. What should you use to clean off excess newly applied synthetic rubber sealing compounds?

8. Which abrasive cloth has the coarser surface, no. 180 grit or no. 240 grit?

9. What precaution should you take when you sand around a component?

10. What two abrading materials should you never use around electrical equipment? Why?

11. What do you use to remove burrs and sharp edges from metal surfaces?

### 407. Cleaning surfaces

1. How should you clean corrosion from coated surfaces?

2. How do you clean fungus growth from rubber surfaces (nonelectrical)?

3. What solution should you use to clean fungus growth from unpainted metal surfaces?

4. How do you clean painted metal with fungus pits in the paint?

5. How should you clean a new preformed packing (O-ring)?

6. How should you clean a contaminated new O-ring?

7. What should you be careful of when lubricating O-rings?

## 2–2. Preservation and Repair

In this section, you will learn how to pretreat metals and repair exterior containers and electrical cables. These procedures are common to our career field. Remember that the substances we are discussing are harmful and toxic—treat them accordingly. You can only use these procedures for paint touch-up; you cannot do complete surface refinishing at any time.

## 408. General surface preservation

This lesson contains procedures for preserving and repairing metal surfaces. These procedures are intended only for touchup or rework of scratched, dented, abraded, or otherwise damaged finishes and do not constitute authority to extend the repair beyond the immediate vicinity of the damaged area. Complete resurfacing is not authorized. Spray painting over minor surface scratches, blemishes, and stencils is authorized if all service-specific limitations and restrictions are observed. Spray painting includes the use of spray guns, air brushes, and approved aerosol cans. Other approved paint applications methods include painting by brush, roller, or dabbing. In addition, when the approximate air-drying times expire, the following conditions will exist:

- To touch: paint is still soft with solid surface film; it is dust dry and will resist a light touch.
- Dry-through: marking can be performed, but no hardware is to be attached.
- Full hardness: all routine procedures may be accomplished.

Organic finishes include primer coating and lacquer or enamel painting. Before applying any surface treatment or finish, use extreme care to prevent any materials from entering mating holes or other critical areas. Plug or cap openings where such surface treatment or finish is not desired. Areas not requiring surface treatment or finish may be masked out as desired.

### Unpainted aluminum preservation

Aluminum and aluminum alloy parts are treated with item 111, aluminum coating compound (also known as Alodine). This compound protects base metal from corrosion and is used primarily for touchup or rework of damaged or unfinished areas of a previously anodized surface. As a warning, aluminum coating compound contains hazardous chemicals, one of which causes cancer. Additionally, it is destructive to nonmetallic materials before and after mixing; therefore, make sure any waste generated containing this compound is disposed in plastic bags with water to reduce its hazardous properties (self-igniting).To apply, perform the following procedures:

1. Mix clean water and Alodine in a ratio recommended by the manufacturer.
2. Wet sand the surface to be refinished using a medium- or fine-grade aluminum oxide or silicone carbide cloth.
3. Thoroughly rinse the surface area with a clean water or wipe with a clean cloth saturated with water.
4. Apply liberal amounts of Alodine while the surface is still wet from the water rinse. Tissue may be used to cover the affected areas while wetting surfaces and applying the Alodine.
5. Allow the solution to set for 1 to 5 minutes before continuing.
6. Wipe the surface area with a clean cloth wet with water, or rinse with clean water before Alodine solution dries. The cloth or paper wipes used may be flammable if the solution is allowed to dry. Be certain you rinse the cloth or paper wipes thoroughly with water immediately after use.
7. Allow the surface area to air dry. For rapid drying, wipe the surface area with a clean, dry cloth or use item 235, pressurizing gas, to blow moisture from the joints and recesses.

If the aluminum was properly treated with the Alodine solution, it should have a thin, iridescent, golden coating. The coating is usually hard and free from powder if the solution was properly mixed and applied. Streaks resulting from brushing and “rundown” of excess solution are acceptable; however, excessive streaking indicates a surface was not properly cleaned before the treatment.

You may have Alodine applicators, which are specialized items for brushing on Alodine. When using these, ensure that you prepare the damaged surface the same as above; however, use these steps for applying the Alodine:

1. Ensure you do not twist or turn the cap because it will cause the applicator to leak. Also, make sure, while using the applicator, that you put the cap back on to reduce the possibility of contamination and evaporation.
2. Hold the applicator upright and remove the cap.
3. Gently press the tip down onto the surface until the Alodine solution fills the applicator tip.
4. You may have to rewet the applicator tip to maintain a consistent coating.
5. Brush in one direction, and make sure you apply the coverage in smooth and even overlapping strokes that cover the entire area to be treated.
6. Within 5 minutes, and apply a second coat with overlapping strokes at a 90° angle to your first application.
7. Allow the entire coating to air dry thoroughly.

### Steel preservation

Cadmium or zinc-plated steel surfaces with scratches, abrasions, or other defects that expose bare metal require repair. Perform the following procedures when repairing cadmium or zinc-plated steel.

1. Clean the surface area by abrasion using a medium-grade abrasive (240–320 grit sandpaper).
2. Thoroughly clean the damaged surface area with item 551, toluene.
3. Allow the surface to air dry completely or use item 235, pressurized gas.
4. If the damaged area does not exceed approximately ¼ in. in diameter, omit the metal pretreatment coating.

If the damaged area exceeds the approximately ¼ in. diameter, proceed with the pretreatment coating. Prepare and apply item 117, metal pretreatment coating compound, IAW instructions supplied in the kit. If the instructions are not available, perform the following steps to prepare and apply the coating:

1. First, the relative humidity shall not exceed 80 percent when preparing and applying the metal pretreatment coating compound. Next, prepare the metal pretreatment coating compound by using the acid-resin kit in a ratio of 80 percent (by volume) of resin compound and 20 percent (by volume) of acid component.
2. Stir the resin component thoroughly before mixing. While stirring continuously, slowly add the acid component to the resin component. The pot life of the metal pretreatment coating compound is limited; therefore, you must use it within 8 hours after adding the acid component to the resin component.
3. Thinning is usually required to obtain a uniform, thin, wet film of metal pretreatment coating compound. This minimizes the “string” or cobweb” effect. To do this, add item 42, isopropyl alcohol, to thin the coating for the required consistency.
4. Finally, apply one light, uniform coat of metal pretreatment coating compound to the surface of the item you are repairing.

Once complete, and depending on the direction of the TO, an organic finish will need to be applied to properly preserve the repaired surface area.

## 409. Repairing metal containers, electrical cables, and other materials

You can make certain repairs to metal containers, electrical cables, plastics, fabrics, and other materials. TO 11N–35–51 gives you both the procedures and the limitations to these repairs. In this lesson, we will primarily focus on repairing metal containers and maintaining electrical cables.

### Reusable metal container repair

The interior and exterior metal containers discussed here are those reusable, standard steel shipping containers ranging from 4- to 19-gallon sizes. Because of the welded construction of these containers,

all dents are repairable except those along the sealing lip or side seam (fig. 2–1). You may repair dents in the cover if the repairs do not distort or impair the cover so that it will not mate with the container. If removal of a dent results in a distortion, reject the cover.

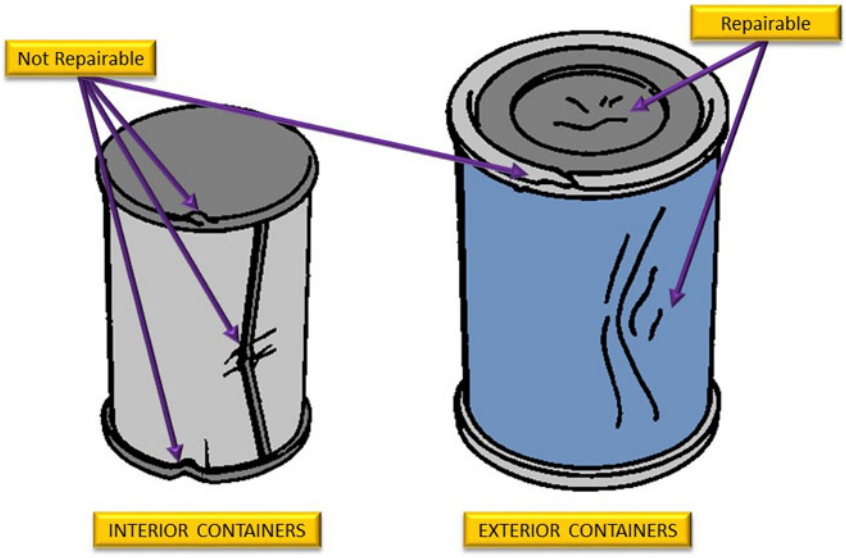


**Figure 2–1. Identifying damage to containers.**

Pound out the dents in the containers or cover them to within ⅛ in. of the original contour, using proper tools and following good commercial practices. Remove rust from the container as applicable and repaint immediately. After completing any repairs near the container lip or container lid, check to see if the lid mates to the container properly. Do this by fitting the lid with the proper gasket and installing it on the container with the locking ring. Reject covers that do not fit. Small dents in the locking ring impair the uniform clamping pressure and subsequent proper sealing, and are reason to reject the ring.

### Electrical cable maintenance

TO 11N–35–51 gives you procedures for maintaining and repairing various types of electrical cables. The main two types of repairs we discuss are silicone jacket and black synthetic rubber (neoprene) insulation repair. The following are some limitations to what should and should not be repaired for both types of repairs:

- Damage to sleeving that also involves damage to wire insulation beneath the sleeving is not repairable.
- Rips and tears in cable sleeving exceeding 2 in. long are not repairable. Radial tears (regardless of length) extending over three-fourths of the total periphery of the sleeving are not repairable.
- Damaged areas of sleeving within 6 in. of each other (or within 6 in. of previously repaired areas) are not repairable.
- Damage that will necessitate cable re-marking is not repairable if no marking facilities are available.
- For neoprene cables, damage to insulation that also involves damage to conductors is not repairable if the number of broken or cut conductors exceeds the acceptable limits in the following table:

| TOTAL NO. OF STRANDS IN CONDUCTOR | ACCEPTABLE LEVEL OF STRAND BREAKAGE |
|---|---|
| 1 to 6 | 0 |
| 7 to 16 | 1 |
| 17 to 26 | 2 |
| 27 to 36 | 3 |
| 37 to 46 | 4 |
| more than 46 | 10% of total |

### *Silicone jacket repair*

You repair damaged silicone jacket by bonding the cut surfaces together with silicone compound or by covering the damaged area with silicone jacket secured with silicone adhesive. First, select silicone jacket of the correct diameter, and cut to the length to cover the damaged area plus ¼ in. on each side. Slit the jacket lengthwise so you can get it over the cable. Clean the cable surfaces with technical acetone. Slide the jacket on the cable and bond it to the cable with the proper adhesive. Make sure you position the silicone jacket over the damaged area so that it extends approximately ¼ in. on either side of the damaged area and so that the lengthwise slit in jacket is on the opposite side of damaged area. Re-mark the cable as necessary.

### *Black synthetic rubber (neoprene) insulation repair*

You repair damaged neoprene insulation by covering the damaged area with electrical insulation tape. Ensure that you are not exceeding any broken or cut conductor strand limits, per specific manual or TO 11N–35–51 (see above table). Clean the area to be repaired with aerospace equipment-cleaning compound and water or isopropyl alcohol. Allow sufficient amount for cleaning material to evaporate until the material is dry. Starting and finishing at least ½ in. to both sides of the damaged area, wrap electrical tape securely in a spiral fashion over the damaged area. You need to make sure that each spiral overlaps approximately one-half of the previous wrap width. Finally, you need to re-mark the cable if necessary.

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## Self-Test Questions

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

### 408. General surface preservation

1. When an item is dried to a dry-through, what procedures are allowed to be performed?

2. What hazards are associated with using item 111, aluminum coating compound Alodine?

3. What may be used to cover the affected area while wetting surfaces and applying Alodine?

4. While using an Alodine applicator how do you apply a second coat and when?

5. When preparing the metal pretreatment coating compound, what is the recommended ratio for the acid-resin kit?

### 409. Repairing metal containers, electrical cables, and other materials

1. Where are you allowed to repair dents in a container?

2. When you are repairing dents in standard steel shipping containers, how closely must the repair match the original contour if it is pounded out?

3. After repairing the container lip or lid, how do you check to see that the lid mates to the container properly?

4. What are the main two types of cable repairs?

5. Explain the limitation on radial tears when repairing cables.

6. You are repairing a black synthetic rubber (neoprene) insulated cable and discover that two of the 15 conductor strands in the cable are broken. Is it repairable? Why or why not? Use figure 2–2 to answer this question.

7. When repairing silicone jackets, what material do you use to clean the cable?

8. When repairing black synthetic rubber (neoprene) insulation, how far must you start and stop the tape repair from both sides of the damaged area?

## Answers to Self-Test Questions

### 406

1. (1) Ensure you do not damage the item during cleaning.
   (2) Ensure you remove fingerprints from critical surfaces of items.
   (3) Ensure you accomplish all cleaning procedures that could invalidate inspection or test results before the inspection or test.
   (4) Remove fibers, lint, and other residue from cleaning and drying materials from the item.
   (5) Do not disassemble weapon beyond the level of required maintenance for cleaning.

2. Use a knife, scraper, or other suitable tool that will not damage the component and carefully scrape or peel off the foreign material.
3. A nonconductive wand or extension (plastic, rubber, or similar material).
4. A clean cloth, disposable paper wipes, cotton swabs, or a bristle brush moistened (damp, but not dripping) with cleaning solvent.
5. Ensure that the solvent dries completely before you close or seal the space.
6. Rinse or wipe the area with clean water and dry the area completely.
7. Use toluene (technical) before the compounds cure.
8. No. 180 grit. The higher numbers represent the finer surfaces.
9. Always take care that particles caused by abrasion don't enter or fall into the item.
10. Emery cloth or steel wool because of the danger of electrical shorts since they are both electrically conductive.
11. A fine-cut file or hard Arkansas stone.

**407**

1. Abrade the corroded area to clean the metal. If the corrosion covers a large area or is deep, remove most of the corrosion with a wire brush or stiff-bristle brush, and then abrade the surface.
2. Use a bristle brush, warm water, and a mild detergent to clean the contaminated surfaces. Rinse with clear water and then thoroughly dry.
3. Wipe the fungus from the affected area with a clean cloth moistened with aerospace equipment cleaning compound and water. Wipe the surface dry or let it air dry.
4. Abrade the affected area with emery cloth. Abrade only enough to clean the metal surface. If the area of contamination is large, first brush the surface with a stiff-bristle brush and then abrade it with the emery cloth. Wipe off the abraded surface with a clean cloth moistened with isopropyl alcohol or other approved solvent.
5. Briefly immerse it in isopropyl alcohol. Let the excess alcohol evaporate from the packing; then let the O-ring air-dry for at least 10 minutes more before use.
6. Wipe it with a clean cloth moistened (damp, but not dripping) with toluene.
7. Use care not to stretch the O-ring and don't apply excessive amounts of lubricant.

**408**

1. Markings can be performed, but no hardware can be attached.
2. Hazardous chemicals, one that causes cancer in humans. It is also self-igniting.
3. Tissue.
4. Within 5 minutes, and apply a second coat with overlapping strokes at a 90° angle to your first application.
5. 80 percent (by volume) of resin compound and 20 percent (by volume) of acid component.

**409**

1. All dents are repairable except those along the sealing lip or side seam.
2. To within ⅛ in. of the original contour.
3. Do this by fitting the lid with the proper gasket and installing it on the container with the locking ring.
4. Repairing silicone jackets and black synthetic rubber (neoprene) insulation.
5. Radial tears (regardless of length) extending over three-fourths of the total periphery of the cable are not repairable.
6. No, because according to the permissible broken strands table in TO 11N–35–51, a cable with 15 total strands is only allowed to have one broken.
7. Technical acetone.
8. ½ in.

**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.

25. (406) Which is a guideline to observe when selecting a suitable cleaning agent?
    a. You must use the list of cleaning materials in technical order (TO) 11N–35–51A without exceptions.
    b. Alternate cleaning agents are not required to meet the equivalent listed in TO 11N–35–51A.
    c. You may substitute disposable paper wipes for a clean cloth when cleaning and drying.
    d. Cotton swabs and tongue depressors have a wide range of substitutes in TO 11N–35–51A.

26. (406) An electrically powered vacuum cleaner is authorized for use on nuclear weapons as long as
    a. the vacuum is grounded through the facility ground using an approved grounding strap.
    b. it has a federal stock code of 85103, nuclear weapons-approved electrical equipment.
    c. a nonconductive wand or extension is attached to the hose.
    d. the vacuum uses a three-prong plug (hospital type).

27. (406) What should you do *after* cleaning a weapon with detergent and hot water?
    a. Wipe dry with two clean, lint-free cloths only.
    b. Rinse or wipe with alcohol and dry completely.
    c. Rinse with any suitable solvent and wipe dry only.
    d. Rinse or wipe with clean water and dry completely.

28. (406) If the technical order (TO) directs using the finest grit sandpaper, you would use
    a. 80 grit.
    b. 180 grit.
    c. 220 grit.
    d. 260 grit.

29. (407) To clean fungus growth from nonelectrical rubber surfaces, use a
    a. piece of wet emery cloth to abrade the surface.
    b. bristle brush with warm water and mild detergent.
    c. solution of germicidal and fungicidal disinfectant.
    d. clean cloth moistened with aircraft cleaning compound.

30. (407) What chemical do you use to clean new preformed packing?
    a. Technical toluene.
    b. Technical acetone.
    c. Isopropyl alcohol.
    d. Aircraft soap.

31. (407) What chemical do you use to clean a removed O-ring that was contaminated following lubrication?
    a. Toluene.
    b. Acetone.
    c. Aircraft soap.
    d. Isopropyl alcohol.

32. (408) What type of air-drying condition exists when paint is still soft with solid surface film?
    a. Semi-hardness.
    b. Full hardness.
    c. Dry through.
    d. To touch.

33. (408) What type of air-drying condition exists when markings can be performed, but no hardware can be attached?
    a. Semi-hardness.
    b. Full hardness.
    c. Dry-through.
    d. To touch.

34. (408) What type of air-drying condition exists when *all* routine procedures may be accomplished?
    a. Semi-hardness.
    b. Full hardness.
    c. Dry through.
    d. To touch.

35. (408) In order to preserve unpainted aluminum, the ratio of item 111, aluminum coating compound (also known as Alodine) to water is as recommended by
    a. the weapon-specific technical order (TO).
    b. weapons system engineers.
    c. the military specifications.
    d. the manufacturer.

36. (408) When preserving unpainted aluminum, what may be used to cover the affected area while wetting surfaces and applying Alodine?
    a. Tissue.
    b. Foam.
    c. Plastic.
    d. Cloth.

37. (408) In order to preserve steel, what is the standard to follow before proceeding with the application of metal pretreatment coating?
    a. Receive direction from an unsatisfactory report (UR) response.
    b. Damaged area must exceed weapon-specific guidance.
    c. Damaged area must exceed ¼ inch (in.) in diameter.
    d. Pretreatment coating can be applied anytime.

38. (408) In order to prepare the metal pretreatment coating, what is the ratio, if any, of the acid-resin kit?
    a. 20 percent (by volume) of resin compound and 80 percent (by volume) of acid component.
    b. 80 percent (by volume) of resin compound and 20 percent (by volume) of acid component.
    c. 50 percent (by volume) of resin compound and 50 percent (by volume) of acid component.
    d. There is no ratio recommendation for the acid-resin kit.

39. (408) What is the pot life of the metal pretreatment coating compound once the acid component is mixed with the resin component?
    a. 8 hours.
    b. 12 hours.
    c. 24 hours.
    d. Indefinite.

40. (409) A dent in a metal shipping container is repairable provided the dent is *not*
    a. on the sealing lip.
    b. on the bottom or top.
    c. over ⅛ inch (in.) in depth.
    d. under ¼ in. from a rivet head.

41. (409) You *must* pound out a dent in a metal shipping container or its cover to within what fraction of an inch of its original contour?
    a. $^{1}/_{16}$.
    b. $^{1}/_{10}$.
    c. $^{1}/_{8}$.
    d. $^{1}/_{5}$.

42. (409) What is the *maximum* length of a rip or tear in the insulation of an electrical cable that is repairable?
    a. 1 inch (in.).
    b. 2 in.
    c. 5 in.
    d. 10 in.

43. (409) Which is the *best* option concerning repair of radial tears of electrical cables?
    a. Radial tears are never repairable.
    b. Radial tears are always repairable regardless of length.
    c. Radial tears (regardless of length) extending over one-quarter of the total periphery of the cable are not repairable.
    d. Radial tears (regardless of length) extending over three-fourths of the total periphery of the cable are not repairable.

44. (409) When repairing black synthetic rubber (neoprene) insulation, how far *must* you start and stop the tape repair from both sides of the damaged area?
    a. ¼ inch (in.).
    b. ½ in.
    c. 2 in.
    d. 3 in.

**Please read the unit menu for unit 3 and continue ➔**

# Unit 3. Joining, Sealing, Packaging, and Markings



IN THIS UNIT, we'll discuss joining and sealing, which are common maintenance practices in your daily workcenter activity. These are routine practices and do not pertain to a specific weapon system. They are used on anything from a piece of handling equipment to a nuclear weapon. We will also discuss packaging and marking procedures for equipment and other items used during daily maintenance. We finish by discussing gas cylinders and some of the procedures that are used. The packaging and marking sections apply to specific items but you can use them as general guidelines for numerous other items.

## 3–1. Hardware Installation and Tightening to a Measured Torque

Fastening and joining usually refers to holding components and parts together with screws, bolts, studs, and so forth. You torque fasteners to be sure they are secured. You need to know how to select, set, use, and maintain torque wrenches or you will not get the right torque values on threaded fasteners. We will discuss installation of common hardware and torqueing as a means of fastening and joining components and parts.

### 410. General joining and sealing

You will find basic joining of parts and installation of bolts, screws, washers, nuts, and cotter pins in TO 11N–35–51. Weapon- or equipment-specific manuals will give you more detailed installation procedures. The following paragraphs discuss general terms and procedures used in standard hardware installation.

#### Install bolts, screws, washers, and nuts

Be sure to check all hardware before you install it. Certain guidelines apply when installing bolts, screws, washers, and nuts. The following are general requirements that apply to all hardware installation unless directed otherwise in accordance with tech data:

- When a weapon-specific document specifies the type of compound, apply the compound only to the bolt or screw. Use only a sufficient amount of compound to fill the "V" of the threads (fig. 3–1). After installing bolt or screw, remove the excess compound.

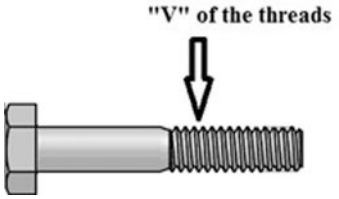



**Figure 3–1. "V" of the threads.**

- When the document specifies that you “finger-tighten,” use only finger force to tighten bolts, screws, or nuts. When the bolt or nut is not readily accessible, you may use an extension or adapter and finger force applied to the extension or adapter. You may not use an extra extension-leverage device for this operation. “Finger-tighten” is generally specified in applications where a part is to be held in position until other procedures are performed, after which further tightening is specified.
- When the document specifies that you “tighten securely,” use appropriate tools and moderate force to seat the bolt, screw, or nut firmly. A fastener is tightened securely if it has reached the point where an increase in torque does not result in additional turning of the nut or fastener head. If hardware installation includes a lock washer, tighten sufficiently to fully compress the lock washer. If doubt exists as to whether or not a steel fastener is properly tightened, use the torque values listed in TO 11N–35–51 as a guide.
- When installing hardware, make sure you use the right tool for the right job. TO 11N–35–51 has a cross-index of common hardware sizes to associated tool sizes. This index helps you to select the proper size tool for a given job.
- When you need to use a recessed washer, install the washer with the recessed side facing the head of the bolt or screw.

### Install cotter pins

Use cotter pins to secure bolts, screws, nuts, and pins. Some cotter pins are made of low-carbon steel, while others consist of stainless steel, and are more resistant to corrosion. Regardless of material, use all cotter pins for the same purpose—to prevent certain nuts and bolts from separating. When you install cotter pins through a castellated nut, use the lowest specified torque value, and tighten the nut until the hole in the shank aligns with the slot in the nut. If the alignment is not correct for cotter pin insertion, tighten the nut (without exceeding the torque specification) until the hole appears in the slot. Proper installation occurs when you align the cotter pinhole so that no more than one-half the diameter of the pin protrudes above the nut. If necessary, you may install a maximum of two washers under the nut to locate the cotter pin properly. Install the proper size cotter pin as shown in figure 3–2. Cut the prongs of the cotter pin as appropriate.

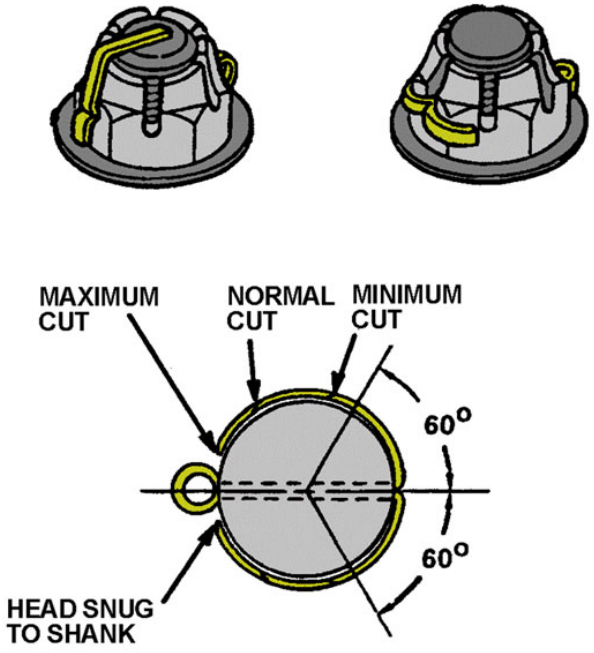



**Figure 3–2. Cotter pin installation.**

## 411. Torque tools

The use of a torque tool, commonly called the torque wrench, is not complicated. However, to use a torque wrench properly, the technician must possess and demonstrate a basic knowledge of the torqueing technique. To acquaint technicians, the following lesson will cover the inspection, preparation, usage, and maintenance of torque wrenches.

### Inspecting

Prior to performing any maintenance operation, the first thing you do is gather the tools necessary to complete an assigned task. This includes signing out torque wrenches from the weapons support section. Some inspection points to keep in mind are as follows:

- Ensure the torque wrench was stored to its lowest incremental torque value or mechanical stop, whichever comes first, upon initial issue from the tool counter.
- Review the certification label to ensure the calibration is still current and not expired. Make sure the label accurately reflects the identification number of the torque wrench. If the torque wrench has a special or limited calibration, make sure you sign or initial in the "user approval" block or "INI" block, to show acceptance of a given calibration.
- Ensure a permanently etched arrow is present on the barrel shaft of the torque wrench. Depending the calibration of the torque wrench, the arrow needs to reflect the direction in which the torque wrench was calibrated for (clockwise only or clockwise and counterclockwise).
- Torque wrenches normally have exposed calibration holes, which may be covered by the calibration activity. Be sure you cover these holes by either a torque seal, remelted fuse plug, lead tape, or a "NOTICE CERTIFICATION VOID WHEN SEAL IS BROKEN" label are acceptable for use. If not, you must remove the torque wrench from service and return it to the precision measurement equipment laboratory (PMEL). The fusible plug or lead tape could become a foreign object damage (FOD) hazard if chipped damaged or lost.

### Preparing torque wrenches

Prior to using any torque wrench that has a breakaway feature (including screwdriver-type torque drivers); the torque device must be cycled through the breakaway torque as recommended by the manufacturer's instructions. If the manufacturer's instructions are not available, then set the torque device to the maximum setting and cycle through the breakaway torque at least six times. You can accomplish this by the following (typical example):

1. Secure the square tang of the torque wrench in a smooth-jawed vise.
2. Cycle through as indicated by the manufacturer's instructions (or six times, if the manufacturer's instructions are not available).

You can perform this breakaway exercise at the beginning of a work shift or any time subsequent; however, it is not required more than once each shift (normally eight hours) on the specific torque wrench(es) to be used. The purpose of the breakaway procedure permits special internal lubricant to recoat internal working parts, eliminating internal resistance to give the most accurate reading possible.

**NOTE:** Large torque wrenches (150 foot-pounds [ft-lb] and over) may be exercised at the torque value they will be used, rather than their maximum setting.

### Using torque wrenches

The impulse-feel-type torque wrench (fig. 3–3) is the most commonly used torqueing device used in maintenance operations; therefore, the following procedures are common for most torque wrenches in the maintenance field:

1. Select the right torque wrench for the job. Unlock the torque wrench and adjust to the desired setting on the scale, then relock. Once locked, ensure the team chief verifies the setting before continuing on to the next step.
2. Install the required attachment on the square drive of the handle. Note the direction of the permanently etched arrow(s) on the torque wrench; this is the calibrated direction(s) of the torque wrench.
3. Place the wrench assembly on the fastener to be torqued, and pull with a smooth and steady motion. (**NOTE:** A fast or jerky motion will result in an improperly torqued fastener.)
4. When the torque applied reaches the predetermined torque setting of the handle, the handle will automatically release or "break" resulting in approximately 5 degrees (°) to 10° free travel. This release is distinct and is easily detected by the user. This completes the torqueing action on the fastener.

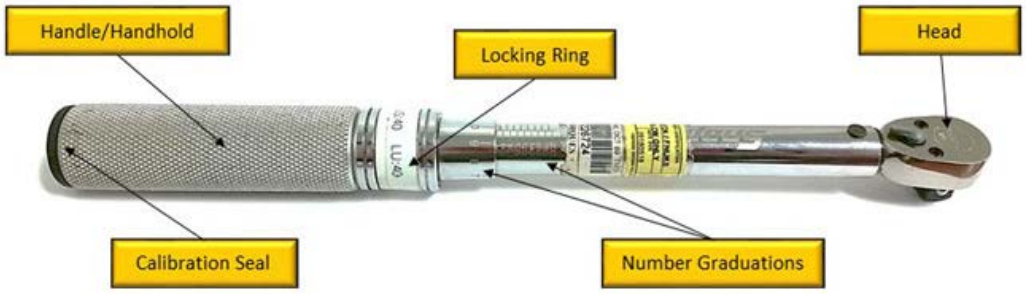



**Figure 3–3. Impulse-feel torque wrench.**

## Maintaining torque wrenches

Handle any item designated as test, measurement, and diagnostic equipment (TMDE) as "delicate instruments" regardless of outer physical appearance. The following list contains guidelines to follow to make sure you maintain torque wrenches properly throughout their calibration cycle:

- Handle all items of TMDE individually unless the item's size and physical characteristics allow it to be held in one hand. TMDE that is too heavy or awkward for one person to handle may require team lifting or mechanical assistance.
- Avoid metal-to-metal contact with TMDE items unless it is contained in a protective case**.**
- Do not make any wrench adjustments to settings lower than the equivalent of one incremental division lower than the lowest torque setting on the wrench assembly.
- Do not exceed applied torque on a wrench beyond the breakaway torque to which the wrench is adjusted. Do not use a torque wrench to apply a greater amount of torque than the rated capacity of the tool.
- When an adjustable value torque wrench is stored or removed from service, set it to its lowest incremental torque value or mechanical stop, whichever comes first. Use extreme care when changing the setting to the lowest increment reading on the wrench to prevent shearing of internal stop pins and possible disengagement of internal mechanisms.
- Do not use torque wrenches to break loose previously tightened nuts and bolts unless the torque wrench used is especially designed for this purpose.
- Do not use universals and universal sockets for final torque unless specifically directed by TO or if the universal is permanently attached when the torque wrench is calibrated. Torque applied using a universal at varying angles will apply incorrect torque on affected hardware.
- Store all TMDE on shelves or racks unless physical characteristics prevent this type of storage. You may store case-contained TMDE on metal or wooden shelving without further

protection. If not, protect TMDE from damage by using suitable containers and appropriate padding.

- Above all, remove TMDE from service if it has been subject to overloading, mishandling, gives suspected results, or is otherwise determined to be defective. Promptly return the TMDE to weapons support (or the responsible work center) to prevent further use and for repair or recalibration.

## 412. General torque procedures

It is important that you torque items properly. Over or under torqueing a fastener can cause the fastener or the assembly to fail. Engineers have developed the correct amount of torque for each part of an assembly during the design process to ensure its proper operation. Anything outside of the specifications would most likely result in a failure of the assembly. Therefore, it is extremely important that the proper torque is applied and in the correct order if there are multiple fasteners. Other general requirements include these:

- Whenever a torque value is required to tightening a screw, nut, or bolt during the assembly of components, it is usually specified at the appropriate location in the TO.
- When no torque value is specified, the torque values in TO 11N–35–51 may be used as a guide as referenced in the below table.

| BOLT SIZE [1] (Fine Thread Series) | TORQUE [2] in–lb | BOLT SIZE [1] (Coarse Thread Series) | TORQUE [2] in–lb |
|---|---|---|---|
| 8-36 | 12-15 | 6-32 | 6-8 |
| 10-32 | 20-25 | 8-32 | 12-15 |
| 1/4-28 | 50-70 | 10-24 | 20-25 |
| 5/16-24 | 100-140 | 1/4-20 | 40-50 |
| 3/8-24 | 160-190 | 5/16-18 | 80-90 |
| 7-16-20 | 450-500 | 3/8-16 | 160-185 |
| 1/2-20 | 480-690 | 7/16-14 | 235-255 |
| 9/16-18 | 800-1000 | 1/2-13 | 400-480 |
| 5/8-18 | 1100-1300 | 9/16-12 | 500-700 |
| 3/4-16 | 2300-2500 | 5/8-11 | 700-900 |
| 7/8-14 | 2500-3000 | 3/4-10 | 1150-1600 |
| 1-14 | 3700-5500 | 7/8-9 | 2200-3000 |
| 1 1/8-12 | 5000-7000 | 1-8 | 3700-5000 |
| 1 1/4-12 | 9000-11000 | 1 1/8-8 | 5500-6500 |
| | | 1 1/4-8 | 6500-8000 |

[1] Bolt and/or nut material: Steel (cadmium plated). Nut (if used) style: self-locking or castellated

[2] For shear nuts (thin, flat nuts), approximately 60 percent of the torque value specified

- Ensure that the nut, bolt, or screw is fully seated before applying final specified torque. Do not tighten the nut, bolt, or screw *close* to the required torque prior to applying torque. Also, the ratcheting feature of a torque wrench may be used for tightening and torqueing operations.
- For tightening nuts that compress gaskets, seals, or packing, measure torque only at the time of installation. Measurement of torque subsequent to assembly is limited to ascertaining that minimum torque exists (nominal torque value minus bracketed range or lowest value of torque range).

- The accuracy of applied torque is dependent on your grip placement on the torque wrench handle. You need to grip the center of the torque wrench handle. Keep in mind, when using Method III (see below), that you take the measurement from the center of the torque wrench drive and the center of the torque wrench handle. Placing your hands anywhere but the center of the handle will result in an inaccurate torque.
- While holding a torque wrench, apply force to the torque wrench handle by pulling slowly and with steadily increasing force (fig. 3–4). When torqueing bolts installed with nonfixed nuts, restrain the bolt or nut from turning and apply torque.

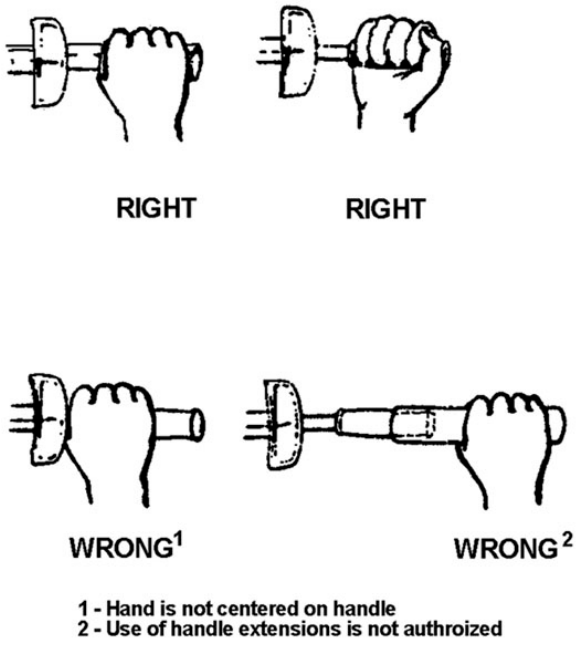



**Figure 3–4. Right and wrong ways to hold a torque wrench.**

- When tightening or measuring breaking torque with a single-action torque wrench (one that gives a torque indication in only one direction), torque only in the direction for which it is designed. Apply force by pulling. If pushing is the only way, use extra caution since applying force by pushing may cause loss of control and slippage, resulting in personal injury.
- When using a single-acting torque wrench, make sure the wrench is installed properly so that the torque indication is obtained when using the wrench in a clockwise direction (for applying torque on right-handed threads) or in a counterclockwise direction (for applying torque to left-handed threads).
- Select the proper wrench so that the torque value to be applied is not within the lower 20 percent of the full-scale value. For example, do not use a 0 to 200 inch-pound (in-lb) torque wrench for torque values less than 40 in-lb, and do not use a 100 to 750 in-lb torque wrench for torque values less than 150 in-lb.

### Method III (using calculations)

You use this method to obtain a specific torque by calculation. It is the mathematical relationship between the indicated torque (torque wrench setting or indication) and applied torque (required by tech data) expressed by the following formula:

$$Indicated\ torque = \frac{\mathrm{L}}{(\mathrm{L}+\mathrm{A})} \times T\ (\text{applied torque})$$

Points of reference for measuring L (length of the torque wrench), A (length of the adapter), and L+A are the center of the torque wrench handle, the center of the torque wrench square drive, and the center of the adapter head where torque is applied to the nut, bolt screw, and so forth (fig. 3–5).

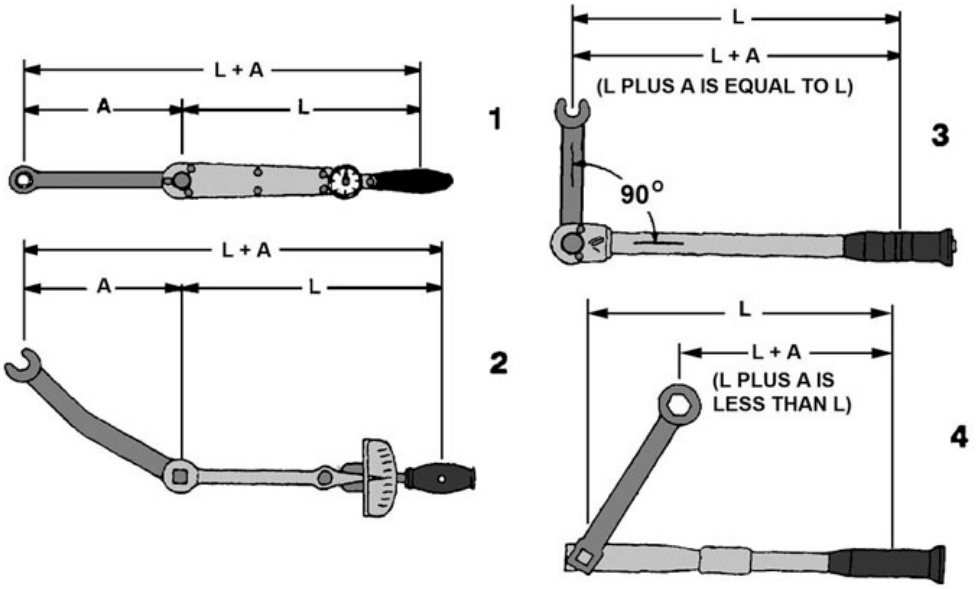



**Figure 3–5. Measuring points of torque wrenches with various adapters.**

For example, you must apply torque to a bolt to 60 in-lb. You are doing this with a dial-type or beam-type torque wrench. The torque handle L is 12 in. (measured from the center of the handle to the center of the male socket holder) and A is 8 in. (measured from the center of the female socket holder to the center of the broached opening). Find the torque setting (S) this way:

Start by substituting measurements and the setting in the appropriate place in the formula.

$L = 12$

$A = 8$

*Applied torque* = 60

$$\frac{12}{(12+8)} \times 60 \quad \rightarrow \quad \frac{12}{(20)} \times 60 \quad \rightarrow \quad 0.6 \times 60 = 36$$

After determining the correct torque, round the decimals to the nearest whole number. Round up when 0.50 or higher. Round down when 0.49 or lower. In this case, there were not any decimals, and your torque wrench setting would be 36.

Click-type, impulse-feel torque wrenches change their length when you adjust the torque setting. Therefore, the procedures are little different. You must first set the torque wrench to the applied torque setting found in the TO. Perform the formula for calculating the new torque setting with the adapter. Once you get that setting, adjust the torque wrench to match. Now, recalculate with the formula using the new length of the torque wrench. This final torque wrench setting will be the one utilized for applying the torque to the fastener.

### Torque conversion

Sometimes torque will be expressed in ft-lb and your torque wrench reads in in-lb. You can do this conversion easily by a simple mathematical method, or for some torques, you may use the torque conversion table in TO 11N–35–51 as represented in the following table.

| in–oz | in–lb | ft–lb |
|---|---|---|
| 1 | | |
| 4 | 1/4 | |
| 8 | 1/2 | |
| 16 | 1 | |
| 96 | 6 | 1/2 |
| 192 | 12 | 1 |
| 384 | 24 | 2 |
| 576 | 36 | 3 |
| 768 | 48 | 4 |
| 960 | 60 | 5 |
| | 72 | 6 |
| | 84 | 7 |
| | 96 | 8 |
| | 108 | 9 |
| | 120 | 10 |

To convert ft-lb to in-lb, multiply the specified torque (in ft-lb) by 12. For example, you are to torque a bolt at 75 ft-lb and your torque wrench reflects in-lb. To solve this problem, multiply 75 by 12 (equals 900 in-lb). To convert in-lb to ft-lb, simply reverse the procedures. You divide the specified torque (in in-lb) by 12, yielding the answer in ft-lb. Round any decimals to the nearest whole number that does not exceed the maximum torque.

Another conversion that you may have to make is inch-ounces (in-oz) to in-lb. In this case, you can also refer to the table in TO 11N–35–51. However, if you have to convert mathematically, divide the torque in in-oz by 16 for the equivalent torque in in-lb. If the required torque is 192 in-oz, what is the torque in in-lb? Divide 192 by 16, which results in a torque of 12 in-lb.

Again, round any decimals to the nearest whole number not exceeding the maximum torque. If you have any trouble converting torque, do not take a chance that it is incorrect—immediately ask your team chief for assistance in determining the correct torque.

## Self-Test Questions

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

### 410. General joining and sealing

1. If the TO specifically calls for a compound to be applied to a screw or bolt, how do you apply it?

2. What does “finger-tighten” mean?

3. What does “tighten securely” mean?

4. When you need to use a recessed washer, how is it installed?

5. What do you do if the hole of the bolt does not line up with the slot in the nut, when installing cotter pins?

## 411. Torque tools

1. While inspecting a torque wrench, what setting should the torque wrench be upon initial issue from the tool counter?

2. What do you review the certification label for while inspecting a torque wrench?

3. How are the torque wrench calibration holes covered?

4. If the manufacturer's instructions are not available, how are torque wrenches prepared for use?

5. What is the purpose of the breakaway exercise for all torque wrenches?

6. What will occur once a torque wrench reaches its predetermined torque setting?

7. How are torque wrenches stored in a metal drawer?

8. How far beyond the lowest setting are users allowed to make torque wrench adjustments?

9. How do you set a torque wrench removed from service?

10. When applying the final torque are you able to utilize a universal joint or universal socket? Why?

## 412. General torque procedures

1. What would happen if you do not torque a fastener to the correct amount?

2. What should you use when no torque value is specified?

3. What should you ensure before applying final specified torque?

4. Where will you position your hand on the handle of the torque wrench?

5. What should you keep in mind when you *have* to push on a torque wrench?

6. What is the usable range of a torque wrench with a torque range of 30-200 in–lb?

7. You're to torque a nut to 325 in-lb using a 6 in. adapter and a dial-type torque wrench (your wrench and extension are set up as shown at the top of fig. 3–6). Your torque wrench handle is 18 in. long. Use Method III and calculate what the setting should be on the wrench.

8. The TO indicates you are to torque a bolt to 175 ft-lb. Your torque wrench only reads in in-lb. What should the torque wrench setting be?

9. You must torque a bolt to 2,340 in-lb. What should you set on a torque wrench that reads in ft-lb?

## 3–2. Safety—Wiring and Bonding

In this section, we will cover how to safety wire and bond materials together. You will learn basic safety wiring procedures, how to inspect and store sealant, how to prepare surfaces for bonding, and how to stake items in multiple ways.

### 413. General safety wiring

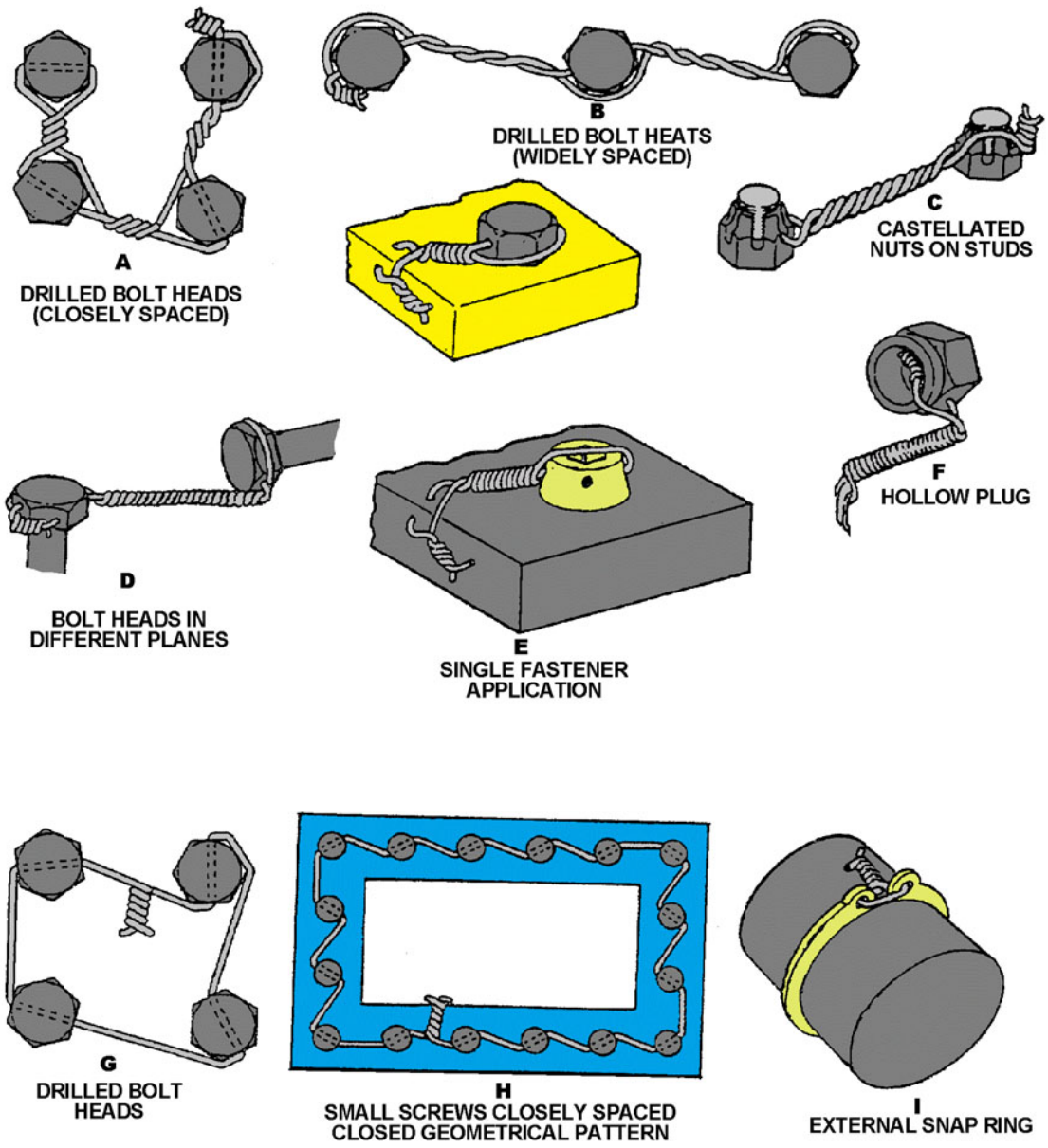
Safety wiring is a method of securing removable fastenings, other than self-locking types, to prevent loosening by vibration. Always install safety wire so that any loosening of the fastener will be overcome by the tightening of the wire (fig. 3–6). Below are additional guidelines:

- Two types of safety wiring methods are used:

  (1) The double-twist method, in which two strands of wire are twisted together between each connected unit.

  (2) The single-wire method, in which a single strand of wire is connecting a closed group of units and is twisted only at the ends. When practical, double-twist method is preferred.

- Use of the single-wire method is limited to groups of similar units in a closed geometrical pattern (square, rectangle, triangle, circle, etc.) on parts in electrical systems or in places where the double-twist method is not practical.




A THROUGH F SHOW DOUBLE-TWIST METHOD OF SAFETY WIRING
G THROUGH I SHOW SINGLE-TWIST METHOD OF SAFETY WIRING

**Figure 3–6. Safety wiring.**

## Standard procedures

The following standard procedures pertain to safety wiring:

- Always install safety wire so that any tendency of a unit to loosen will be restricted by an additional tightening of the wire. Ensure you install the safety wire in reverse if the bolt or screw has left-hand threads.
- Unless otherwise specified, use item 607 or 608, corrosion-resistant steel wire (0.020 or 0.032 in. diameter respectively).
- When wiring by the single-wire method, use the largest nominal-size-diameter wire of specified material that the hole will accommodate.

- Do not reuse wire after you remove it from a part.
- When safety wiring components in tight assemblies, end the wire at any convenient location. In all cases, make sure that the wire and wire ends will not interfere with any moving parts.
- When twisting wire, use the following guidelines:
  - Use approximate number of twists per in. as indicated below and ensure twists are within approximately $^1/_8$ in. of each safety wire hole. A twist is defined as the rotation of two crossed strands of wire through 180°.

| Wire Diameter (in.) | Twists per in. |
|---|---|
| 0.020 (item 607) | 9–12 |
| 0.032 (item 608) | 7–10 |

  - Pull wire sufficiently taut to minimizing chafing and fatigue caused by vibration; however, make certain that the wire is not overstressed.
  - Avoid kinks, and other abrasions to the wire surface, except those caused by commercial wire-twisting pliers.
  - If pliers are used, those with smooth jaws are recommended.
  - Exercise care to avoid damaging adjacent components or electrical wiring with pliers.
- Always install safety wire through the holes provided. If no holes are provided, safety wire to a convenient adjacent part, making sure the wire does not interfere with the function of that part.
- When safety wiring multiple groups using the double-twist method, three units shall be the maximum number in a series. A maximum of 6 in. between each unit will be adhered to.
- When safety wiring multiple groups using the single-wire method, the maximum number of units in a series shall be the number of units that can be safety wired by a 24 in. length of wire.
- After safety wiring the final unit, twist pigtail approximately ½ in. long (3 to 7 twists), and bend pigtail back or under to prevent snagging.

## Safety wiring threaded fasteners

There are several methods of installing safety wire on various types of threaded fasteners and hardware. The following procedure is a typical example and may not reflect an actual maintenance situation. We discuss each of the methods below:

### *Double-twist method*

The double-twist method is preferred where practical. It involves twisting two strands of wire together between each pair of connected items. A twist is the rotation of two crossed wires through 180°. Use the following procedures to use the double-twist method:

1. Assemble the unit by torqueing the bolt or screw. If the unit has a castellated nut use the lowest specified torque value until the hole in shank aligns with the slot in nut (without exceeding torque specification) until hole appears in slot.
2. Insert the wire through the first unit and route the free strand either around or over the unit.
   a) If the free strand is routed around the unit, make sure the wire is twisted so that the free strand crosses under the strand protruding from the hole, thus preventing the free strand from forming a slack loop by slipping up over the unit.
   b) If the free strand is routed over the unit, the direction of twist is not important. Always use this method when safety wiring tapered bolt heads or castellated nuts, no exceptions.

If the stud protrudes beyond the top of the castellated nut, route the free strand over the nut and alongside the protruding stud.

3. While holding the strands taut, twist to within approximately $^{1}/_{8}$ in. of each unit safety wire hole. If the free strand is to be routed around the second unit, make sure it crosses under the strand that enters the hole of the second unit.
4. After the final unit has been wired, twist a pigtail approximately ½ in. and bend it back or under to prevent snagging.
5. Figure 3–7 shows the correct method of safety wiring in the double twist method. Figure 3–8 shows some common mistakes with both double twist and single wire, which we discuss next.

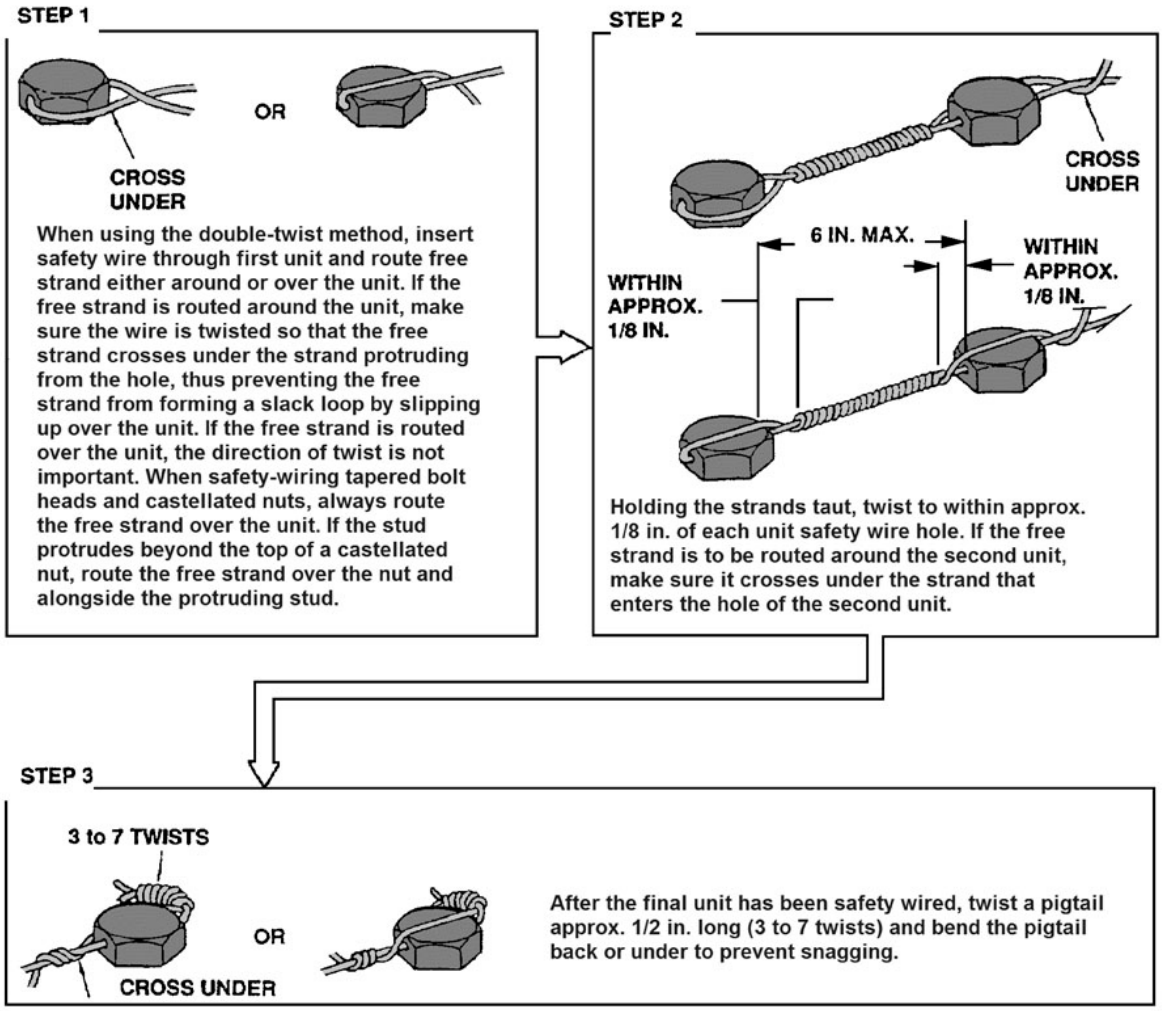



**Figure 3–7. How to install safety wire.**

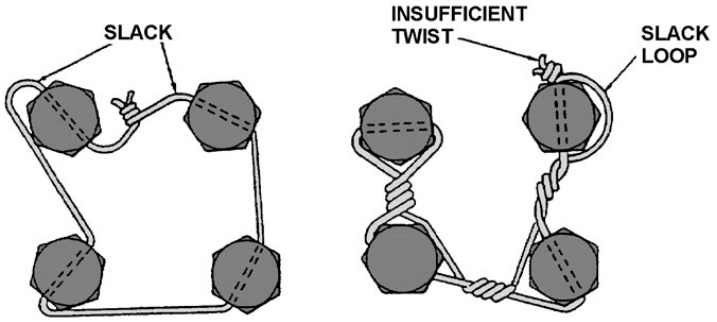



**Figure 3–8. Incorrect safety wiring.**

### *Single-wire method*

This method involves using a single wire to connect a group of fasteners, twisting occurs at the starting and ending point. It is limited to groups in a geometric pattern, such as a square, rectangle, or circle or where the double-twist method is not practical. Use the following procedures to use the single-twist method:

1. Assemble the unit. Torque all bolts or screws in the series.
2. Pass the safety wire through the series of drilled units, making sure that the tension of the wire is applied in direction of torque of each unit.
3. Ensure the wire returns to the original starting point in order to form a pigtail at the end.

## Safety wiring AN- and SA-AN-type connectors

There are some common procedures for all AN- and SA-AN-type connectors. The external components of these type of connectors are provided with holes for safety wiring. Before safety wiring these connectors, ensure that the coupling nut is securely tightened. Safety wire is installed on connectors so that the drilled coupling nut, cable clamp, and cross-drilled screws are held by wire in the direction of tightening of the component. Unless otherwise specified, connectors with at least one undamaged hole may be safety wired.

Refer to figure 3–9 as we discuss AN- and SA-AN-type connectors. The following are the specific procedures for safety wiring the four types of AN- and SA-AN-type connectors, which are split-back angle connector, angle connector to receptacle, flange-type mounting plug to receptacle, and connector plug and receptacle.

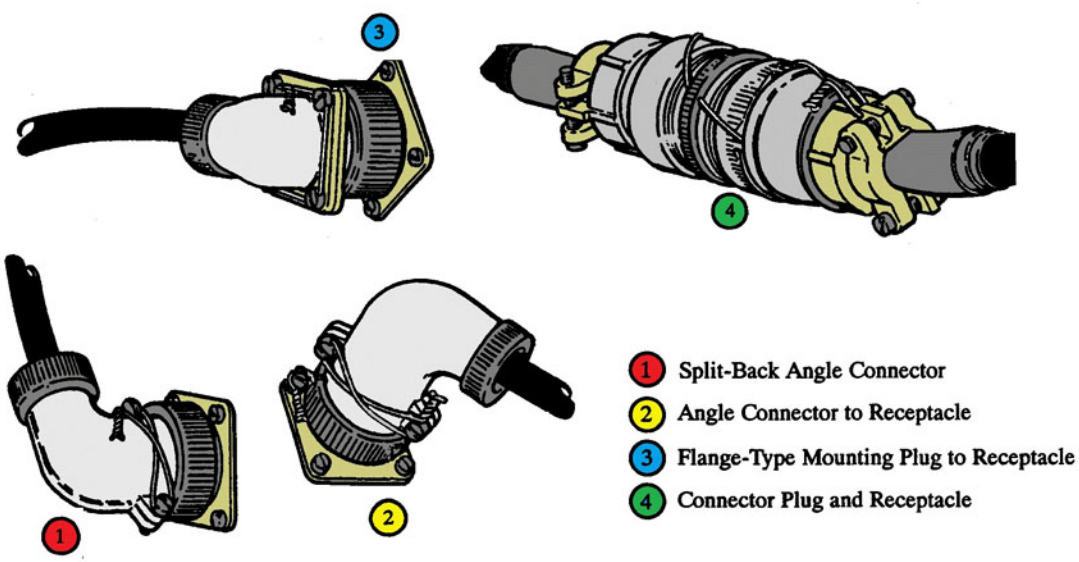



**Figure 3–9. AN/SA-AN connectors.**

#### *Split-back angle connector*

You need to thread the safety wire through the screw heads and cross the safety wire from left to right. Draw taught and twist the safety wire ends with three to seven twists, and cut off the excess wire ends. Finally, bend the twisted safety wire ends back against the connector.

#### *Angle connector to receptacle*

You need to lace the safety wire through the coupling nut. Then twist both strands of wire down to a point just above the receptacle mounting screw. Thread the safety wire through the screw head, draw taught, and twist the safety wire ends with three to seven twists. Finally, cut off the excess wire ends and bend the twisted safety wire ends back against the coupling nut.

#### *Flange-type mounting plug to receptacle*

You need to thread the safety wire through all four of the screw heads. Next, draw taught and twist the safety wire ends with three to seven twists and cut off the excess wire ends. Finally, bend the twisted wire ends back against the connector shell.

#### *Connector plug and receptacle*

You need to install safety wire so that the wire holds all drilled components in a tightening direction. Next, draw the wire taut and twist the wire ends three to seven twists. Then cut off the excess wire ends and bend the twisted wire ends down against the adapter.

## 414. Bonding and staking

In your job, you will use rubber- and silicone-based adhesives to bond metal, plastic, rubber, felt, and cloth to themselves and to each other. The bonding processes described in this lesson apply to the bonding of various materials using rubber-base adhesives and silicone adhesives.

### General bonding

Surface preparation before bonding is critical because the cleanliness and texture of the bonding surfaces largely determines the strength and durability of the bond. These procedures are general and apply only as specified by the governing tech data. If the use of other materials is required, readjust the procedures as necessary in accordance with military or manufacturer’s specifications, or according to information derived from tests performed previously on sampled materials.

### Surface preparation

Generally, abrade or sand the surface(s) you want to bond together. Roughened surfaces tend to bond together better than smooth, glossy surfaces. However, do not abrade plated metal, lead, tin, or metal surfaces that have been newly treated with conversion coatings, such as Alodine. Abrade plastic and rubber surfaces (except cellular or expanded rubber) only enough to roughen the surface and remove the surface gloss.

Before you start the bonding process, you need to thoroughly clean both surfaces of old bonding material, abraded material, dirt, oil, grease, tarnish, and other contaminates. Thoroughly dry both surfaces after cleaning. Minimize contact with surfaces after cleaning by wearing clean gloves. Complete the bonding as soon as possible after the cleaning process.

### Rubber-based adhesives

For general use, use rubber-based contact adhesives or their alternatives (listed in TOs 11N–35–51 and 11N–35–51A). For bonding felt, cloth, and sponge rubber materials, the recommended adhesive is reclaimed rubber. For bonding neoprene rubber and fabric, use the recommended contact adhesives.

#### *Preparing the adhesive*

First, stabilize the bonding surfaces and adhesives at room temperature (about 72 °F). If required, add solvent to the adhesive, using the manufacturer’s instructions. Then mix the adhesive completely until you get a uniform consistency and viscosity (thickness).

### *Methods of applying*

Depending on the bond strength needed, you can use any of three methods to apply rubber-based adhesives: open or wet bonding, solvent reactivation, and heat reactivation. Heat reactivation bonds the strongest; open or wet bonding has the least strength. For detailed application procedures, see TO 11N–35–51. We summarize the methods below.

#### *Open or wet bonding*

Use this method when one or both bonding surfaces are porous or when you need only relatively low-bond strength. To use, simply apply a thin, even film of adhesive to both surfaces and let dry until tacky. You can tell when they are ready by touching the adhesive; your finger should stick, but the adhesive should not come off the surface when you pull your finger away. Then press or roll the surfaces together. Wipe off the excess adhesive and keep the pressure on for at least 24 hours.

#### *Solvent reactivation*

This method is recommended when you need a cold bond with maximum solvent release. First, apply a thin, even film of adhesive to both surfaces, and dry until no longer tacky or sticky at a room temperature of approximately 72 °F. This drying time may vary from a minimum of 1 to 2 hours for very thin films; however, a drying period of 19 to 24 hours is recommended. Higher temperatures speed the drying time. Then, moisten one surface (preferably the denser or heavier part) with a clean cloth saturated (not dripping) with the appropriate solvent. Immediately press or roll the items together (ensuring all points stick), wipe off the extra adhesive and maintain pressure for at least 12 hours.

#### *Heat reactivation*

Use this method when you need maximum strength or where the surfaces are not porous. Apply the adhesive to both surfaces and dry until no longer sticky or tacky. At a room temperature of about 72 °F, this drying time may vary from 1 to 2 hours for very thin films to about 24 hours for thick films, but 18 to 24 hours is recommended. Press or roll the surfaces together and wipe off the excess adhesive. As you maintain pressure, heat the bond line to a temperature of 250 to 275 °F for 5 to 15 minutes. Use the longer time schedule for the lower curing temperature. Let the assembly cool under pressure.

### Silicone rubber adhesives

The silicone rubber adhesives you use are either silicone rubber adhesive or silicone compound. You will bond silicone to silicone or silicone to nonsilicone—the procedures are different for each.

### *Bonding silicone to silicone*

To prepare the surfaces for bonding silicone to silicone, first clean the surfaces with an aerospace equipment cleaning compound water solution and rinse them with clean water. Dry at room temperature; then rinse the surfaces with clean acetone (technical) for up to 5 seconds or wipe them with a clean cloth or paper wipe moistened with clean acetone. Force dry for about a ½ hour at a temperature of approximately 160 °F. If it is not feasible to clean the surfaces this way, use a clean cloth moistened with acetone to clean the surfaces and then air-dry them until all the acetone evaporates. If this method is used, make sure acetone is not trapped in recesses or cracks. Next, lightly abrade the surfaces and wipe off all loose particles with a clean cloth. Be careful not to handle the item after you clean and abrade it. If you must handle it, do not contaminate the surface.

Apply a thin, even film of silicone adhesive or silicone compound to the surfaces and immediately press them together. Make sure that contact is tight and complete. Apply enough pressure to force the excess adhesive out of the bond and wipe it off while it is still wet. Use a clean cloth moistened with acetone to do this. Keep pressure on the bond and do not disturb it until it has air cured for at least 4 hours at room temperature. Then oven cure it for at least another 8 hours at 200 ± 10 °F. On the other hand, if you want to air cure, cure at room temperature for at least 20 hours minimum.

### *Bonding silicone to nonsilicone*

Prepare the surface the same way as for bonding silicone to silicone. Then, if the surface is metal, completely degrease it and abrade it by sanding or sandblasting. After abrading, wipe the surface with a clean cloth moistened with a suitable solvent. Use acetone, or toluene, depending on the type of metal. You do not have to abrade a freshly machined or plated metal surface, but completely clean it with a solvent.

If you are bonding the silicone to molded or laminated plastic, abrade or sandblast the surface to remove any surface gloss and mold release agents. Wipe off loose particles with a dry cloth or paper wipe. Again, if the surface is freshly machined plastic, do not abrade it—just clean it with a solvent. Apply a thin, even film of silicone primer to all the nonsilicone surfaces, and air-dry the primer at room temperature for at least 30 minutes. Then, apply the adhesive or compound and cure the same way as in bonding silicone to silicone.

## Staking

Staking is another way you can secure or fasten bolts, screws, studs, and pins together. Staking prevents loosening or backing off. We will discuss the four types of staking methods listed in TO 11N–35–51: staking mechanically, staking with paint, staking with electrical insulating compound (Glyptal), and staking with sealing compound (Loctite).

### *Stake mechanically*

Mechanical staking is fastening by physically pushing materials together. When you mechanically stake bolts, studs, or screw threads, you hit a punch or similar tool with a hammer into the first exposed thread. Hit the punch and nick or jam the thread against the nut. Pins and bushings are a little different (fig. 3–10). Impress the stake with a punch next to the hole of the pin or bushing.

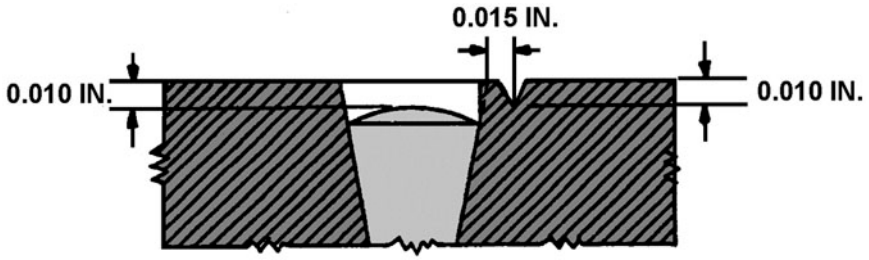



**Figure 3–10. Staking of a pin.**

### *Stake with paint*

Staking with paint is applying liberal amounts of paint to the exposed threads of a bolt, nut, or stud. This secures or fastens the bolt, nut, or stud and prevents it from loosening or backing off.

### *Stake with electrical insulating compound (Glyptal)*

When you stake with this compound, you apply it directly to the bolt, screw, nut, or pin (fig. 3–11). It hardens and prevents loosening of the threaded fastener. This is the more commonly used staking method and is used with electrical type items and equipment.

### *Stake with sealing compound (Loctite)*

Using cleaning procedures from TO 11N–35–51, clean the surface where you are going to apply the sealant. On the inert surfaces (zinc and cadmium plating, and plastics) apply Locquic Primer T activator, and allow to dry before applying torque sealing compound (Loctite). Apply only sufficient amounts of sealing compound to metal fasteners to provide an effective seal when parts are joined. Once they are joined, remove all excess sealant from the fastener. It hardens and prevents loosening of the threaded fastener just like Glyptal.

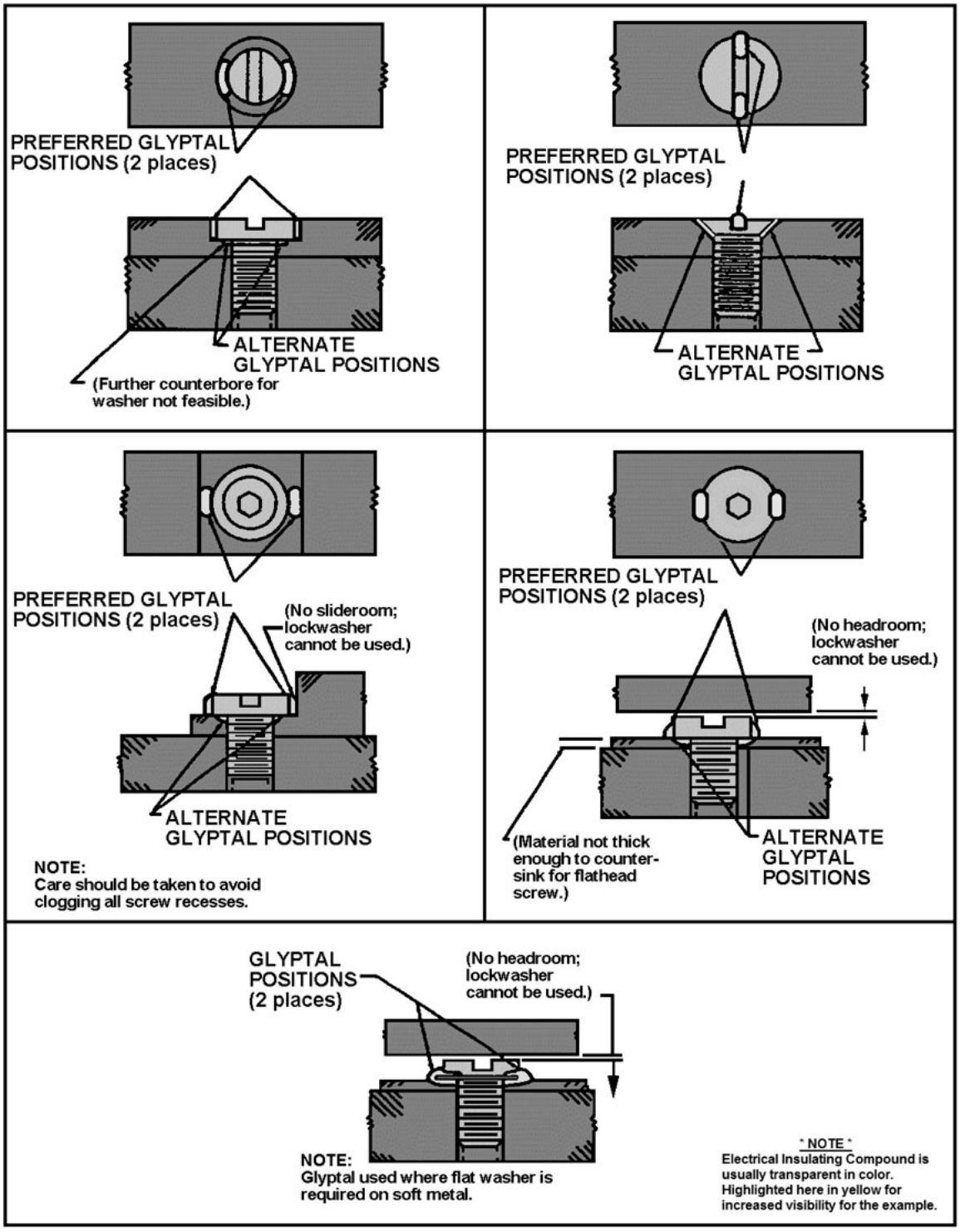



**Figure 3–11. Staking with electrical insulating compound (Glyptal).**

## Self-Test Questions

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

### 413. General safety wiring

1. What are the two types of safety wiring methods used?

2. When practical, what is the preferred method of safety wiring?

3. What should you do if you are safety wiring a bolt with left-handed threads?

4. How close should safety wire twists be from each unit?

5. If no holes are present, how should the safety wire be installed?

6. How many items can be safety wired with the single-wire method?

7. How should the free strand be routed when safety wiring a tapered bolt head?

8. Unless otherwise specified, AN-type connectors with at least how many undamaged hole(s) may be safety wired?

9. What are the four types of AN and SA-AN connectors?

### 414. Bonding and staking

1. Why is it critical to prepare the surface prior to bonding?

2. Which surfaces bond better—roughened or smooth surfaces?

3. What type of rubber-based adhesive should you use to bond felt?

4. What are the three methods of applying rubber-based adhesives?

5. How do you apply a rubber-based adhesive by the solvent-reactivation method?

6. If you want to bond two nonporous materials with a strong bond, which bonding method should you use?

7. Number these procedures in the right sequence for bonding silicone to silicone.

   ____ (a) Maintain pressure on bond for at least 4 hours.

   ____ (b) Apply a thin, even film of adhesive to surfaces.

   ____ (c) Clean surfaces with an aerospace equipment cleaning compound-water solution.

   ____ (d) Press surfaces together and squeeze out excess adhesive.

   ____ (e) Air cure at room temperature for at least 20 hours.

   ____ (f) Lightly abrade surfaces and wipe off all loose particles with a clean cloth.

   ____ (g) Rinse with clean water.

   ____ (h) Force-dry surfaces for $^1/_2$ hour at approximately 160 °F.

   ____ (i) Dry at room temperature.

   ____ (j) Wipe the surfaces with a clean cloth moistened with clean acetone.

8. How do the procedures for bonding silicone to silicone differ from those for bonding silicone to a nonsilicone?

9. What is staking?

10. What are the four types of staking in TO 11N–35–51?

## 3–3. Identification Markings, Packaging, and Gas Cylinders

Packaging and marking go hand-in-hand. Certain equipment and items have specific procedures outlined in specific TOs. Some items will have to be marked, packed, and then the outside parcel marked again. It depends on the specific item.

During your career, you will work with gas cylinders (or bottles). For instance, you will use them during a container leak test and backfill operations. Most gas cylinders are highly pressurized. They are potentially dangerous if you do not handle them properly. The cylinders are hazardous material (HM).

### 415. Identification markings

It is easy to understand why clear and legible markings are so important on nuclear weapons and equipment. We have to be able to identify items, be aware of their capacities and limitations, and be able to observe special precautions during use. The TO for an item has specific instructions for identification markings, and TO 11N–35–51 gives general guidance for applying them.

### Referencing documents

The referencing document provides specific marking instructions to reflect the status of the item you are marking. Markings are either *functional* or *nonfunctional*. TO 11N–35–51 defines functional markings as "those required for efficient and safe handling of major assemblies." These markings must be kept clear and legible and in good condition. Other external markings are nonfunctional. Although a referencing TO may not necessarily require maintenance of nonfunctional markings, this does not mean you can obliterate or remove them.

### Permissible variations in markings

The item TO specifies the size, layout, location, and color of markings. The location, spacing, and orientation are approximate unless the TO gives the marking in specific dimensions. You may deviate from the specified size, location, orientation, and color of noncritical markings within reasonable limits, if you do not violate the intent of the markings. The markings content must be correct and functionally clear. Some markings in the field may not be the same as those shown in the procedural manual. Re-marking the material only to modernize noncritical markings is not necessary. The exception to the above is critical markings. Critical markings, such as chock bands, centers of gravity, and match-marks are located dimensionally, and you must follow the directions exactly.

### Agreements

You may use some items that do not meet the DOE WR standards for training purposes. We call these items "nonconforming material." The DOE and DOD agreed that this type of material should be identified to ensure they are only used in training weapons. Therefore, you may use nonconforming DOE WR material on TYPE weapons or major assemblies if both of the following apply:

1. A slash is marked through the two-digit suffix of the eight-digit part number (000000-ØØ).
2. If appropriate limitations and the nonconforming material number are marked on the material (e.g., "For TYPE 3 Use Only per 123SA65SC").

To maintain accountability of these items and order replacements properly, consider that the part number does not have slash through the suffix. This agreement and procedures are not required for material specifically designed for trainer use.

### Marking materials

TO 11N–35–51A lists all the expendable materials you can use for identification markings. Unless otherwise specified, alternate marking material (enamels and lacquer) listed in the table may be used. If the TO does not indicate the solvents and thinners to use, use those listed in table 4–1 of TO 11N–35–51.

### Marking methods

Before you mark any surface, remove all dirt, grease, mold-release agents, oxidized surface film, or other foreign matter. Properly space and align markings so they are legible and neat. Marking methods include stenciling, ink marking, or using tags, labels, and decals. When specified apply a cover coat. Two of the more common methods are ink marking and stenciling.

#### *Stencil marking*

Apply stenciled markings by brush, roller, dabbing, or permanent marker. If you observe all service-specific limitations and restrictions, you may apply the stencils by spraying. To place stencils on irregular surfaces, apply tape to the stencil board before cutting it. After you apply the marking, carefully lift the stencil from the surface. This avoids blurring the marking and damaging the organic finish.

#### *Ink marking*

Use waterproof ink that is compatible with the organic finish. Apply using stencils, rubber stamps, or commercially procured permanent ink markers. If required, when the ink is thoroughly dry, cover-coat the ink stamp using a clear lacquer or varnish.

### Changing markings

When you have to obliterate markings from surfaces coated with epoxy-type paints, remove the markings with a cloth or nonmetallic scouring pad, moistened (damp, but not dripping) with isopropyl alcohol or dope and lacquer thinner. When you obliterate markings from surfaces with conventional paint, remove all dirt, grease, or other foreign material; make a note of the markings; lightly abrade; then paint over them using enamel or lacquer of a color that matches the surface. When you are applying a new designation and the color and size for the new one are not specified, match the color and the size with existing markings. If there are no existing markings, use a size and color consistent with good maintenance practices, and be sure to refer to TO 11N–35–51.

### Permanent markings of bombs and warheads

In addition to stenciled identification markings, WR bombs, WR warheads, joint test assemblies (JTA), and TYPE units are marked with an external permanent identification marking. Examples of these permanent markings are NUCLEAR, TYPE 3A, JTA1, and the serial number (123456). Once assigned, the serial number remains associated with the unit and is not changed. WR units may have 5-, 6-, or 7-digit serial numbers. TYPE weapons are assigned 4-character alphanumeric serial numbers (e.g., L234, L235, B001, or B00 2). JTAs normally are assigned 3-digit serial numbers. The permanent marking provides a means to distinguish between nuclear and nonnuclear weapon configurations quickly and accurately.

Pantex makes this permanent mark, which is usually a die-impact impression. Some other techniques used for permanent marking are mechanical engraving, mechanical engraving with fill, sandblast impression, and surface conversion. Surface conversion is an electrochemical process that engrains the marking in the metal so that it can be seen but not necessarily felt.

When alteration of basic function is required, like a WR nuclear weapon turned into an inert JTA, the permanent marking needs to be defaced. We deface the original words NUCLEAR, HIGH EXPLOSIVE, INERT, or INERT WITH LIVE PIT by metal deformation using the letter “X” across the entire original word. If you remove it via abrasion or routing, then the authenticity will be indicated by an impression stamped with the letters “DOE”.

### Markings of war reserve and non-war reserve materiel

The types of identification marking for WR materiel are established as Type DOE and Type Mil. Both identification-marking styles are acceptable. Type Mil is newer than Type DOE. Non-WR weapons and their containers are marked in the same manner as WR weapons except for the addition of the TYPE-series designator. Weapon assemblies will have its TYPE designator immediately after and in line with the MK-Mod designation or above this line if space is unavailable.

All major components and subassemblies of training weapons, shipping packages, weapon-associated items of training weapons, and military spares (not serving dual-purpose as WR) will be marked with the words “TRAINING ONLY”. If the materiel is already marked with a TRA or TRB, it does not have to be marked “TRAINING ONLY”. If the item is too small, a “T” or a “TR” will be sufficient.

### Marking shipping and storage containers

There are numerous types and sizes of shipping containers. When you have to mark shipping containers, be sure to refer to the specific item TO and TO 11N–35–51. Do not use labels on shipping containers except in the following circumstances—for domestic addresses, required precautionary labels, and when containers are too small to stencil with the specified size. Also, do not remove or obliterate any existing markings on containers unless specified to do so. When labels are used, make sure you cover-coat them with lacquer or varnish. Test and handling equipment both have specific marking requirements listed in TO 11N–35–51.

## 416. Unpacking and packing items

For the most part, unpacking is self-explanatory and requires common sense. Still, observe how you unpack the item, and keep all packaging and cushioning materials so you can use them when you

need to send the component back. Note the condition of components immediately after their removal from the package. It is also a good idea to write down serial numbers and other pertinent information at this time. Usually, you will not have to fabricate your packaging materials. You will have to fabricate some more common items, such as water-vaporproof barrier bags, crepe paper barriers, and cushioning.

### General instructions

Many of the packing operations that perform do not have specific instructions. TO 11N–35–51 provides general guidelines and specific packaging procedures, if directed by a governing manual.

Always use the smallest sized parcels and packages that are consistent with the amount of protection the component requires. See that flexible materials such as wrappings, sleeves, and so forth, conform as closely as possible to the shape of the item. The only dunnage (the protective material put around an item to prevent damage and movement) needed is the amount required to protect the item. When the TO does not call for specific packaging procedures use the general guidelines in TO 11N–35–51.

Unless the TO specifies otherwise, put all items in an initial wrap or bag. When possible, segregate items of the same part number into different bags. The materials to use for initial wraps are primarily plastic bags, flexible greaseproof/waterproof barrier material, laminated and creped wrapping paper, and chemically neutral wrapping paper.

Sometimes the TO will specify that you use an interior container. Put the initially wrapped item in an interior container (package, box, and so forth) before placing it in its shipping container (drum, crate, and so forth). You may find it necessary to use interior containers to protect protruding parts and irregular shapes or to satisfy other shipping requirements.

### General packaging information

Frequently, containers require desiccant in or around them. Desiccant is a substance that absorbs moisture, thereby keeping an area dry. It comes in various sizes (so many “units” per bag) and bulk form. Desiccant is an HM. The table below shows the appropriate personal protective equipment to wear when handling desiccant.

| Desiccant | Personal Protective Equipment |
|---|---|
| Bulk Desiccant | Long sleeves.<br>Close-weaved cotton gloves with tight-fitting or taped wrists.<br>Dust respirator.<br>Goggles. |
| Bagged Desiccant Torn | A dust mask. |

Use TO 11N–35–51 to calculate the amount of desiccant required. When desiccating a container, you usually must include a humidity indicator. Humidity indicators are small cards, either round or rectangular, that show how much moisture is in an area. The colors blue and pink show the moisture content; various shades of the colors show the degree of moisture. Blue means a dry condition and pink shows a higher-moisture content. The cards contain labeled spots or dots to depict the amount of moisture or humidity in the air. For example, a card might have four dots labeled “5 percent,” “10 percent,” “15 percent,” and “20 percent.” When the 5 percent dot is blue, the moisture content of the container is 5 percent—that’s low. If the 15 percent or 20 percent dot is pink, figuratively speaking, you are in trouble! The moisture content is high, possibly at a level that could damage certain components.

Always locate the humidity indicator in the package as far away as possible from the desiccant; however, make sure it shows easily when the package is open. Never place it in direct contact with the desiccant. When you tape a humidity card in place, do not cover the indicating spots with tape.

## Detailed packaging methods

TO 11N–35–51 contains details for different packing methods (Methods I, IA, IC, II, III) that you will use when packaging materials. Method IA–Water-Vaporproof covers five different ways to package items; Method IC–Waterproof covers four ways, and Method II–Water-Vaporproof with Desiccant covers six different ways to package items. We will only cover Method IA and Method II.

### *Method IA–8–Sealed Water-Vaporproof Bag*

You must enclose many items in your package in a sealed water-vaporproof bag. This is a container made out of a flexible, water-vaporproof barrier material. It is strong and seals out all moisture, including humidity. For method IA–8, you will first construct either a flat water-vaporproof bag or a square/rectangular water-vaporproof bag, which we discuss in the next paragraphs. To prevent sharp edges from puncturing the bag, ensure the item is cushioned before placing it in the bag. Close and seal the bag, and print, label, tag or stencil the bag according to TO 11N–35–51.

#### *Flat water-vaporproof bag*

To make a flat water-vaporproof bag, find the size of material you need. To determine the width of the bag, add the container's height and width plus 2 in. For the length of the bag, add the container's height and length plus 6 in. Seal with a sealing iron with heated jaws that clamp with pneumatic pressure or with a rotary-type heat sealer. Usually, sealing instructions are printed on the reverse side of the barrier material or are furnished by the manufacturer with the sealing iron.

To fabricate the bag, cut two pieces of the barrier material of the size you determine and seal the pieces along three sides. Make sure all seals are 1 in. wide. Place the container in the bag and seal the open end except about 1½ in. on one corner. Into this small opening, insert the small end of a vacuum cleaner hose tool and remove the excess air. The suction causes the bag to "form fit" the container. Remove the vacuum hose tool and immediately seal the opening. Fold the excess barrier material (flap of the bag) against the ends of the container, and tape it securely.

#### *Square or rectangular water-vaporproof bag*

To determine the size of material, you need to make a square or rectangular water-vaporproof bag. Measure the height and width of the sides and ends of the item being packaged. Cut your pieces 2 in. larger than the measurement for each side and end. Next, measure the top or bottom of the item and cut two pieces of material 2 in. larger than the measurement.

To fabricate the bag, seal one edge of each side to the bottom material, and then seal all four vertical edges to form a box-like bag without a top. Make all seals 1 in. wide. If required, install a humidity indicator card or humidity indicator plug.

One way to install a humidity indicator card is to cut an opening in the top piece of the fabricated bag large enough to see the humidity indicator card, and seal a piece of transparent plastic material to the opening with tape. Tape a humidity indicator card inside the window so you can see the printed side of the card through the window. Another way is to tape the humidity indicator card to the outside of the container to so it is visible when you open the bag. To install a humidity indicator plug, simply cut a hole in the top of the bag big enough for the threaded portion of the plug, place it in the hole, and thread the nut onto the backside.

Next, place the item in the bag. If the item being packaged is heavy and hard to handle or is packed according to Method IIA in TO 11N–35–51, invert the bag and place it over the item being packed. Seal the top in place except about 1½ in. on one corner. Insert the vacuum tool and remove the excess air. Remove the vacuum hose tool and immediately seal the opening.

### *Method IA–14–Container, Bag, Container*

TO 11N–35–51 lists the containers used for this method. Here are the procedures you use for this method of packing:

1. Package and secure the item in interior wraps.

2. Snugly fit the item using the appropriate shipping box and insert them in the container.
3. Cushion the items as needed to prevent excess movement and secure the container, if required.
4. Blunt the corners of the container to prevent puncturing the bag, and inset the container into the bag you constructed (flat water-vaporproof bag or a square/rectangular water-vaporproof bag).
5. Close and seal the bag according to TO 11N–35–51.
6. Secure “dog ears” with pressure-sensitive adhesive tape.
7. Protect bag as required from abrasion by wrapping or any suitable means.
8. Print, label, tag, or stencil the bag and obtain an outer container according to TO 11N–35–51.
9. Insert the bag into an outer container and close according to proper procedures.
10. Print, label, tag, or stencil the container.

#### *Method IA–15–Bag and Container*

Use this method for small items, weighing five pounds or less, that you pack with other items in the same shipping container. You will use the same materials listed in method IA–14 except the outer container is not used. Overwrap the package with a suitable flexible barrier material unless it is placed in an intermediate container with a number of identical packages.

#### *Method II–Water-Vaporproof with Desiccant*

The six detailed packaging methods that fall under this category are method IIA through method IIF. The methods are very similar in nature to those listed in method 1A with a difference being the addition of desiccant and a humidity indicator card in each method used. Remember that you will need to calculate the quantity of desiccant for the container according to procedures listed in TO 11N–35–51.

### Packaging for shipment

You need to understand some basic requirements that apply when packaging shipping containers. Shipping containers are interchangeable within specified limits. Replace containers with containers of approximately the same size. Ensure containers are as small as possible and still maintain protection requirements. Fit contents and required dunnage into an appropriate-size fiberboard box. You need to use TO 11N–35–51 to choose the correct size, drum-type container, boxes, or shipping containers. The use of $^{5}/_{8}$ in. steel strapping for boxes weighing 200 pounds (lb.) or less and 1¼ in. for boxes weighing 200 lb. or more. However, if a box weighs 40 lb. or less, the strapping is optional. Four strips of filament-reinforced, pressure-sensitive adhesive tape are used to secure fiberboard containers.

### Drum-type containers

Some components and equipment require the use of drum-type containers for storage and shipment. Use the following procedures to open and close drum-type containers.

#### *Opening drum-type containers*

Exercise care when removing the cover. Pressure may build up within a container not equipped with a relief valve. To prevent injury to the eyes, wear eye protection when cutting seals or trimming safety wire. Perform the procedures listed below for opening a drum-type container:

1. Operate the relief valve on the container if present.
2. If required, remove and retain the yellow or red tag from the container.
3. Remove any seal(s) on the container.
4. Remove the nut and bolt that secures the locking ring.
5. Remove the locking ring and cover.

### *Closing drum-type containers*

Perform the following procedures when closing drum-type containers:

1. Place the gasket in the lid of the container so the flat part of the gasket contacts the upper bead on the container when you install the lid.
2. Place the lid on the container.
3. Using the proper machine bolt and nut, tighten the locking ring to secure the lid. Tap around the locking ring with a rubber mallet while you tighten. This ensures that you pull the ring tight around the entire circumference of the container.
4. Do not allow the ends of the locking ring to touch or come closer than ⅛ in. to one another.

## 417. Compressed-gas cylinders

Gas cylinders are often the same size and shape. The only differences are the color-coding (shows type of gas) and the part number. To confuse one gas with another gas could have disastrous results. Always verify the type of gas when you receive the cylinder and before you use it. Compressed-gas cylinders in use by DOD agencies and other government activities are of three basic types: high pressure (up to 6,000 pounds per square inch [psi]); low pressure (below 900 psi); and low pressure for gas in solution.

### Markings

All cylinders should be made and maintained according to Department of Transportation (DOT) regulations. They bear an Interstate Commerce Commission (ICC) specification marking. The ICC marking normally is stamped in the metal on the shoulder near the cylinder's neck. In addition, there is a stamp in the metal showing the last hydrostatic test date. Hydrostatic tests are required every 5 years. AF compressed-gas-cylinder color-coding and stenciling is done according to Military Standard (MIL-STD)–101, *Color Code for Pipelines and for Compressed Gas Cylinders*. The name of the gas is stenciled parallel to the longitudinal axis of the cylinder on two locations diametrically opposite of each other. Finally, the cylinders are marked legibly in large letters and are color-banded to identify contents.

Nitrogen is a good example. You may need either Class 1, "oil-free" (formerly "water-pumped") or Class 2, "oil-tolerant" (formerly "oil-pumped") nitrogen. Both cylinders are painted gray and "nitrogen" is stenciled lengthwise on the cylinders. The differences are the part number and the number of painted black bands. The oil-tolerant nitrogen cylinder has one band and the oil-free nitrogen cylinder has two bands. Where a title includes a modifier, such as "oil-free," the modifier follows the chemical designation.

### Receipt and inspection

When you receive a cylinder, it should have two Department of Defense (DD) Forms 1574, Serviceable Tag–Materiel, and an Air Force Technical Order (AFTO) Form 489, Cylinder Status Tag, or equivalent attached. One DD Form 1574 identifies the content of the cylinder, and the other identifies the cylinder. The AFTO Form 489 annotates leak test dates. Verify the tags and inspect the cylinder to make sure that it is properly painted and marked. Cylinders with their hydrostatic test overdue or due within 6 months are limited to shipment and issue within the continental limits of the United States. There is a warning that any cylinder exceeding the periodic hydrostatic test date must not be refilled until the required hydrostatic test is done. Compressed-gas cylinders installed in service or in storage that are fully or partly charged are considered serviceable regardless of the hydrostatic test due date if the cylinder complies with all of these rules:

- The cylinder meets the inspection requirement of TO 42B5–1–2, *Gas Cylinders (Storage Type) – Use, Handling, and Maintenance.*
- The cylinder meets the leak test requirement of TO 42B5–1–2.

- Any cylinder exceeding the hydrostatic test date and/or does not comply with the two preceding items will be turned in for retest and/or inspection.

The cylinders you use come with a protective cap to protect the cylinder valve. When the cylinder is not in use, always install the cap. Also, make sure there is a valve-outlet dust cap installed. The dust cap must not be plastic. You should always check to make sure the valve is closed tightly. Cylinders come with a hand wheel to open the valve. Never use anything other than hand pressure to open or close the valve. If you need to use more than hand pressure, reject the cylinder, attach a green DD Form 1577–2, Unserviceable (Reparable) Tag – Materiel, and identify the discrepancy in the remarks section.

Empty cylinders must be identified properly and have 5 to 38 pounds per square inch gauge (psig) pressure for shipment. Remove the DD Form 1574 identifying the *contents.* Overstamp the *cylinder* DD Form 1574 with empty ("MT") to show that the gas has been used/exhausted and the cylinder is still serviceable. For special dry-air-gas cylinders, the cylinder is considered empty and returnable when the psig drops to 75 ± 25. You will stencil P/N 281438–00 with white 1 in. high characters if not present, and mark out P/N 178181–00 if present before shipping the empty gas cylinder.

### Handling and use

When using or storing cylinders in an upright position, make sure you secure them in an upright or horizontal position to prevent them from falling or striking other cylinders. Some types of cylinders/gases can be stored *only* in the upright position. As a minimum, use a metal chain, strap, or brace. Do not use nylon straps on flammable gases. Cylinders containing gas while in storage (at base supply or the using activities) are checked for leaks every 12 months. A cylinder fully or partly charged, with or without a valve cover, not physically connected to a system or equipment, is considered in storage. When you lift a cylinder, do not use the valve or protective cap. Also, never drag a cylinder, slide it, or roll it on its side. However, you may tilt a cylinder slightly and roll it on the bottom edge for minimal positioning, but do not handle it by twisting the valve or its protective cap. Use suitable trucks with provisions for holding cylinders securely in position for longer distance and movement that is more frequent.

### Regulate pressurizing and purging systems

Specific procedures on hookup, use of the equipment, and choice of the system for use are in the referencing TO. *Never* use compressed gas for purposes other than its intended use or without a regulator. To prepare the cylinder for use, remove the protective cap and the valve-outlet dust cap. Before installing a regulator, momentarily "crack open" the cylinder valve (turn about one-fourth turn); then close immediately. This clears the valve port of any dust, dirt, or moisture. It also prevents contaminants from entering the regulator. After you install the regulator, check that the adjusting screw is released or fully backed out before opening the cylinder valve. Slowly open the cylinder valve to prevent a jolt of gas from being discharged into the regulator.

The regulator gauge (fig. 3–12) near the cylinder indicates cylinder pressure. Now, open the regulator valve until the second gauge indicates the desired purging or pressurizing pressure. To permit gas to flow through the system, open the shut-off valve (the valve between the regulator and the vessel you are pressurizing).

If required, check all fittings for leaks using a suitable leak-detecting compound. When not "in use," or before removing the regulator, close the cylinder valve and open the regulator to bleed off existing pressure. Do *not* use the final 75 ± 25 psig of gas for purging or pressurizing.

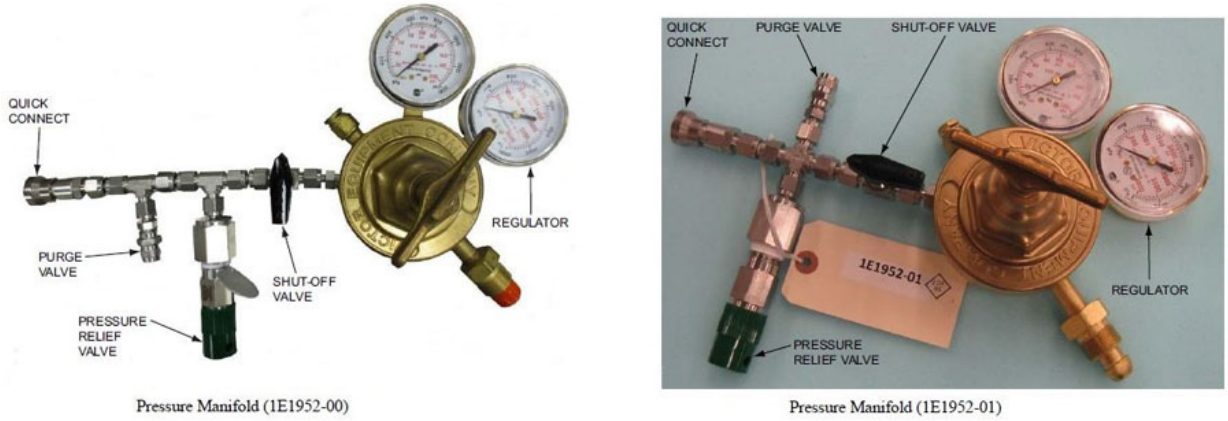



**Figure 3–12. Typical gas cylinder regulator system.**

## Self-Test Questions

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

### 415. Identification markings

1. Define the term “functional markings.”

2. Where do you find a list of expendable materials for identification markings?

3. How can you avoid fuzzy edges on letters when stenciling?

4. What is the cover coat used with ink stamping?

5. Give some examples of permanent markings.

6. What words will be marked on all major components and subassemblies of training weapons, shipping packages, weapon-associated items of training weapons, and military spares (not serving dual-purpose as WR)?

### 416. Unpacking and packing items

1. What criteria should you consider when choosing packaging materials?

2. Why would you use an interior container?

3. Is desiccant an HM item?

4. What protective equipment is required for bulk desiccant?

5. A package's humidity indicator has a 5 percent dot that is blue in color. What does this indicate?

6. Where in a package should you place a humidity indicator card?

7. When fabricating a flat water-vaporproof bag for a container, how can you determine the proper length of material for the bag?

8. Describe the procedures for closing a square or rectangular water-vaporproof bag.

9. Why do you blunt the corners of a container before inserting it into a vaporproof bag?

10. When is method IA–15 used for packaging items?

11. How many strips of filament-reinforced, pressure-sensitive adhesive tape are used to secure fiberboard containers?

12. Why must you exercise care when opening drum-type containers?

13. How close can the ends of the locking ring be after tightening?

### 417. Compressed-gas cylinders

1. What four items are marked on gas cylinders?

2. Without looking at the part number, how can you tell the difference between “oil-tolerant” and “oil-free” nitrogen?

3. What is the warning for cylinders that exceed the hydrostatic test date?

4. How often are full cylinders in storage checked for leaks?

5. What is the purpose of “cracking” the valve before installing a regulator?

## Answers to Self-Test Questions

**410**

1. Apply only a sufficient amount to fill the “V” of the threads of the bolt or screw.
2. Use only finger force to tighten bolts or nuts.
3. Use appropriate tools and moderate force to firmly seat bolts, screws, and nuts. A fastener is tightened securely if it has reached the point where an increase in torque does not result in additional turning of the nut or fastener head.
4. Install the washer with the recessed side facing the head of the bolt or screw.
5. Tighten the nut (without exceeding the torque specification) until the hole appears in the slot and the cotter pin can be installed.

**411**

1. Lowest incremental torque value or mechanical stop, whichever comes first.
2. Review the certification label to ensure the calibration is still current and not expired. Ensure the label accurately reflects the identification number of the torque wrench. If the torque wrench has a special or limited calibration, ensure the “user approval” or “INI” is signed or initialed respectively to show acceptance of a given calibration.
3. They are covered by a torque seal, remelted fuse plug, lead tape, or a NOTICE CERTIFICATION VOID WHEN SEAL IS BROKEN label.
4. Set the torque wrench to the maximum setting and cycle through the breakaway torque at least six times.
5. It permits special internal lubricant to recoat internal working parts, eliminating resistance to give the most accurate reading possible.
6. The handle will automatically release or “break” resulting in approximately 5° to 10° free travel.
7. No, avoid metal-to-metal contact unless the wrench is in a protective case.
8. Do not make any wrench adjustments to settings lower than the equivalent of one incremental division lower than the lowest torque setting.

   Set the torque wrench to its lowest incremental torque value or mechanical stop, whichever comes first.

10. No, unless specifically directed by TO or if the universal is permanently attached when the torque wrench is calibrated. Torque applied using a universal at varying angles will apply incorrect torque on affected hardware.

**412**

1. Over or under torqueing a fastener can cause the fastener or the assembly to fail. Engineers have developed the correct amount of torque for each part of an assembly during the design process to ensure its proper operation.

2. The torque values in TO 11N–35–51 may be used as a guide.
3. Ensure that the nut, bolt, or screw is fully seated before you torque it.
4. With your hand centered on the torque wrench handle.
5. Use extra caution since applying force by pushing may cause loss of control and slippage, resulting in personal injury.
6. 40-200 in-lb.
7. Approximately 243.75 in-lb rounded up to 244. Here is how to use the formula to figure it:
   a) $S = [18 \div (18 + 6)] \times 325$
   b) $S = [18 \div 24] \times 325$
   c) $S = 0.75 \times 325$
   d) $S = 243.75$
8. 2,100 in-lb.
9. 195 ft-lb.

**413**

1. Double-twist and single wire method.
2. Double-twist is the preferred method.
3. Ensure the safety wire is installed in reverse.
4. Ensure twists are within approximately 1/8 in. of each safety wire hole
5. Safety wire to a convenient adjacent part, ensuring the wire does not interfere with a function or part.
6. The number of items that can be safety wired with a 24 in. piece of wire.
7. Ensure the free strand is routed over the unit and not under.
8. One.
9. Split-back angle connector, angle connector to receptacle, flange-type mounting plug to receptacle, and connector plug and receptacle.

**414**

1. The cleanliness and texture of the bonding surfaces is largely determines the strength and durability of the bond.
2. Roughened surfaces tend to bond together better than smooth, glossy surfaces.
3. Reclaimed rubber.
4. Open or wet bonding, solvent reactivation, and heat reactivation.
5. First, apply a thin, even film of adhesive to both surfaces and let dry until they are no longer tacky or sticky. Drying may take up to 24 hours. Then moisten one surface with a cloth saturated with the appropriate solvent. Press or roll the items together (ensure all points stick), wipe off the extra adhesive, and maintain pressure for at least 12 hours.
6. Heat reactivation.
7. (a) 9.
   (b) 7.
   (c) 1.
   (d) 8.
   (e) 10.
   (f) 6.
   (g) 2.
   (h) 5.
   (i) 3.
   (j) 4.
8. If the surface is metal, completely degrease it and abrade by sanding or sandblasting. After abrading, wipe the surface with a clean cloth moistened with a suitable solvent. You do not have to abrade a freshly machined or plated metal surface, but completely clean it with a solvent. Apply a thin, even film of silicone

primer to all the nonsilicone surfaces and allow the primer to air-dry at room temperature for at least 30 minutes.

9. It is another way you can secure or fasten bolts, screws, studs, and pins together and prevents loosening or backing off.
10. Staking mechanically, staking with paint, staking with electrical insulating compound (Glyptal), and staking with sealing compound (Loctite).

**415**

1. Those required for efficient and safe handling of major assemblies.
2. TO 11N–35–51A, table 1–1.
3. After you apply the marking, lift the stencil from the surface carefully to avoid blurring the marking and damaging the organic finish.
4. Clear lacquer or varnish.
5. NUCLEAR, TYPE 3A, JTA1, and serial numbers (123456).
6. TRAINING ONLY.

**416**

1. Always use the smallest-sized parcels and packages that are consistent with the amount of protection the component requires. Conform flexible materials as closely as possible to the shape of the item.
2. Because the TO calls for one, to protect protruding parts and irregular shapes, or to satisfy other shipping requirements.
3. Yes.
4. Long sleeves, close-weaved cotton gloves with tight-fitting or taped wrists, dust respirator, and goggles.
5. The moisture content is low.
6. As far as possible from the desiccant and where it shows easily when the package is opened.
7. Add the container’s height and length plus 6 in.
8. Place the item in the bag and seal the open end except about 1½ in. on one corner. Insert the small end of a vacuum cleaner hose tool and remove the excess air. Remove the tool and immediately seal the opening.
9. To prevent puncturing the bag.
10. When packaging small items weighing five pounds or less that are packed with other items in the same shipping container.
11. Four.
12. Because pressure may build up within a container not equipped with a relief valve.
13. $^{1}/_{8}$.

**417**

1. An ICC specification marking; the last hydrostatic test date; the name of the gas in large letters in two locations, diametrically opposite of each other; and color bands to identify the contents.
2. “Oil-tolerant” nitrogen cylinders have one black band, and “oil-free” nitrogen cylinders have two black bands.
3. It will not be refilled until the required hydrostatic test is performed.
4. Every 12 months.
5. It purges the valve port of any dust, dirt, or moisture so they will not enter the regulator.

**Complete the unit review exercises.**

## Unit Review Exercises

**Note to Student:** Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter.

45. (410) What is the *proper* way to apply compound to a standard hardware?
    a. Very light coat of compound on the threads inside the nut.
    b. Very light coat of compound on the threads of the screws.
    c. Sufficient compound to fill the "V" on the threads inside the nut.
    d. Sufficient compound to fill the "V" on the threads of the screw.

46. (410) When "finger-tighten" is specified in a technical order (TO), use the appropriate tools and
    a. moderate force to firmly seat bolts, screws, and nuts.
    b. maximum force to firmly seat bolts, screws, and nuts.
    c. use only finger force to lightly seat bolts, screws, and nuts.
    d. use maximum tensile strength to lightly seat bolts, screws, and nuts.

47. (410) When "tighten securely" is specified in a technical order (TO), use the appropriate tools and
    a. moderate force to firmly seat bolts, screws, and nuts.
    b. maximum force to firmly seat bolts, screws, and nuts.
    c. use only finger force to lightly seat bolts, screws, and nuts.
    d. use maximum tensile strength to lightly seat bolts, screws, and nuts.

48. (410) How should a recessed washer be installed on a bolt?
    a. Any direction.
    b. A recessed washer should never be used.
    c. The recessed side facing the head of the bolt or screw.
    d. The recessed side facing away from the head of the bolt or screw.

49. (411) Prior to performing any maintenance operation, you inspect a torque wrench to
    a. ensure a permanent etched arrow is present on the barrel shaft.
    b. verify the calibration is still current by reviewing the Department of Defense (DD) Form 1574.
    c. ensure the torque wrench was stored at its breakaway torque.
    d. make sure the calibration holes are not obstructed by torque seal.

50. (411) How is the breakaway exercise applied, if required, to torque wrenches?
    a. Set torque wrench to the lowest usable setting and cycle at least six times.
    b. Set torque wrench to the maximum setting and cycle at least six times.
    c. Set torque wrench to the needed torque value and cycle at least six times.
    d. Do not perform a breakaway exercise since it shortens the life cycle of torque wrenches.

51. (411) How is the breakaway exercise applied, if required, to large torque wrenches (150 foot-pounds [ft-lb] and over)?
    a. Set torque wrench to the lowest usable setting and cycle at least six times.
    b. Set torque wrench to the maximum setting and cycle at least six times.
    c. Set torque wrench to the torque value that will be used, rather than at the maximum setting.
    d. Do not perform a breakaway exercise since they shorten the life cycle of torque wrenches.

52. (411) How should users properly maintain torque wrenches throughout calibration?
    a. Multiple torque wrenches may be held in one hand.
    b. Metal-to-metal contact with torque wrenches shall be avoided.
    c. Torque wrenches must be stored at its mechanical stop, regardless of lowest value.
    d. Torque wrenches subject to overloading are still serviceable since calibration is still valid.

53. (411) A torque wrench in storage should be set at
    a. one incremental division lower than the lowest setting.
    b. one incremental division above the lowest setting.
    c. any setting above the lowest setting.
    d. the lowest incremental torque value.

54. (412) What percentage of the full-scale value of the impulse-feel-type torque wrench cannot be used?
    a. 15.
    b. 20.
    c. 25.
    d. 30.

55. (412) Consider this situation. You need to torque a nut to 288 inch-pounds (in-lb), but the only torque wrench available is in foot-pounds (ft-lb). What should the setting be?
    a. 12.
    b. 16.
    c. 20.
    d. 24.

56. (413) When twisting 0.020-inch (in.)-diameter safety wire, the wire should have how many twists per in.?
    a. 3 to 6.
    b. 5 to 8.
    c. 7 to 10.
    d. 9 to 12.

57. (413) For the double-twist method, the *maximum* number of items you can safety wire with one piece of wire is
    a. 2.
    b. 3.
    c. 4.
    d. 5.

58. (413) For the single-wire method, the *maximum* number of units you can safety wire is the number of units
    a. that can be safety wired by a 24-inch (in.) wire.
    b. that can be safety wired by a 36 in. wire.
    c. within a 24 $in.^2$ area.
    d. within a 36 $in.^2$ area.

59. (413) How is the free strand routed when safety wiring a castellated nut?
    a. Under the nut.
    b. Around the nut.
    c. Over the nut.
    d. Routing of free strand is not important.

60. (413) How many twists are required, when twisting the safety wire ends of *all* four types of AN- and SA-AN-type connectors?
    a. 1 to 2 twists.
    b. 3 to 7 twists.
    c. 5 to 10 twists.
    d. As many as necessary.

61. (414) Use the pen or wet-bonding method of applying adhesive when bonding surfaces are
    a. nonporous.
    b. metallic.
    c. smooth.
    d. porous.

62. (414) The *first* step when preparing surfaces for bonding silicone to silicone with silicone-rubber adhesives is to
    a. clean the surfaces with acetone.
    b. abrade the surfaces with aluminum oxide abrasive.
    c. abrade the surfaces with aluminum oxide abrasive and rinse with acetone.
    d. clean the surfaces with an aerospace equipment cleaning compound water solution.

63. (414) Which is *not* a staking method procedure described in Technical Order (TO) 11N–35–51?
    a. Stake with electrical insulating compound (Glyptal).
    b. Stake with sealing compound (Loctite).
    c. Stake with cadmium sulfide.
    d. Stake mechanically.

64. (415) If the technical order (TO) does *not* indicate which solvents and thinners to use, you should use those listed in table 4–1 of TO
    a. 11N–45–51 series.
    b. 11N–H61 series.
    c. 11N–100–12.
    d. 11N–35–51.

65. (415) When applying an identification marking using an ink stamp, what do you use to cover-coat the ink stamp?
    a. Phenolic resin-base coating.
    b. Multi-polyurethane coating.
    c. Clear lacquer or varnish.
    d. Acid resin varnish.

66. (415) Permanent identification markings on nuclear weapons are *usually*
    a. a stencil.
    b. not required.
    c. coded for secrecy.
    d. a die-impact impression.

67. (415) What word(s) will be marked on *all* major components and subassemblies of training weapons?
    a. NUCLEAR.
    b. NOT REAL.
    c. DO NOT USE.
    d. TRAINING ONLY.

68. (416) Which is *not* a material used primarily as an initial wrap for packing operations?
    a. Creped wrapping paper.
    b. Barrier material.
    c. Plastic bag.
    d. Newspaper.

69. (416) What condition exists when a humidity indicator in a package has a dot marked 15 percent that is pink in color?
    a. The moisture content is dangerously low.
    b. The moisture content is dangerously high.
    c. The moisture content is moderate and acceptable.
    d. The pink color indicates an acceptable, dry condition.

70. (416) When using packing method IA–14–Container, Bag, Container, why do you blunt the corners of the container before inserting it into the bag?
    a. To ventilate the container.
    b. Ensure the container will fit.
    c. To prevent puncturing the bag.
    d. Prevent excess movement of items.

71. (416) When closing drum-type containers, how close may the locking ring ends come together?
    a. ⅛ inch (in.).
    b. ¼ in.
    c. ⅜ in.
    d. ½ in.

72. (417) What form is used to identify gas cylinders and their contents?
    a. Air Force Technical Order (AFTO) Form 95.
    b. AFTO Form 175.
    c. Air Force (AF) Form 988.
    d. Department of Defense (DD) Form 1574.

73. (417) What action would you take if more than hand pressure is required to open a gas cylinder valve that is equipped with a hand wheel?
    a. Use an adapter wrench to add extra leverage.
    b. Remove the hand wheel and use an open-end wrench.
    c. Reject the cylinder and tag it to reflect the discrepancy.
    d. Accept the cylinder and tag it to reflect the discrepancy.

74. (417) Which method is used to identify an empty gas cylinder?
    a. Overstamp the contents tag with “MT” only.
    b. Overstamp both the contents and cylinder tags with “MT” only.
    c. Remove the contents tag and overstamp the cylinder tag with “MT.”
    d. Remove the contents tag and overstamp the cylinder body with “MT.”

75. (417) Which material may you use to secure flammable gas cylinders in an upright position?
    a. Safety wire.
    b. Nylon rope.
    c. Nylon strap.
    d. Metal chain.

# Glossary of Abbreviations and Acronyms

| | |
|---|---|
| **°** | degree |
| **°F** | degree Fahrenheit |
| **A** | length of the adapter |
| **AF** | Air Force |
| **AFTO** | Air Force technical order |
| **CDC** | career development course |
| **DD** | Department of Defense |
| **DOD** | Department of Defense |
| **DOE** | Department of Energy |
| **DOT** | Department of Transportation |
| **FOD** | foreign object damage |
| **ft-lb** | foot-pound |
| **H-equipment** | handling equipment |
| HM**/HM** | hazardous material |
| HM F | hazardous material, flammable |
| **IAW** | in accordance with |
| **ICC** | Interstate Commerce Commission |
| **in.** | inch |
| **in-lb** | inch-pound |
| **in-oz** | inch-ounce |
| **JTA** | joint test assembly |
| **L** | length of the torque wrench |
| **lb.** | pound |
| **MIL–STD** | military standard |
| **MT** | empty |
| **NNSA** | National Nuclear Security Agency |
| **no.** | number |
| **PAL** | permissive action link |
| **PMEL** | precision measurement equipment laboratory |
| **psi** | pounds per square inch |
| **psig** | pounds per square inch gauge |
| **S** | torque setting |

| | |
|---|---|
| **SNL** | Sandia National Laboratories |
| **T** | applied torque |
| **TMDE** | test, measurement, and diagnostic equipment |
| **TO** | technical order |
| **UR** | unsatisfactory report |
| **WR** | war reserve |

# Student Notes

# AFSC 2W251
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