

TECHNICAL MANUAL

**OPERATOR AND ORGANIZATIONAL
GENERAL MAINTENANCE
FOR THE
IMPROVED HAWK GUIDED MISSILE SYSTEM**

**This copy is a reprint which includes
current pages from Changes I through 5.**

AUGUST 1972

WARNING**RADIATION HAZARD**

This equipment contains the following radioactive items:

<i>Nomenclature</i>	<i>NSN</i>	<i>Isotope</i>	<i>Amount (Microcuries)</i>
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NOTE

Refer to manual containing specific item of equipment for a list of radioactive tubes in that equipment.

Refer to TM 3-261, TM 38-250, and TB 43-0116 for information relative to shipping, storage, handling, and disposal of radioactive material.

FIRST AID FOR RADIOACTIVE CONTACT

The following first aid procedure for wounds caused by anything coated with a radioactive particle material represent the only reasonable first aid treatment which would possibly be available:

- a. Stimulation of mild bleeding by normal pressure about the wound and by use of suction cups.

WARNING

Do not suck the wound by mouth. The wound must be washed with soap and flushed with plenty of clear water

- b. If the wound is of the puncture type, or the opening is quite small, an incision should be made to promote free bleeding and to facilitate cleaning and flushing of the wound.

- c. Evacuate patient to a medical facility where monitoring of the wound can be accomplished. All such wounds should be examined by a medical officer.

- d. For wounds involving the extremities, pending medical attention, place a lightly constricting band (tourniquet) 2 to 4 inches closer to the heart than the site of the wound. The band should be tight enough to halt the flow of blood in superficial blood vessels but not tight enough to stop the pulse (arterial flow).

CLEANING SURFACES ON WHICH TUBES HAVE BEEN BROKEN

Wet Method. Put on rubber or plastic gloves. Pick up large fragments with forceps then, using a wet cloth, wipe across the area. Make one wipe at a time and fold cloth in half, using the clean side for wiping each time. When cloth becomes too small, discard and start again with a clean piece of cloth. Care must be taken not to rub the radioactive particles into the surface being cleaned by using a back and forth motion. All debris and cloths used for cleaning should be sealed in a container such as a plastic bag, heavy waxed paper, ice cream carton, or glass jar for disposal.

WARNING FOR RADIO-FREQUENCY RADIATION HAZARD

Radio-frequency (rf) radiation from radar antennas and associated equipment is a potential hazard to personnel. Rf radiation is not cumulative but it can be hazardous. It heats the body tissues, and, if the radiation intensity is sufficiently high, will permanently damage the tissue. This damage is not immediately apparent.

Precautions should be taken to ensure that personnel are not exposed to rf radiations of hazardous intensity levels. Personnel who must be within the hazardous distances for the below listed radars should be instructed not to place themselves on the radiating side of the antenna, and to never look into a transmitting horn or open waveguide which is connected to an energized transmitter.

Personnel are prohibited from entering areas where they may be exposed to levels of rf radiation above 10 milliwatts per square centimeter (10 mw/cm²). This level, though not considered hazardous, is stipulated by AR 40-583 as the maximum permissible exposure level for personnel.

A power intensity of at least 10 mw/cm² is present along the axis of each radar's transmitted beam, for the distances listed below. These distances are based on calculations and actual measurements and may be used as a guide to prevent radio-frequency radiation injury. In each instance, radiation intensity rapidly diminishes as the distance is increased.

ANTENNA	DISTANCE
High-powered Illuminator Radar	111.5 m (366 ft)
Cw Acquisition Radar non-scanning	74 m (243 ft)
scanning	36 m (118 ft)
Pulse Acquisition Radar	15.2 m (50 ft)
Range-only Radar	45.1 m (148 ft)

The 36 m distance for the scanning CWAR antenna does not mean the system constitutes a hazard to personnel while the antenna is scanning. When the antenna stops scanning and is stationary, those systems capable of producing power densities greater than 50 mw/cm² must be controlled so that under no circumstances will personnel be exposed to intensities equal to or greater than 50 mw/cm². When the radar is energized to full radiate, personnel must not be within 74 meters (243 feet) of the antenna along the designated azimuth.

No radiation hazard exists at radar ground level if the radars are not depressed below zero degrees elevation. When at all possible during maintenance, however, place the antenna at a high elevation. Personnel are restricted from the area atop the radars or other elevated locations in front of the antennas when radiating.

Personnel may move in and around the CWA R to zero range at ground level provided they are below the horizontal center line of the antennas. There is no height restriction to either side or rear of the antennas.

Potentially hazardous power density levels do not exist in the radiation field of the pulse acquisition radar when scanning.

The above information is applicable to typical HAWK sites. The services of the U.S. Army Environmental Hygiene Agency are available, in accordance with the provisions of AR 40-583 for the evaluation of potential radio-frequency hazards at sites where unusual operating or site conditions may exist.

WARNING**DANGEROUS VOLTAGE**

is used in the operation of this equipment

DEATH ON CONTACT

may result if personnel fail to observe safety precautions

Never work on electronic equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent in administering first aid. When the technician is aided by operators, he must warn them about dangerous areas.

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Take particular care to ground every capacitor likely to hold a dangerous potential. When working inside the equipment, after the power has been turned off, always ground every part before touching it.

Use extreme caution when operating equipment protected by interlocks. Ensure that interlocks (doors, panels, and drawers) are functioning properly. (TM 9-1425-525-12-4)

Be careful not to contact high-voltage connections when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through the vital organs of the body.

WARNING

Do not be misled by the term "low voltage." Potentials as low as 50 volts may cause death under adverse conditions.

For artificial respiration, refer to FM 21-11.

EXTREMELY DANGEROUS POTENTIALS

Refer to manual containing specific item of equipment for a list of those units with greater than 500 volts in that equipment.

For the pulse acquisition radar:**MECHANICAL HAZARD**

When performing maintenance procedures in the vicinity of the antenna, ensure that the antenna SAFE/ OPERATE switch, located on the receiver-transmitter group, is in the SAFE position, and the stow lock is engaged.

For the IFF antenna:**MECHANICAL HAZARD**

When performing maintenance procedures in the vicinity of the IFF antenna, ensure that both of the two antenna safety switches (one located on the IFF antenna pedestal and the other on the whip antenna base) are set to SAFE. In addition, not more than three personnel should occupy the roof of the ICC or PCP at any time.

For the cw acquisition radar:**MECHANICAL HAZARD**

When performing maintenance procedures in the vicinity of the antenna, ensure that the antenna SAFETY SWITCH, located on the radar set group, is in the SAFE position.

For the range-only radar:**MECHANICAL HAZARD**

When performing maintenance procedures in the vicinity of the antenna, ensure that the antenna SAFETY SWITCH, located on the base of the pedestal, is in the SAFE position.

For the high-powered illuminator radar:**MECHANICAL HAZARD**

When performing maintenance procedures in the vicinity of the antenna, ensure that the antenna PEDESTAL SAFETY SWITCH, located on the motor-generator assembly, is in the SAFE position.

For the launcher:**MECHANICAL HAZARD**

When performing maintenance procedures in the vicinity of the LCHR boom, ensure that the correct LAUNCHERS SAFE-OPERATE-ALERT switch for the LCHR to be checked, located on the launching section control box, is set to the LAUNCHERS SAFE position.

WARNING**EXPLOSIVES**

Intercept-aerial guided missiles MIM-23B, MIM-23C, MIM-23D, MIM-23E, and MIM-23F contain explosives. All applicable safety regulations will be strictly enforced. Explosive components containing electrical wiring must be protected at all times from stray voltages or induced electrical currents.

Handling operations should not be performed during electrical storms.

WARNING**X-RAY HAZARD**

X-rays exist within the PAR when radiating.

The X-rays are emitted from stabilotron tube QK630(V5) and thyatron tube 5949A(V3). Do not operate the PAR with the receiver-transmitter screened doors open or the shield removed from VS.

Failure to heed the warning may result in unnecessary exposure to low-level radiation. The severity of this exposure damage is dependent on the proximity of the source (tube) and the length of exposure.

WARNING**X-RAY HAZARD**

X-rays exist within the HIPIR when radiating.

The X-rays are emitted from PA klystron tube VA968(V2). Do not operate the HIPIR with the protective tube shield removed from V2.

Failure to heed the warning may result in unnecessary exposure to low-level radiation. The severity of this exposure damage is dependent on the proximity of the source (tube) and the length of exposure.

WARNING**DANGEROUS CHEMICALS**

are used in the operation
of this equipment

DEATH

may result if personnel fail
to observe safety precautions

The following is a list of chemicals used in the operation or maintenance of the equipment in this manual, including proper care and handling procedures and corrective actions (fire and first aid procedures).

Item (NSN/APN)	Care and Handling Procedures	Corrective Actions
Methyl chloroform 1, 1, 1- trichloroethane	<p>Flammable. Avoid heat, sparks, and open flames</p> <p>Excessive inhalation can cause drowsiness, dizziness, drunkenness, unconsciousness, and death at extreme doses</p> <p>Avoid prolonged or repeated contact with skin. Wear protective gloves to 15 minutes.</p> <p>Avoid contact with eyes. Do not wear contact lenses when working with this material. Wear safety goggles.</p> <p>Avoid swallowing</p>	<p>Use CO₂ or dry chemical extinguisher.</p> <p>Remove victim to fresh air. If not breathing, perform artificial respiration. If breathing is difficult, give oxygen. Get medical attention.</p> <p>Wash skin promptly and thoroughly with flowing water or shower for 5</p> <p>Flush eyes promptly with water for 5 to 15 minutes.</p> <p>Do not induce vomiting. Get medical attention.</p>
Electrolyte (sulfuric acid)	<p>Non-flammable. Can ignite finely divided combustible materials.</p> <p>Vapors can cause irritation of nose and throat.</p> <p>Avoid contact with skin. Can cause severe irritation, burns, and ulceration. Wear safety clothing.</p> <p>Avoid contact with eyes. Can cause severe irritation, corneal damage, and blindness. Wear safety goggles.</p> <p>Avoid swallowing. Can cause severe damage or death.</p>	<p>Use CO₂ or dry chemical extinguisher.</p> <p>Remove victim to fresh air. If not breathing, perform artificial respiration. Get medical attention.</p> <p>Remove soaked clothing promptly. Wash skin thoroughly with large amounts of water. Get medical attention.</p> <p>Flush eyes promptly with large amounts of water. Get medical attention.</p> <p>Give victim large amounts of water, if conscious. Get medical attention.</p>

WARNING**DANGEROUS CHEMICALS**

Continued

Item (NSN/APN)	Care and Handling Procedures	Corrective Actions
<p>Dry cleaning solvent type I P-D-680</p>	<p>Flammable. Avoid heat, sparks, and open flame.</p> <p>Excessive inhalation can cause headache, dizziness, and nausea. Use with adequate ventilation. When heated, may yield carbon monoxide.</p> <p>Avoid prolonged or repeated contact with skin</p> <p>Avoid contact with eyes. Vapor is irritating to eyes. Do not wear contact lenses when working with this material. Wear safety goggles.</p> <p>Avoid swallowing</p>	<p>Use CO₂ or dry chemical extinguisher.</p> <p>Remove victim to fresh air. If not breathing, perform artificial respiration. Get medical attention.</p> <p>Wash skin promptly and thoroughly with mild soap and water. Apply skin cream.</p> <p>Flush eyes promptly and thoroughly with water. Get medical attention.</p> <p>Do not induce vomiting. Get medical attention.</p>
<p>Butyl alcohol OC 265</p>	<p>Extremely flammable. Avoid heat, sparks, and open flame. Can ignite under almost all normal temperatures.</p> <p>Vapors are toxic. Can produce symptoms of intoxication. Use with adequate ventilation</p> <p>Avoid contact with skin</p> <p>Avoid contact with eyes. Wear safety goggles.</p> <p>Avoid swallowing. Can cause severe nausea, vomiting, abdominal pain, bleeding and central nervous system damage,</p>	<p>Use CO₂ or dry chemical extinguisher.</p> <p>Remove victim to fresh air. If not breathing, perform artificial respiration. If breathing is difficult, give oxygen. Get medical attention.</p> <p>Remove soaked clothing promptly. Wash skin thoroughly with water for 15 minutes minimum. Get medical attention.</p> <p>Flush eyes promptly with water for 15 minutes minimum. Get medical attention.</p> <p>Never give anything by mouth to an unconscious person. If victim is not alert, give black coffee and active charcoal. If victim is alert, induce vomiting. Get medical attention.</p>

WARNING**DANGEROUS CHEMICALS**

Continued

Item (NSN/APN)	Care and Handling Procedures	Corrective Actions
Methanol 0M232, grade A	<p>Flammable. Avoid heat, sparks, and open flame.</p> <p>Vapors can cause headache, dizziness, weakness, gastrointestinal or visual disturbance.</p> <p>Avoid contact with skin. Wear rubber gloves.</p> <p>Avoid contact with eyes. Wear safety goggles.</p> <p>Avoid swallowing. Can cause drowsiness, visual disturbances, possible blindness.</p>	<p>Use CO2, dry chemical or 'alcohol type' foam extinguisher.</p> <p>Remove victim to fresh air. If not breathing, perform artificial respiration. If breathing is difficult, give oxygen. Keep victim warm and cover eyes to exclude light. Get medical attention.</p> <p>Remove soaked clothing promptly. Wash skin thoroughly with large amounts of water for 15 minutes minimum. Get medical attention.</p> <p>Flush eyes promptly with large amounts of water for 15 minutes minimum.</p> <p>If conscious, give victim large amounts of soapy water and induce vomiting. Get medical attention.</p>
Isopropyl alcohol, technical IT 1735 grade 3	<p>Flammable. Avoid heat, sparks, and open flame. Fumes may spread long distances and flash back.</p> <p>Vapors can cause irritation of nose and throat.</p> <p>Avoid prolonged or repeated contact with skin. Wear protective gloves.</p> <p>Avoid contact with eyes. Can cause corneal burns and eye damage. Wear safety goggles.</p> <p>Avoid swallowing. Can cause depression, dizziness, headache, vomiting, and unconsciousness. Can cause death.</p>	<p>Use CO2, dry chemical or 'alcohol type' foam extinguisher.</p> <p>Remove victim to fresh air. If not breathing, perform artificial respiration. If breathing is difficult, give oxygen. Get medical attention.</p> <p>Remove soaked clothing promptly. Wash skin thoroughly with soap and water for 5 minutes minimum. Get medical attention.</p> <p>Flush eyes promptly with water for 15 minutes minimum. Get medical attention.</p> <p>Get immediate medical attention.</p>

WARNING**DANGEROUS CHEMICALS**

Continued

Item (NSN/APN)	Care and Handling Procedures	Corrective Actions
Insulation varnish MIL-V-173	<p>Flammable. Avoid heat, sparks, and open flame.</p> <p>Vapors can cause drowsiness, headache, dizziness and irritation of eyes, nose and throat. Use with adequate ventilation.</p> <p>Avoid prolonged or repeated contact with skin. Wear rubber gloves.</p> <p>Avoid contact with eyes. Wear safety goggles.</p> <p>Avoid swallowing</p>	<p>Use CO2 or dry chemical extinguisher.</p> <p>Remove victim to fresh air. If not breathing, perform artificial respiration. Get medical attention.</p> <p>Wash skin promptly and thoroughly with mild soap and water. Apply skin cream.</p> <p>Flush eyes promptly with water for 15 minutes minimum. Get medical attention.</p> <p>Do not induce vomiting. Get medical attention.</p>
Polychlorinated biphenyls (PCB) (contained in General Electric and Electrical Utilities capacitors located in the motor-generator assembly)	<p>Do not allow capacitors to become overheated. Replace any capacitors that show signs of swelling or leakage.</p> <p>If material leaks or vaporizes, persons in the area should wear protective clothing (paper suits, gloves, disposable booties, organic respirators) when disposing of contaminants.</p> <p>Excessive inhalation can cause nausea, vomiting, loss of weight, liver damage and abdominal pain. When liver damage is severe, it can be fatal.</p> <p>Avoid contact with skin. Wear protective gloves.</p> <p>Avoid contact with eyes. Do not wear contact lenses when working with this material. Wear safety goggles.</p> <p>Avoid swallowing</p>	<p>Remove victim to fresh air and give oxygen if short of breath. If not breathing, perform artificial respiration. Keep victim warm. Get medical attention.</p> <p>Remove all ignition sources. Ventilate the area. If solid material is present, sweep onto paper or other suitable material and burn in safe place. If in a liquid form, absorb on paper towels. Evaporate in a safe place, then burn. PCB material can also be disposed of in an approved hazardous waste location.</p> <p>Remove victim to fresh air and give oxygen. Get medical attention.</p> <p>Remove contaminated clothing promptly. Blot excess with paper towels. Wash skin thoroughly with soap and water for 15 minutes minimum.</p> <p>Flush eyes promptly with water for 15 minutes minimum. A drop of vegetable oil may be added to relieve irritation. Get medical attention. Get medical attention immediately.</p>

WARNING**DANGEROUS CHEMICALS**

Continued

Item (NSN/APN)	Care and Handling Procedures	Corrective Actions
Toluene OC 265	<p>Flammable. Avoid heat, sparks, and open flame.</p> <p>Vapors can cause dizziness, headache or unconsciousness.</p> <p>Avoid prolonged or repeated contact with skin. Wear protective gloves and clothing.</p> <p>Avoid contact with eyes. Wear safety goggles.</p> <p>Avoid swallowing.</p>	<p>Use CO2, dry chemical, 'alcohol type' foam, water spray or fog extinguisher.</p> <p>Remove victim to fresh air. If breathing is irregular or stopped, perform artificial respiration. Get medical attention.</p> <p>Remove soaked clothing. Wash skin promptly and thoroughly with mild soap and water.</p> <p>Flush eyes promptly with clear water for 15 minutes minimum.</p> <p>Do not induce vomiting. Get medical attention.</p>
Mineral spirits	<p>Flammable. Avoid heat, sparks, and open flame.</p> <p>Vapors can cause dizziness, headache or unconsciousness.</p> <p>Avoid prolonged or repeated contact with skin. Wear protective gloves and clothing.</p> <p>Avoid contact with eyes. Wear safety goggles.</p> <p>Avoid swallowing.</p>	<p>Use CO2, dry chemical, 'alcohol type' foam, water spray or fog extinguisher.</p> <p>Remove victim to fresh air. If breathing is irregular or stopped, perform artificial respiration. Get medical attention.</p> <p>Remove soaked clothing. Wash skin promptly and thoroughly with mild soap and water.</p> <p>Flush eyes promptly with clear water for 15 minutes minimum.</p> <p>Do not induce vomiting. Get medical attention.</p>

WARNING**DANGEROUS CHEMICALS**

Continued

Item (NSN/APN)	Care and Handling Procedures	Corrective Actions
<p>Freon (Cleaning compound solvent) (Ethylene glycol freon cleaning solvent)</p>	<p>Non-flammable. Use in small quantities. Open flames, high temperatures, alkali or alkaline earth metals may cause hazardous decomposition with emission of hydrochloric and hydrofluoric acids which are possible carbonyl halides.</p> <p>Use in well-ventilated area. Vapors will concentrate in low areas. Excessive inhalation may cause lightheadedness, shortness of breath, possible stupor, and at high concentrations can affect heart rhythm. Use an air mask at high concentrations.</p> <p>Avoid prolonged or repeated contact with skin. Wear protective gloves.</p> <p>Avoid contact with eyes. Wear safety goggles.</p> <p>Avoid swallowing.</p>	<p>Absorb spills with paper, vermiculite, floor absorbent, or other absorbent material.</p> <p>Remove victim to fresh air. If not breathing, perform artificial respiration. If breathing is difficult, give oxygen. DO NOT give epinephrine or similar drugs, since such drugs may induce erratic heartbeat. Get medical attention.</p> <p>Wash skin promptly and thoroughly with mild soap and water.</p> <p>Immediately flush eyes thoroughly with water.</p> <p>If conscious, give two glasses of water. Induce vomiting immediately. DO NOT induce vomiting in an unconscious victim. Get medical attention.</p>
<p>Dielectric coolant fluid OS45 type 2</p>	<p>Avoid water contamination as mixture can become flammable.</p> <p>Excessive high temperature may produce irritating vapors.</p> <p>Avoid prolonged or repeated contact with skin.</p> <p>Avoid contact with eyes. Wear safety goggles.</p>	<p>Use CO2 or dry chemical extinguisher.</p> <p>Remove victim to fresh air.</p> <p>Wash promptly and thoroughly.</p> <p>Flush eyes promptly and thoroughly with water. Get medical attention.</p>

WARNING**DANGEROUS CHEMICAL**

Continued

Item (NSN/APN)	Care and Handling Procedures	Corrective Actions
Coolant (Union Carbide PM-3961)	<p>Flammable. Avoid open flames and sparks.</p> <p>Avoid contact with skin. Wear rubber gloves.</p> <p>Avoid contact with eyes. Wear safety goggles.</p> <p>Avoid swallowing. Can cause damage to the central nervous system and severe kidney damage.</p>	<p>Use CO2 or dry chemical extinguisher.</p> <p>Wash skin promptly and thoroughly with water.</p> <p>Flush eyes promptly and thoroughly with water.</p> <p>Get medical attention immediately.</p>
Dielectric coolant fluid OS59 type 3	<p>Avoid water contamination as mixture can become flammable.</p> <p>Excessive high temperature may produce irritating vapors.</p> <p>Avoid prolonged or repeated contact with skin.</p> <p>Avoid contact with eyes. Wear safety goggles.</p>	<p>Use CO2 or dry chemical extinguisher.</p> <p>Remove victim to fresh air.</p> <p>Wash skin promptly and thoroughly.</p> <p>Flush eyes promptly and thoroughly with water. Get medical attention.</p>
Naphtha TTN 97 TTYIGRA	<p>Flammable. Avoid open flames and sparks.</p> <p>Use in well-ventilated area.</p> <p>Avoid contact with skin. Wear protective clothing (rubber gloves, apron, and safety goggles).</p> <p>Avoid contact with eyes. Do not wear contact lenses when working with this material. Wear safety goggles.</p> <p>Avoid swallowing.</p>	<p>Use CO2 or dry chemical extinguisher.</p> <p>Remove victim to fresh air. If breathing has stopped, perform artificial respiration. Get medical attention.</p> <p>Wash skin promptly and thoroughly with soap or mild detergent and water. If irritation persists after washing, get medical attention.</p> <p>Flush eyes promptly and thoroughly with water. Get medical attention.</p> <p>Do not induce vomiting. Get medical attention immediately.</p>

Insert the latest changed pages in accordance with the instructions on the transmittal sheet.

LIST OF EFFECTIVE PAGES

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Dates of issue for original and changed pages are:

Original 0, 28 Aug 1972
 Change 1, 6 Feb 1978
 Change 2, 7 Mar 1979
 Change 3, 15 Jun 1981
 Change 4, 31 Mar 1987
 Change 5, 5 Dec 1988

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B



**OPERATOR AND ORGANIZATIONAL
GENERAL MAINTENANCE
FOR THE
HAWK GUIDED MISSILE SYSTEM**

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publication and Blank Forms) direct to: Commander, U.S. Army Missile Command, ATTN: AMSMI-LC-ME-PM, Redstone Arsenal, Alabama 35898-5238. A reply will be furnished to you.

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CHAPTER 1 INTRODUCTION

1-1. Scope

a. This technical manual (TM) contains instructions for the information and guidance of the personnel responsible for operation and organizational maintenance of the HAWK air defense guided missile system.

b. The requirement for nomenclature distinction between 'Basic and Improved' HAWK Systems and major items is no longer applicable. Action to delete this distinctive terminology will be taken as the respective pages of this manual are changed for other reasons.

1-2. Forms, Records, and Reports

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738-750, The Army Maintenance Management System (TA MMS). The DA PAM is published in the Maintenance Management UPDATE. Units may subscribe to Maintenance Management UPDATE by submitting a completed DA Form 12-13.

1-3. Reporting Equipment Improvement Recommendations (EIR's)

If your equipment needs improvement, let us know. Send us an EIR. You, the user, are the only one who can

tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to the address stated in DA PAM 738-750. We'll send you a reply.

1-4. Responsibilities

Operators and crew chiefs are directly responsible for assigned materiel. Section and platoon leaders are charged with supervisory responsibility for material pertaining to their commands. Unit and organizational commanders are required to ensure that materiel issued or assigned to their commands is properly used and maintained in a serviceable condition.

1-5. Periodic Tests

Certain units and panel meters require periodic tests to ensure their accuracy. These periodic tests are performed by DS and GS personnel. It is the responsibility of organizational personnel, however, to ensure that these tests are performed as scheduled and that the units are available for testing. The list of units requiring periodic test is contained in Appendix D of TM 9-4935-1540-14-1.

(1-2 blank)1-1

CHAPTER 2 ELECTRICAL INSPECTION AND REPAIR

2-1. General

The purpose of this visual electrical inspection guide and repair data is to detect the first signs of electrical failures of assemblies in the materiel, and to insure that appropriate corrective action is taken before expensive and time-consuming repairs or replacements are required. The system of preventive maintenance services is based on frequent inspections and services accomplished by operators or maintenance personnel under active supervision of all commanders and leaders.

2-2. Inspection

Refer to table 2-1, the visual electrical inspection guide, to:

- a. Determine the condition of an item, i.e., serviceable or unserviceable.
- b. Recognize conditions which would cause failure.
- c. Insure proper application of maintenance policies at prescribed levels.

2-3. Electrical Troubleshooting

This paragraph provides information for locating and correcting troubles in the electrical systems of the major items of the improved HAWK air defense guided-missile system. Troubleshooting procedures in a systematic step-by-step operation are designed to aid the technician in isolating defective components in a minimum of time. The malfunction column of table 2-2 lists the troubles that may be expected to occur in the electrical system of the shelters. In items 1, 2, 3, and 9, it is assumed that power is present in the input cables from the outside power source. The probable cause column lists the causes of the trouble. The corrective action column gives the procedures for locating the cause of trouble and, where necessary-, the remedial steps to be taken.

2-3.1. Meter Demagnetizing

Erratic meter readings may be caused by a buildup of static electricity on the meter face. This buildup can be neutralized by the application of neutralizer "STAT-NUL" 6850-00-882-6690 to the face of the affected meters. This neutralizer should be used whenever it is suspected that meters have become magnetized and prior to performing the periodic meter test procedures.

2-4. Soldering

a. *General. Soldering.* is the most common method of binding connections in electrical or electronic work. There are many types of connections, each of which may require a slightly different method of soldering. Standard soldering methods, based upon experience, indicate the best way to solder particular types of electrical connections.

b. *Soldering Electrical Connections.* The following data supplements information contained in TB SIG 222. A 25- to 35-watt soldering iron is used for printed circuit board repair, especially when repairing heat-sensitive devices such as semiconductors. Low-temperature rosin-core solder is used, and special care taken to insure that excess solder does not short to an adjacent part. Although rosin flux is non-conductive, it may flake and fall into components and interfere with their operation. Remove excess rosin flux with alcohol. Figures 2-1 through 2-30 illustrate typical soldering techniques for electrical components.

2-5. Removal and Installation of Electrical Components

a. *General.* This section contains typical removal and installation procedures for electrical components in general use throughout the system. Each illustration represents a typical electrical component and its associated hardware.

b. *Malfunction.* In the event of malfunction, the consoles or accessories should be returned to a serviceable condition as quickly as possible by replacing the defective subassembly or chassis with a good unit. The faulty unit can be taken to a bench to be repaired and returned to operational spares.

c. *Printed Circuit Board Mounted Parts.*

NOTE

The key numbers shown below in parentheses refer to figure 2-31.

(1) *Method A.* Cut the leads (l) as close to the defective part as possible and discard the part. Use needle-nose pliers to loop the leads of the new

Table 2-1. Visual Electrical Inspection Guide -Typical

Part	Condition
Cables and wires	Securely attached to pins and terminals. Not broken or kinked. Insulation free from breaks, cracks, tears, cuts, abrasions, oil, grease, burns, and fungus growths, and not pulled loose from connectors.
Capacitors	Securely installed. Not broken, cracked, charred, blistered, discolored, or swelled. No evidence of oil or electrolyte leakage.
Coils	Securely installed. Not broken, cracked, charred, blistered, discolored, or swelled. No evidence of oil or potting compound leakage.
Connectors	Securely installed. Not broken, cracked, chipped, or corroded. Inserts not broken, burned, or corroded. Pins not broken, burned, or corroded. Clean and free from foreign matter.
Electron tubes	Correct tubes installed. Envelopes not broken or cracked. Not loose in base. High-voltage tubes clean and free from foreign matter and caps in place and secure.
Electron tube sockets	Securely installed.
Electron tube shields, clamps and retainers	Not broken, cracked, or chipped. In place and secure.
Fuses	Not broken, cracked, bent, or chipped. Not blown. Securely installed.
Indicator lamps	Proper type and rating. Correct lamps installed, securely seated, and not broken. Lenses securely seated and not broken or cracked.
Meters	Securely installed. Pointers not broken or bent. Covers not broken.
Push switches	Securely installed. Depress easily and return to original position when released.
Push-pull (interlock) switches	Securely installed. Depress easily and return to original position when released. Pull out and remain out, but return easily to original position when depressed.
Reactors	Electrical connections are secure, and offer a continuous path for current flow. Securely installed. Not broken, cracked, charred, blistered, discolored, or swollen, No evidence of oil or potting compound leakage. Standoff insulators not broken, cracked, or chipped, and no hairline cracks or carbonized arc-over paths.
Relays	Standoff insulators clean and free from foreign matter. Securely installed. Not broken, charred, or discolored. Contacts not burned, pitted, or stuck together.
Resistors	Securely installed. Not broken, cracked, charred, blistered, discolored, or swollen.

2-1. Visual Electrical Inspection Guide -Typical-- Continued

Part	Condition
Rotary switches	Securely installed. Knobs securely attached to shaft and not broken, cracked, or chipped, Knobs turn easily to all positions. Indexes aline with pointers at the lock position. Insulation is free from breaks or cracks. Stops are operative where applicable. Movable contacts aline themselves with the stationary contact at each position.
Standoff insulators	Contacts are free from bends, burns, and breaks. Not broken, cracked, or chipped. No hairline cracks or carbonized arc-over paths. Clean and free from foreign matter.
Terminal boards	Securely installed. Not broken, chipped, or cracked. Free from foreign matter.
Toggle switches	Securely installed. Move easily to all positions. Momentary-contact toggle switches return to original position when released.
Transformers	Electrical connections are secure, and offer a continuous path for current flow. Securely installed. Not broken, cracked, charred, blistered, discolored, or swollen. No evidence of oil or potting compound leakage. Standoff insulators not broken, cracked, or chipped, and no hairline cracks or carbonized arc-over paths. Standoff insulators clean and free from foreign matter.
Variable resistors	Securely installed. Not broken, cracked, charred, or swollen. Terminals not shorted.
Variable transformers	Securely installed. Windings clean and not broken, rough, or loose. Brushes securely installed and not broken, cracked, or chipped. Brushes bear firmly on windings along entire brush paths and do not go off ends of windings. Clean and free from foreign matter.

part around the remaining sections of the old leads. Solder the new part in place and cut off any excess lead. Insure that the clippings do not fall onto the board to cause short circuits.

(2) *Method B.* Cut the leads (1) close to the board and discard the defective part. Heat the connections (2) long enough to melt the solder and remove the remaining leads. Insert the leads of the new part into the mounting holes. If necessary, enlarge the mounting holes with a sharp-pointed tool. Solder the leads, using as little solder as possible.

NOTE

The key numbers shown below in parentheses refer to figure 2-32.

d. *Semiconductors.* The semiconductors (2) should be replaced on the printed circuit board as described in subparagraph c. Semiconductors can be easily ruined by

the application of t(x) much heat. The wattage rating of the soldering iron (3) must not exceed 35 watts and low-temperature rosin-core solder must be used, A heat sink (long-nosed pliers) (1) must always be used. The terminal lead (4) must be held by, long-nosed pliers during the soldering to insure that the heat is diverted away from the semiconductor. The pliers should remain attached to the terminal lead for a short time after soldering is completed to insure that the heat is drawn away.

e. *Submodules.* Refer to figure 2-33.

f. *Submodule Electron Tubes.* Refer to subparagraph e to remove the submodule. Refer to figure 2-34 for submodule electron tube removal and installation procedures. Refer to subparagraph e to install the submodule.

Table 2-2 Electrical Troubleshooting of the Main Power Supply Typical

Item	Malfunction	Probable cause	Corrective action
1.	GENERATOR ON indicator lamp does not light.	Burned out or broken lamp	Replace
WARNING			
Notify the power source operator to set the generator circuit breaker to the OFF position and disconnect the power cable from the generator before taking corrective action to replace a faults component.			
2.	PHASE INDICATOR lamp, does not light.	Poor connection between 416-vac power cable and cable entry connector Loose connection due to damaged or cross threads on plug and connector Loose wire connections or improper wiring	Inspect connector and cable plug for damaged pins or plugged pin holes Check wire connections for tightness at cable entry connector Check out wiring using applicable schematic.
3.	MAIN POWER ON lamp does not light	Same as above Improper phase sequence from power source	Same as above Disconnect input 416-vac power cable and notify power source operating personnel
4.	UTILITY ON indicator lamp does not light	Burned out or broken lamp Poor connection between 416-vac power cable and cable entry connector Loose wire connections or improper wiring Faulty MAIN POWER circuit breaker	Replace Inspect connector and cable plug for damaged pins or plugged pin holes. Check wire connections for tightness at cable entry connector Check out wiring using applicable schematic, Check wire connectors on load side for tightness. Using a voltmeter, check for presence of 416 vac on load side of the circuit breaker. If not present, replace the circuit breaker,
4.	UTILITY ON indicator lamp does not light	Burned out or broken lamp Faulty UTLITY POWER circuit breaker Faulty transformer Improper or faulty wiring check the light circuit for faulty, broken, or improper wiring.	Replace. Check wire connectors on load side for tightness. Using a voltmeter, check for presence of 416 vac on load side of the circuit breaker. If not present, replace the circuit breaker, Check all wire connections for tightness. Using a voltmeter, check for presence of 208 vac on secondary' side of the transformer. If not present, replace transformer. Using the applicable schematic,

Table 2-2. Electrical Troubleshooting of the Main Power Supply - Typical - Continued

Item	Malfunction	Probable cause	Corrective action
5	No output from 416-vac receptacle. MAIN POWER indicator lamp illuminated	Faulty receptacle Poor wire connections Improper wiring Broken wire	Shut off MAIN POWER circuit breaker. Using applicable schematic, working from the receptacle, check all wire runs and connections until source of trouble is located.
6	Normal light circuit not functioning. UTILITY ON indicator lamp illuminated	Faulty light switch ground Faulty blackout controls Improper wiring, poor connections or broken wire between LIGHTS switch and blackout controls.	Using a 120 vac test lamp, one lead of the test lamp and check the load side of the switch for presence of 120 vac. If all connectors and connections are in good order and 120 vac is not present, replace switch. Check switches as above. Using the applicable schematic, check wiring between switches.
7	No output from 120-vac receptacle . Normal lights illuminated	Faulty receptacle Poor wire connections Improper wiring Broken wire	Shut off MAIN POWER circuit breaker. Using applicable schematic, working from the receptacle, check all wire runs and connections until source of trouble is located.
8	No power from 208-vac receptacle. UTILITY ON indicator lamp illuminated.	Same as above	Same as above.
9	Emergency lights do not illuminate.	Poor connection between emergency power cable and cable entry connector Loose wire connections or improper wiring Faulty EMERGENCY circuit breaker Improper or faulty wiring	Inspect connector and cable plug for damaged pins or plugged holes . Check wire connections for tightness at cable entry connector. Check out wiring using applicable schematic. LIGHTS Check wire connectors on load side for tightness. Using a volt- meter, check for presence of 24 or 28 vdc, whichever is applicable to the shelter, on the load side of circuit breaker. If not present, replace the circuit breaker. Using the applicable schematic, check the light circuit for faulty, broken, or improper wiring.

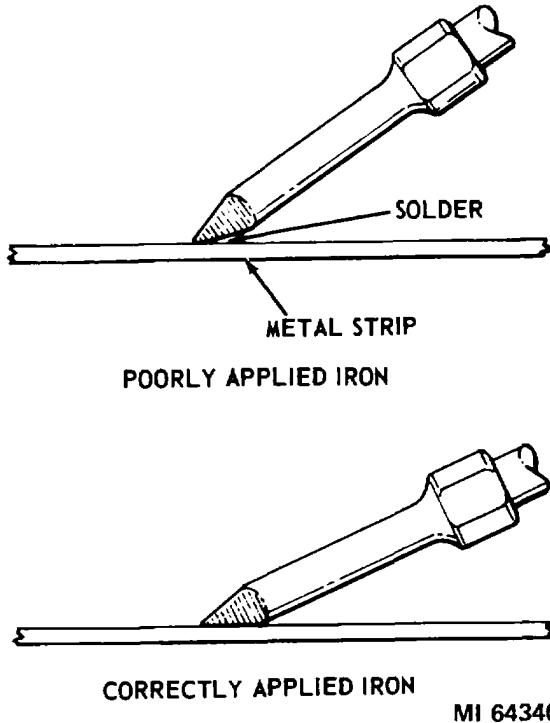


Figure 2-1. Correct and incorrect methods of applying soldering iron - typical.

CAUTION

In step g below, the threads on the control shaft will be stripped if excessive force is used to tighten the nut.

- g. Variable Resistors. Refer to figure 2-35.
- h. Reactors. Refer to figure 2-36.
- i. Meters. Refer to figure 2-37.
- j. Relays. Refer to figure 2-38.
- k. Transformers. Refer to figure 2-39.
- l. Indicator Lamps and Lampholders. Refer to figure 2-40.
- m. Fuses and Fuseholders. Refer to figure 2-41.
- n. Toggle Switches. Refer to figure 2-42.
- o. Rotary Switches. Refer to figure 2-43.
- p. Connectors. Refer to figure 2-44.

q. Circuit Breakers. Refer to figure 2-45.

r. Tip Jacks. Refer to figure 2-46.

2-6. Replacement of Typical Modules

WARNING

Ensure that power has been removed from the drawer before removing and installing modules.

Removal and installation of typical modules are shown in figures 2-46.1 and 2-47. Figure 2-46.1 and view A of figure 2-47 show the removal of the module when the module extractor is required. View H of figure 2-47 shows the removal of the hand-type modules. When using the module extractor, attach it and then jiggle it back and forth firmly, but not excessively, until the module is loosened from the parent board connector. Let the hand, not the arm, do the work on the module extractor. Disengage the module extractor and carefully remove the module by hand.

CAUTION

During installation, if resistance is encountered, check to see if the module is correctly keyed for the slot and check for pin and jack damage.

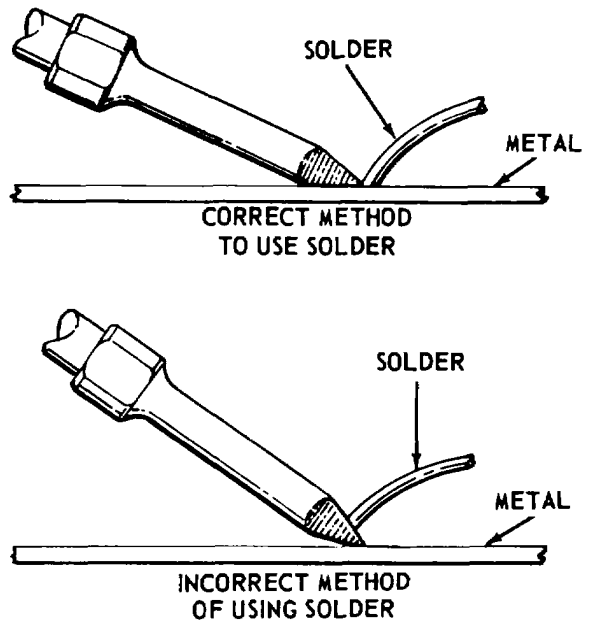


Figure 2-2. Correct and incorrect methods of using solder - typical.

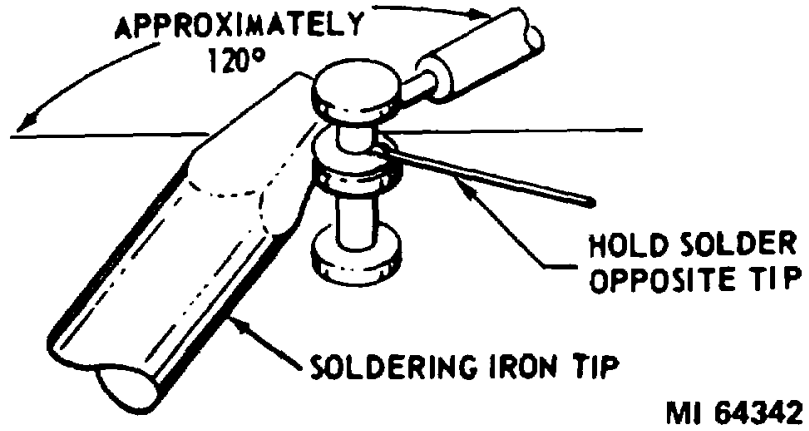


Figure 2-3. Correct method of positioning soldering iron - typical.

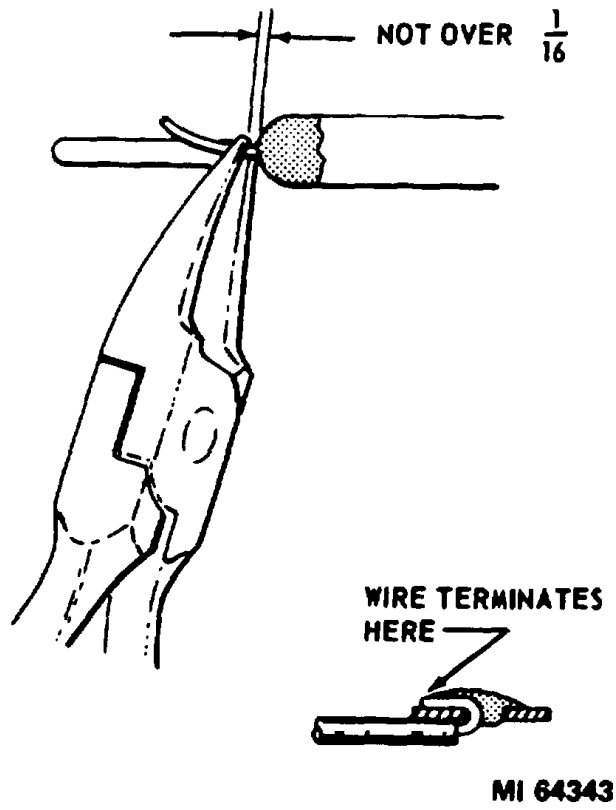
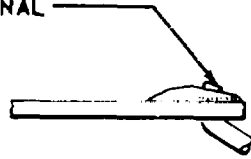


Figure 2-4. Removing excess wire after soldering - typical.

WIRE CUT OFF TOO CLOSE
AND NOT BENT OVER END
OF TERMINAL



WIRE EXPOSED AND SHOWS
IMPERFECT AMALGAMATION
AT SIDES AND TOP



THE ABOVE CONNECTIONS DO NOT HAVE SUFFICIENT
MECHANICAL STRENGTH TO WITHSTAND STRESSES
APPLIED TO THE WIRE.

EXPOSED WIRE



WIRE IMPERFECTLY
IMBEDDED IN SOLDER



THE EXPOSED PORTION OF BARE WIRE SHOULD BE
TOUCHED WITH A HOT IRON UNTIL THE SOLDER FLOWS
OVER ALL SURFACES. IF THE WIRE IS COATED WITH
ENAMEL, OR IS DIRTY, IT MUST BE CLEANED.

AIR SPACE



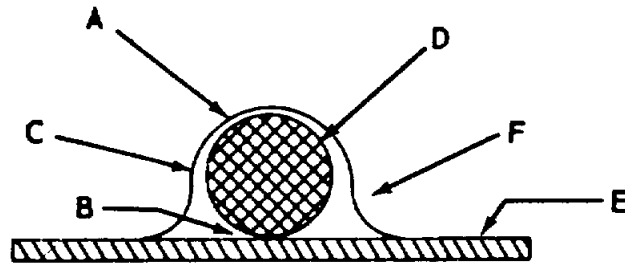
POCKET FILLED WITH BLACK
ENAMEL OR ROSIN



AIR SPACES AND POCKETS FILLED WITH BLACK ENAMEL
PERMIT ENTRANCE OF AIR WHICH, IN TIME, MAY CAUSE
OXIDATION OF WIRE AND SOLDER, WEAKENING THE
CONNECTION.

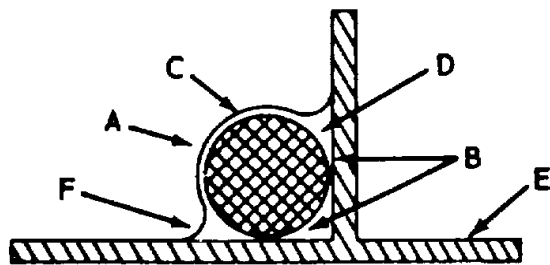
MI 64344

Figure 2-5. Faulty soldering connections - typical.



PC-TYPE SOLDER CONNECTION

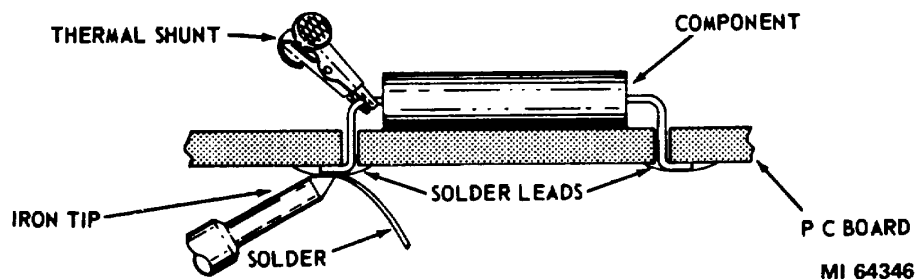
- A. A MINIMUM AMOUNT OF SOLDER SHALL COVER THE TOP OF THE CONDUCTOR.
- B. WIRE, SOLDER AND TERMINAL MUST BE COMPLETELY FUSED AT THIS POINT AND WIRE MUST BE ADJACENT TO TERMINAL.
- C. ENTIRE MASS CONSISTING OF TERMINAL, WIRE AND SOLDER MUST BE FREE OF ALL FOREIGN SUBSTANCES.
- D. CONDUCTOR WIRE (COPPER).
- E. TERMINAL OR PRINTED CIRCUIT (PC) PAD.
- F. SMOOTH SOLDER CONTOUR AND PROPER FILLETING ACTION INDICATING REQUIRED FLOWING AND WETTING ACTION.



SOLID TERMINAL TYPE SOLDER CONNECTION

MI 64345

Figure 2-6. Enlarged cross-sections of properly soldered connections - typical.



MI 64346

Figure 2-7. Thermal shunt - typical.

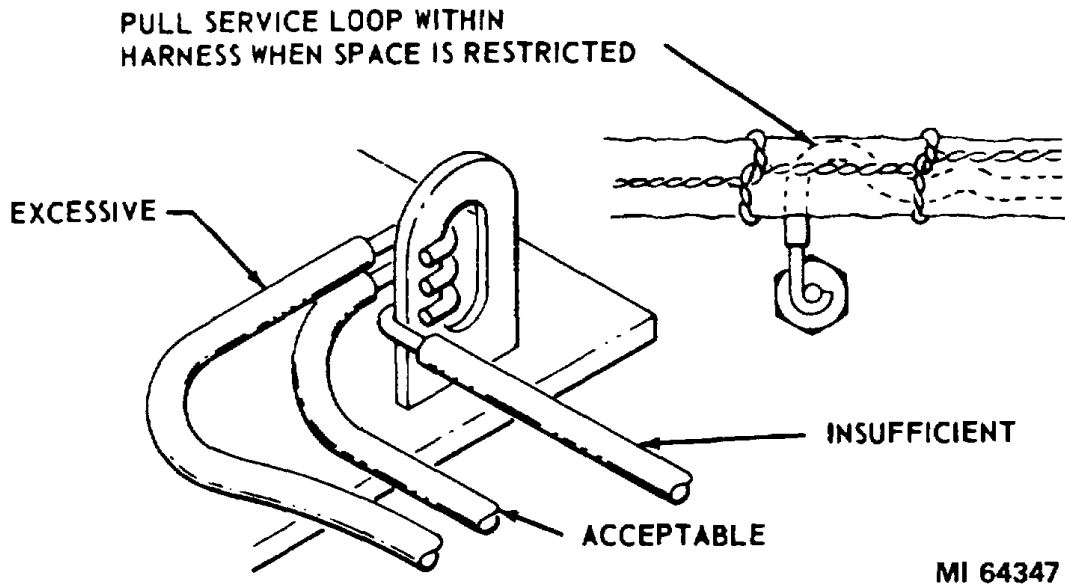


Figure 2-8. Correct ribration bend - typical.

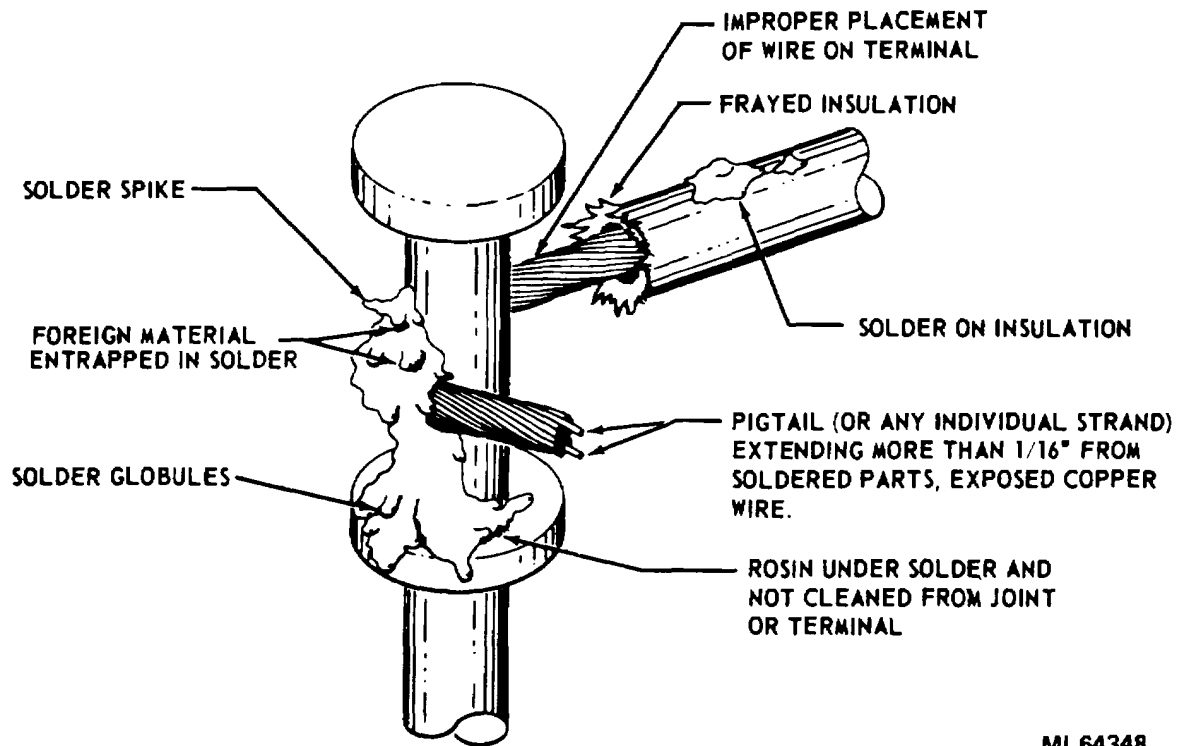
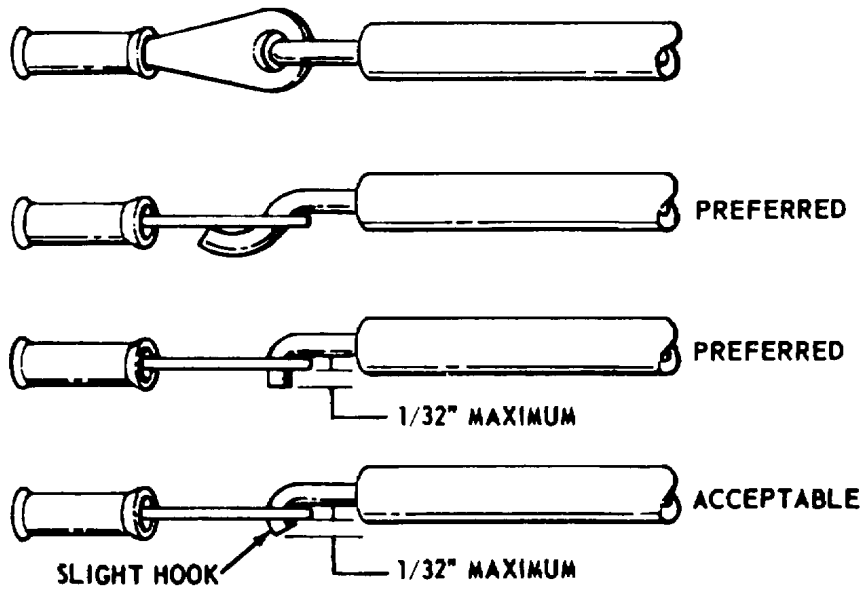
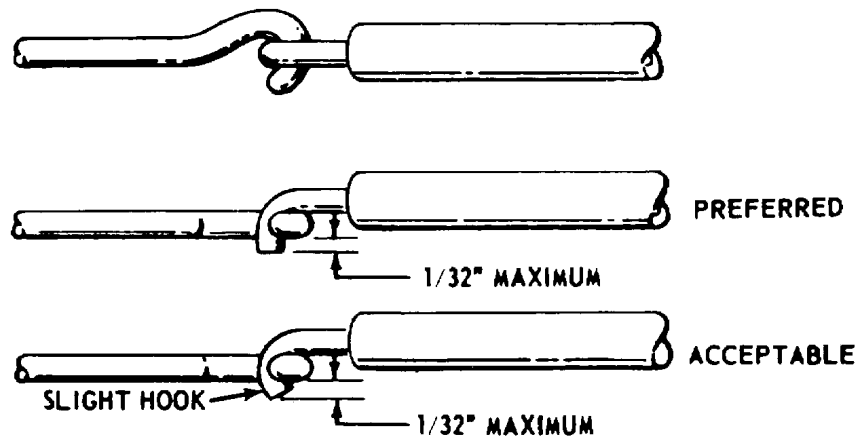
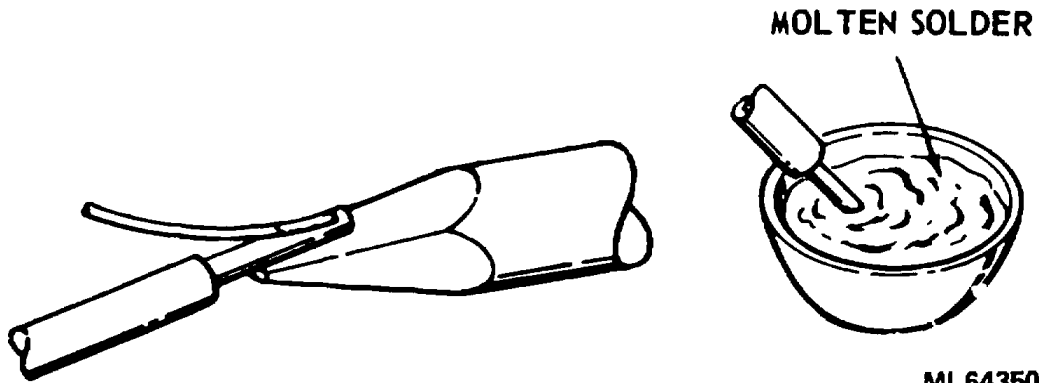


Figure 2-9. Incorrect methods of soldering - typical.



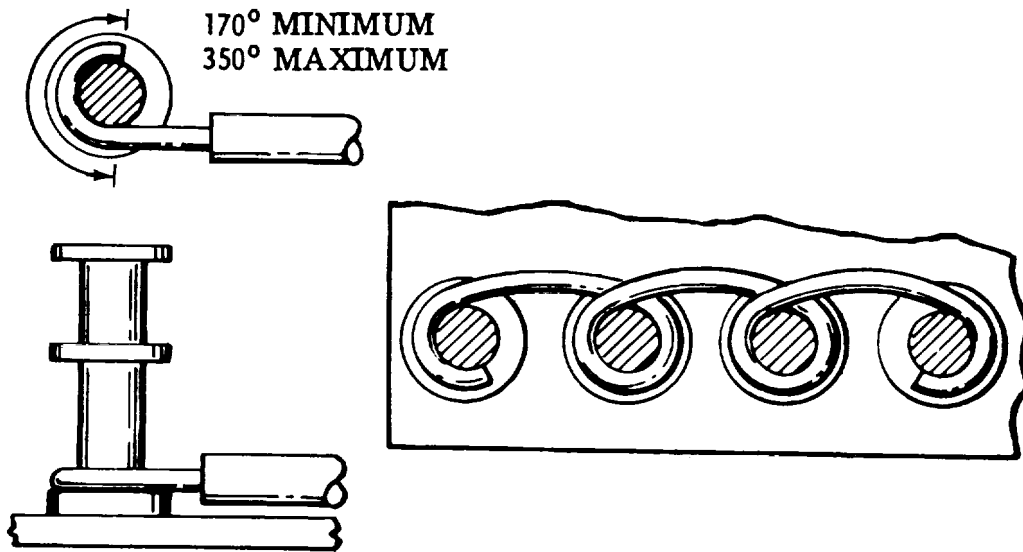
MI 64349

Figure 2-10. Eyelet terminals - typical.



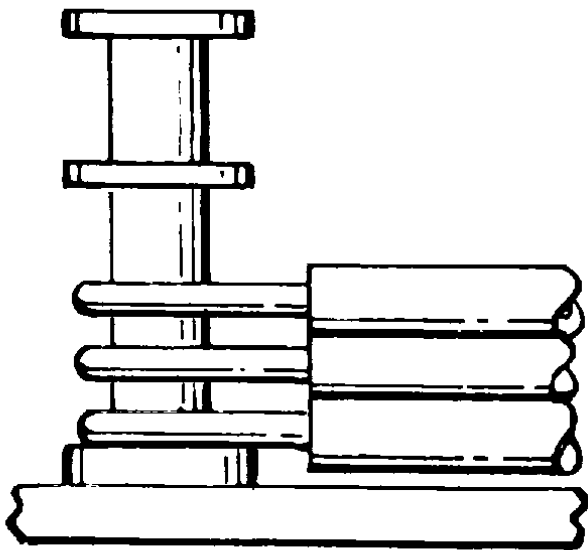
MI 64350

Figure 2-11. Suggested methods for tinning (wire) - typical.



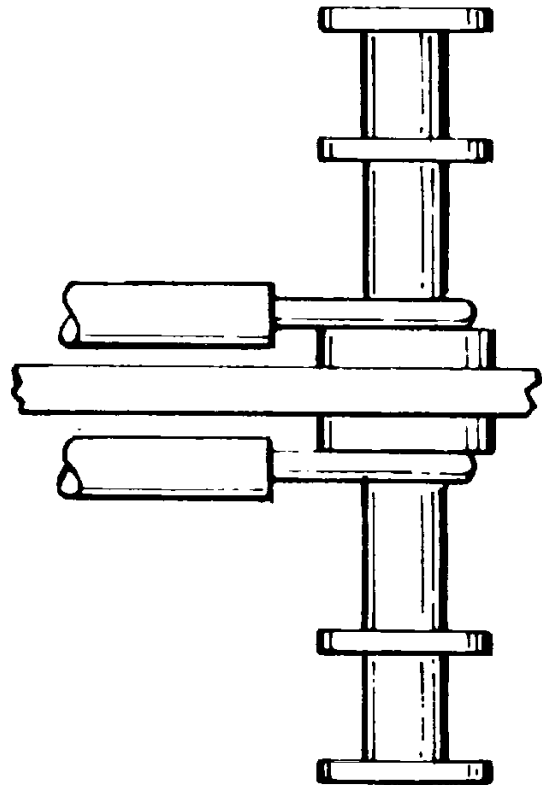
MI 64351

Figure 2-12. Soldering turret-type terminals - typical.



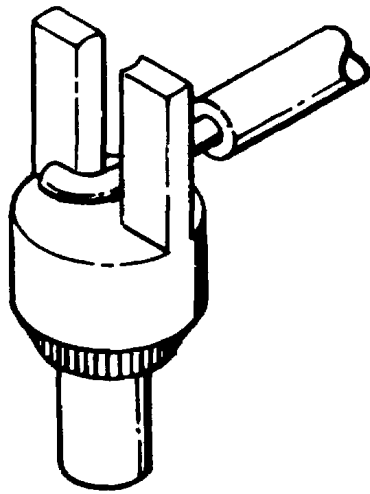
MI 64352

Figure 2-13. Soldering multiple-type connections - typical.



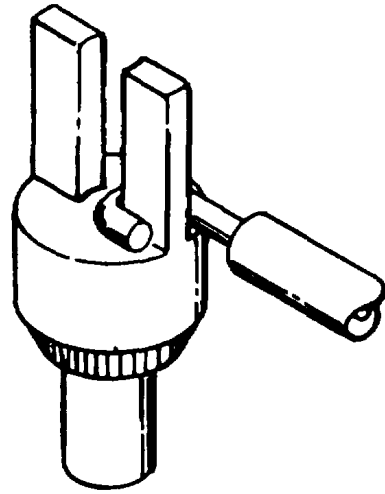
MI 64353

Figure 2-14. Soldering double-ended terminals - typical.



A

90° BEND PREFERRED

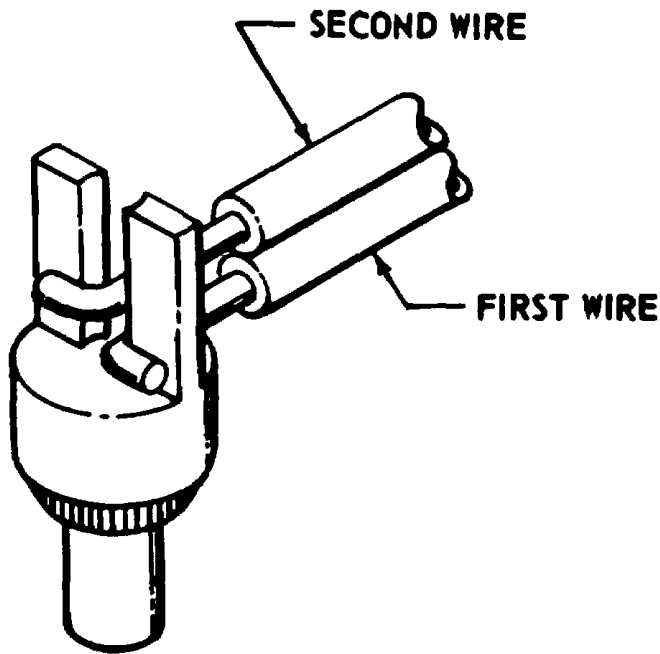


B

180° BEND PERMITTED WHEN MECHANICAL HOLDING IS REQUIRED

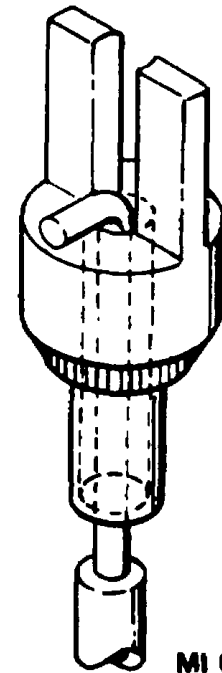
MI 64354

Figure 2-15. Soldering bifurcated terminal side route single connection - typical.



MI 64355

Figure 2-16. Soldering bifurcated terminal multiple side route connections - typical.



MI 64356

Figure 2-17. Soldering bifurcated terminal bottom route connections - typical.

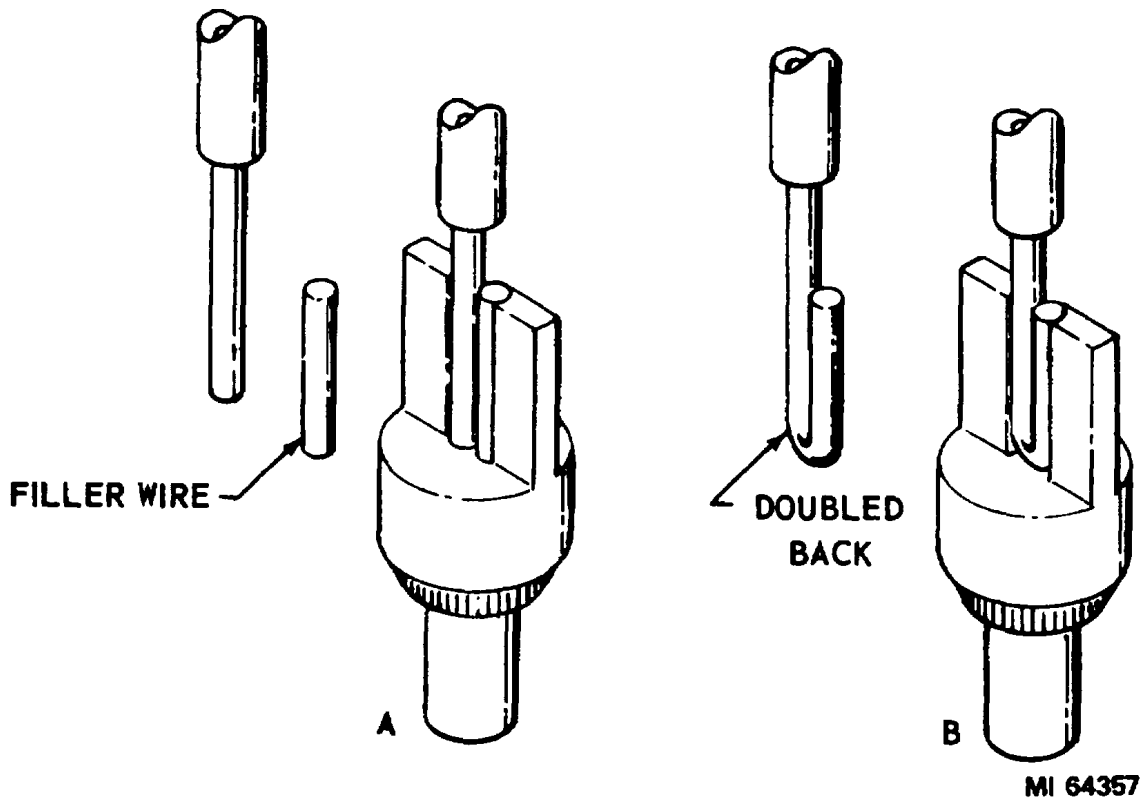


Figure 2-18. Soldering bifurcated terminal top route connections - typical.

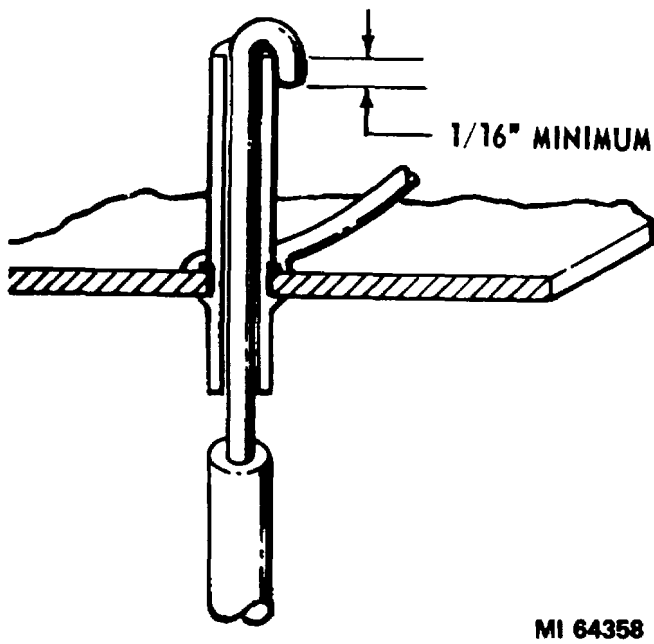


Figure 2-19. Soldering feedthru terminal top termination - typical.

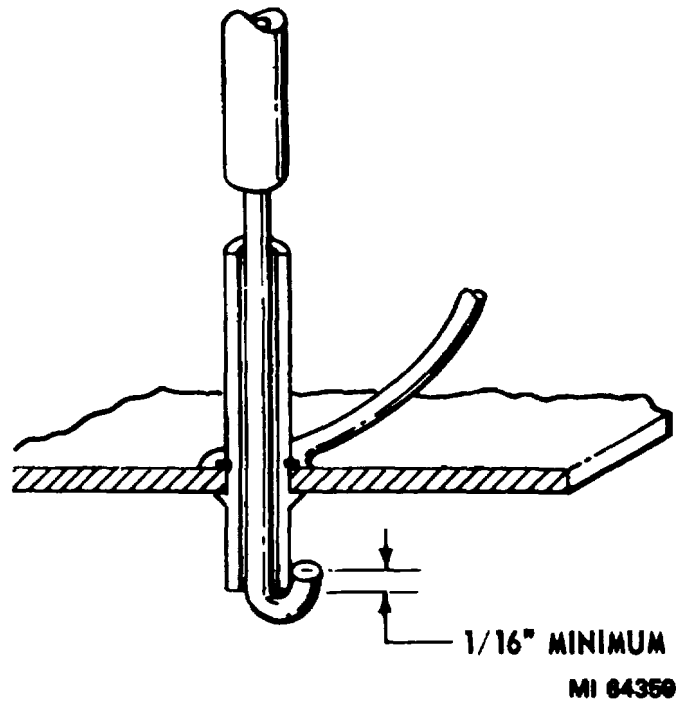
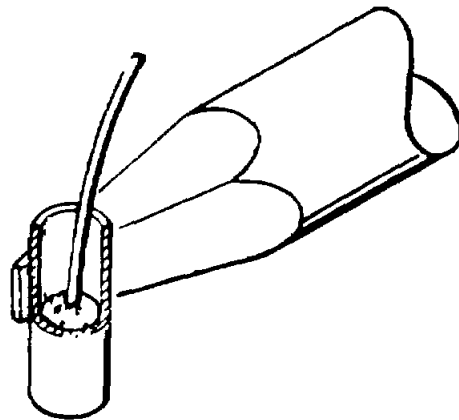
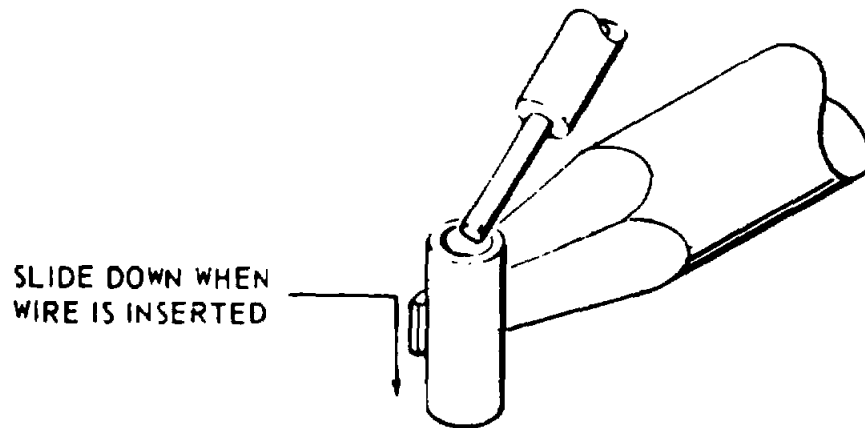


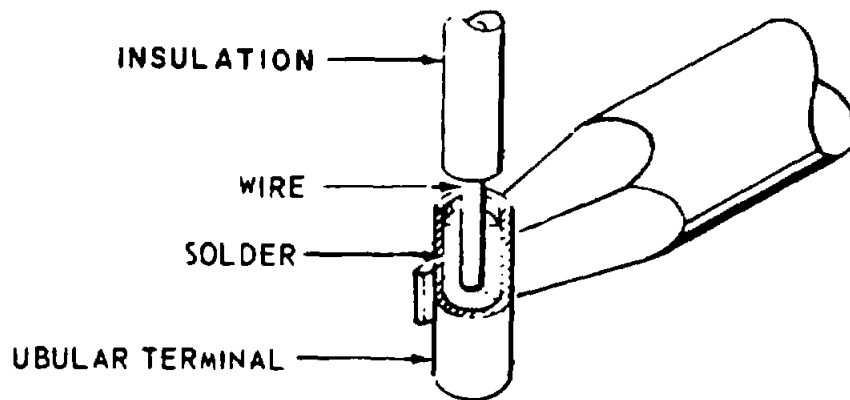
Figure 2-20. Soldering feedthru terminal bottom termination - typical.



FILLING HOLE WITH SOLDER

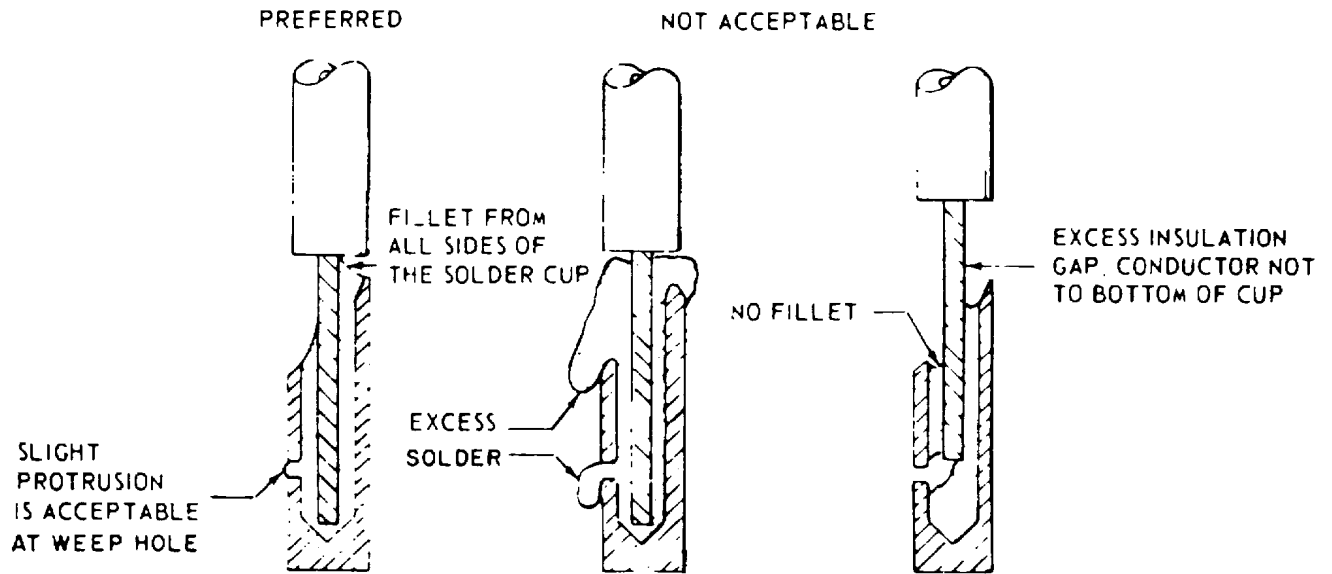


INSERTING THE WIRE



MI 64360

Figure 2-21. Soldering wire inserted in hole - typical.



MI 64361

NOTE ANY SOLDER ON THE OUTSIDE SURFACE OF THE SOLDER CUP SHALL BE IN THE FORM OF A THIN FILM ONLY

Figure 2-22. Soldering wire inserted in tubular terminal with weep hole - typical.

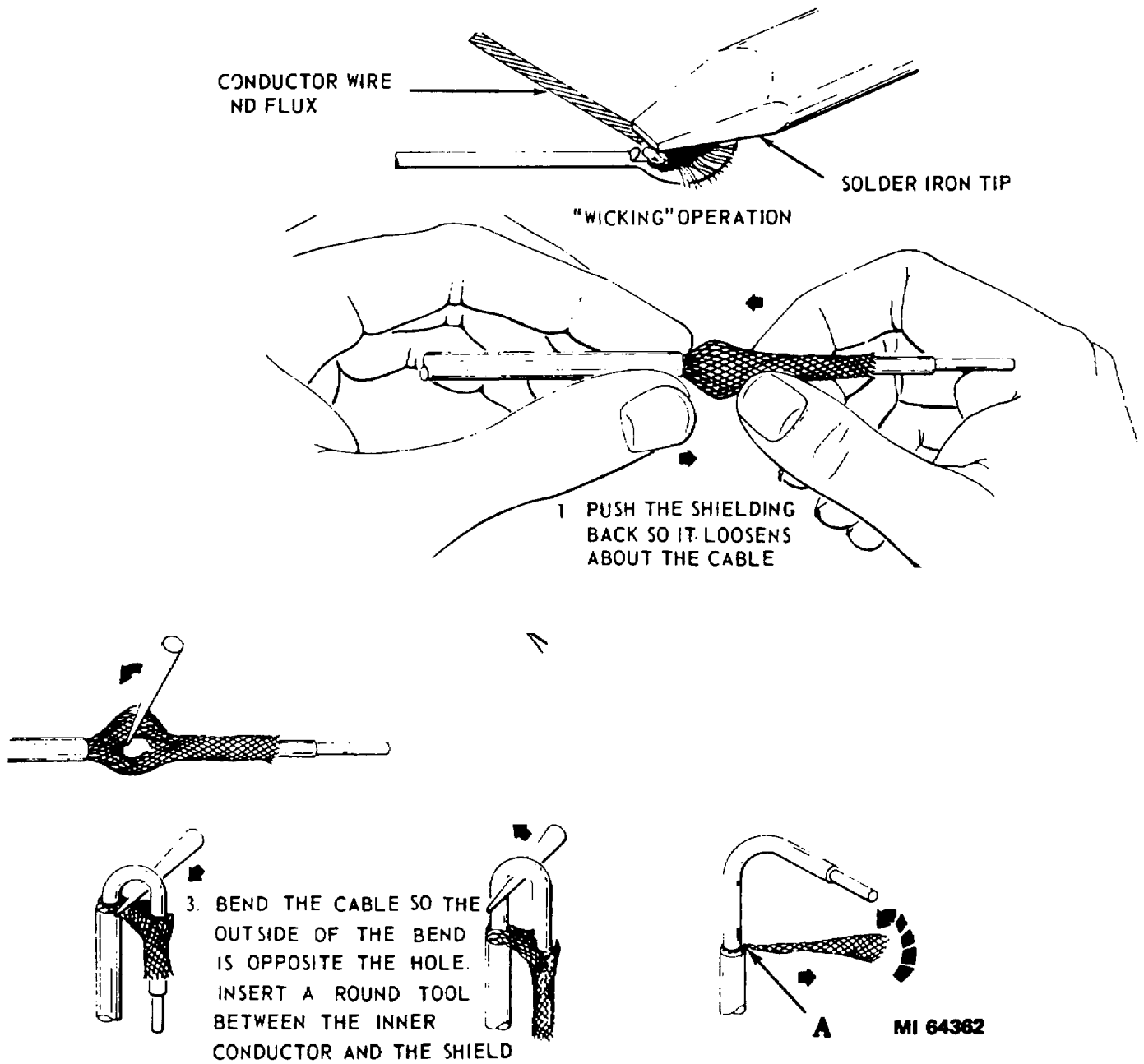


Figure 2-23. Separating braided shielding at inner conductor - typical.

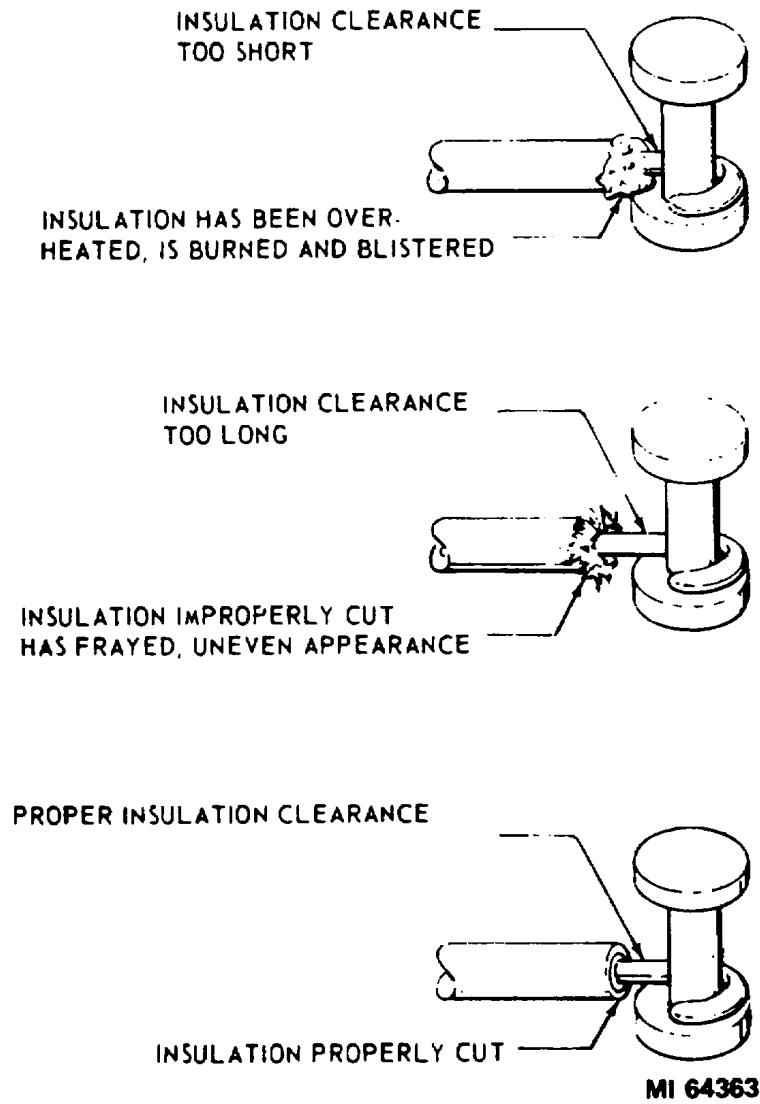


Figure 2-24. Examples of insulation trim - typical

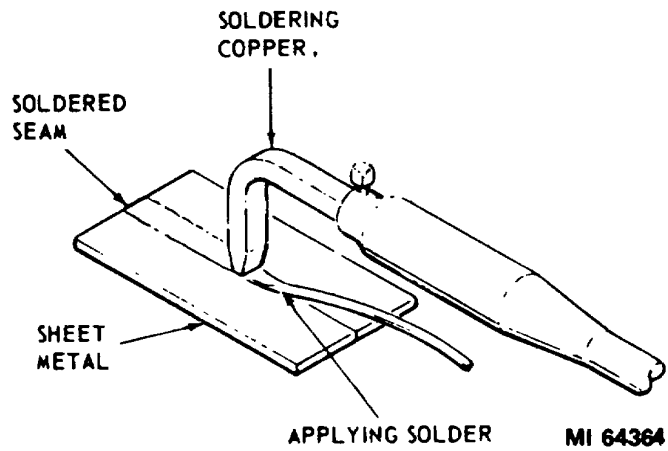


Figure 2-25. Soldering butt joints - typical.

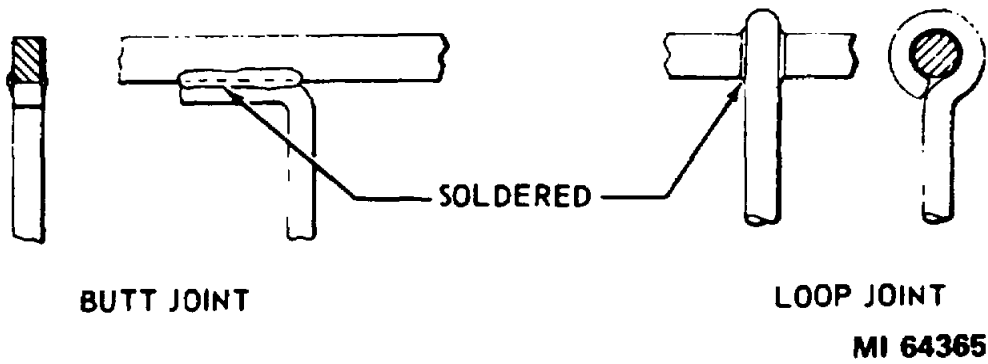


Figure 2-26. Soldering butt joints and loop joints - typical.

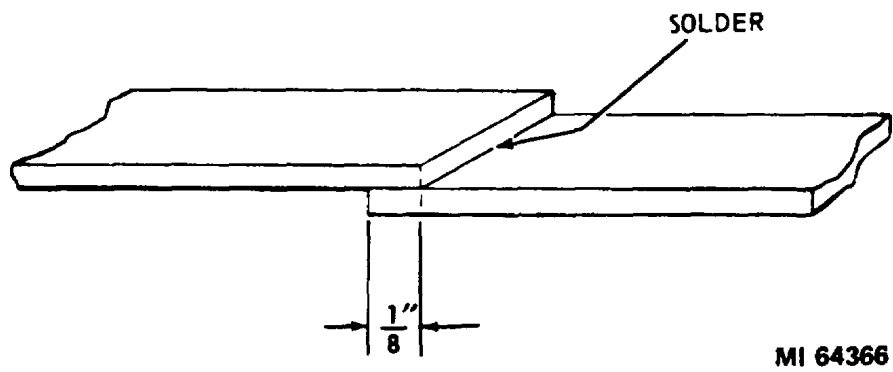


Figure 2-27. Soldering overlapping flat surfaces - typical.

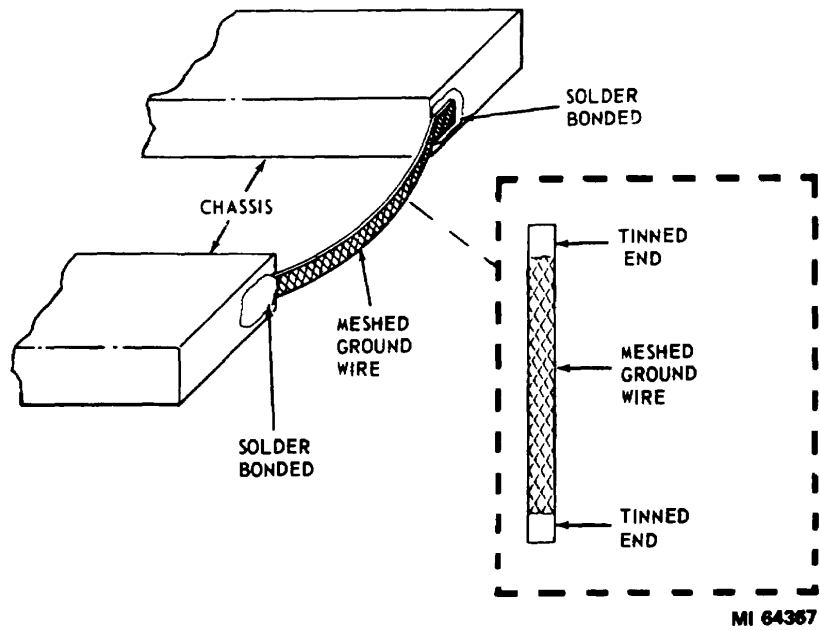


Figure 2-28. Soldering ground connections - typical

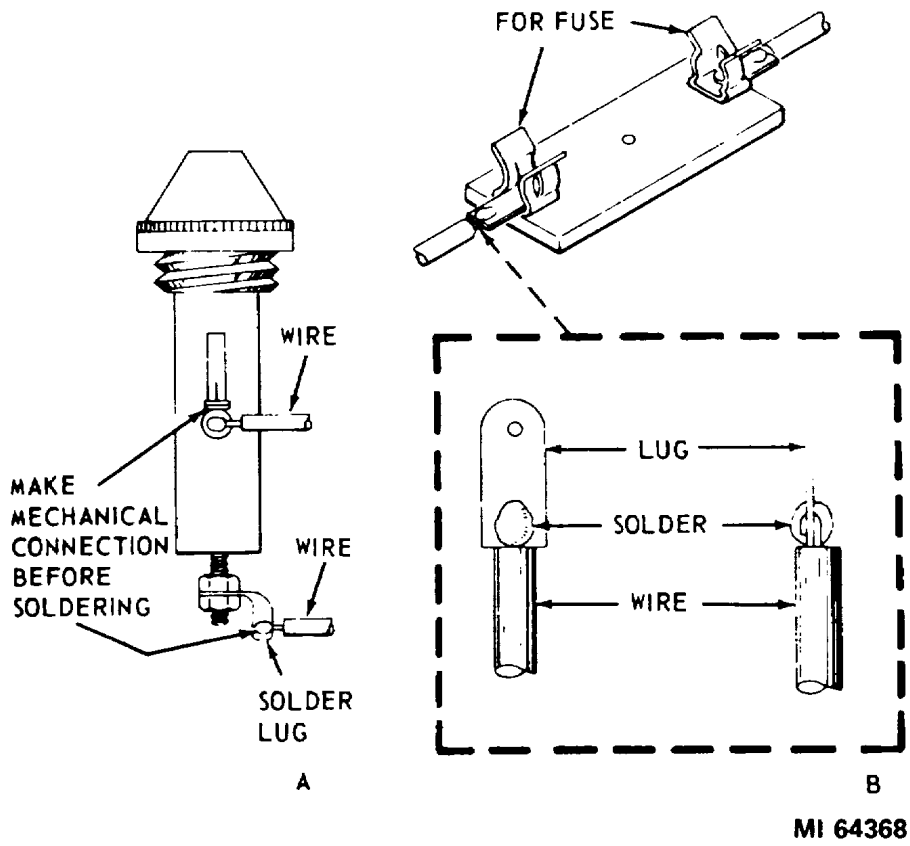


Figure 2-29. Soldering wires to fuseholders - typical.

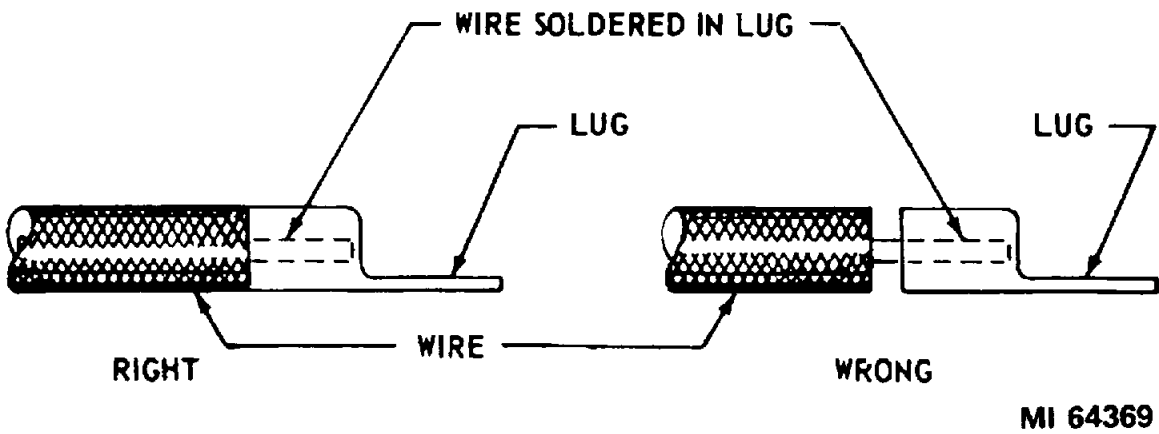


Figure 2-30. Soldering clamp-type lug terminals to wire - typical.

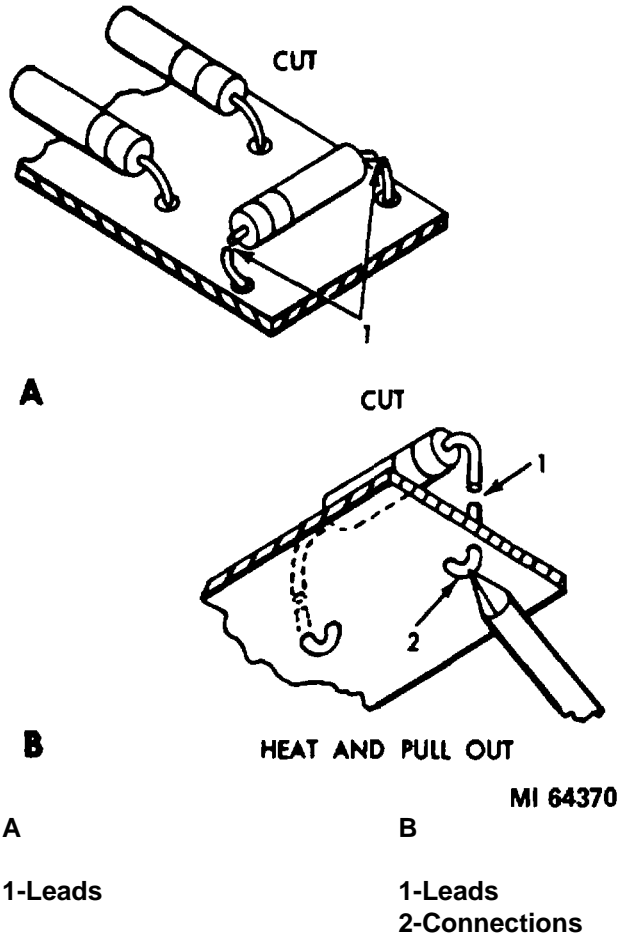


Figure 2-31. Printed circuit board, mounted part removal and installation - typical.

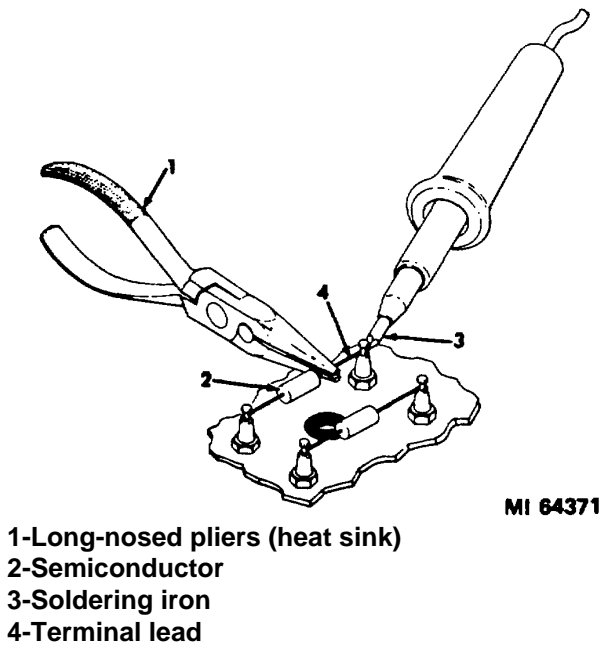


Figure 2-32. Semiconductor removal and installation - typical.

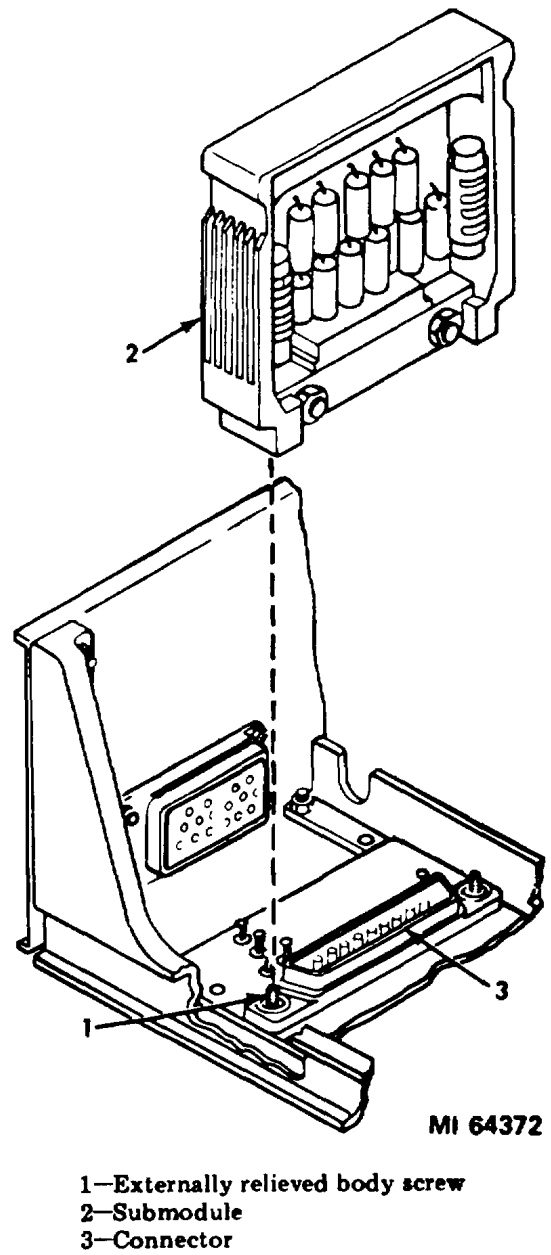
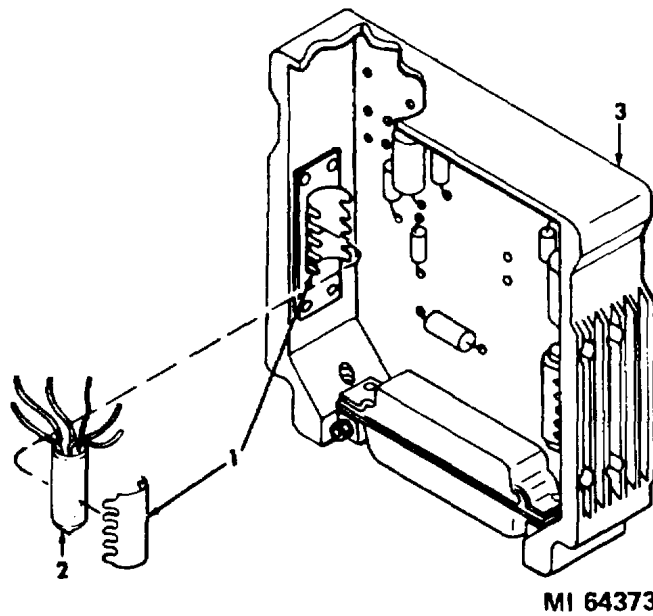
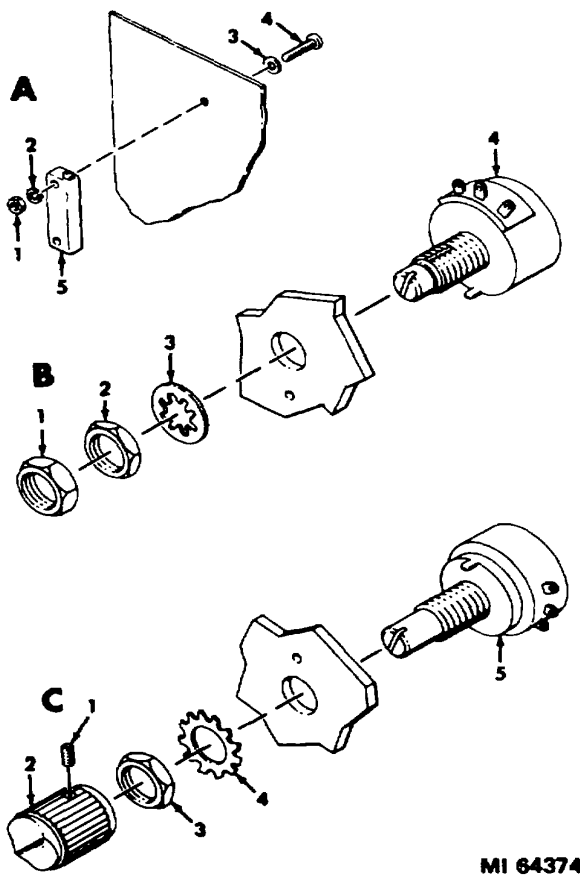


Figure 2-33. Submodule removal and installation - typical.



- 1—Electron tube shield
- 2—Electron tube
- 3—Submodule

Figure 2-34. Submodule electron tube removal and installation - typical.

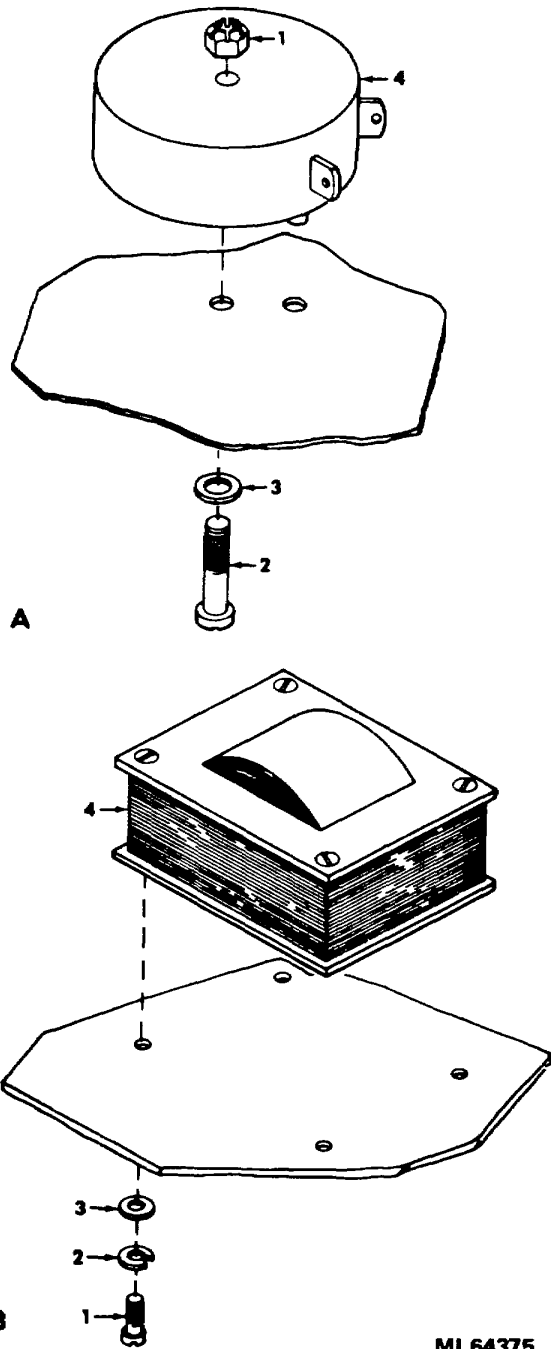


- A
- 1—Hexagon nut
 - 2—Lockwasher
 - 3—Flat washer
 - 4—Panhead screw
 - 5—Variable resistor

- B
- 1—Hexagon nut
 - 2—Locking nut
 - 3—Lockwasher
 - 4—Variable screw

- C
- 1—Setscrew
 - 2—Knob
 - 3—Locking nut
 - 4—Lockwasher
 - 5—Variable resistor

Figure 2-35. Variable resistor removal and installation- typical.

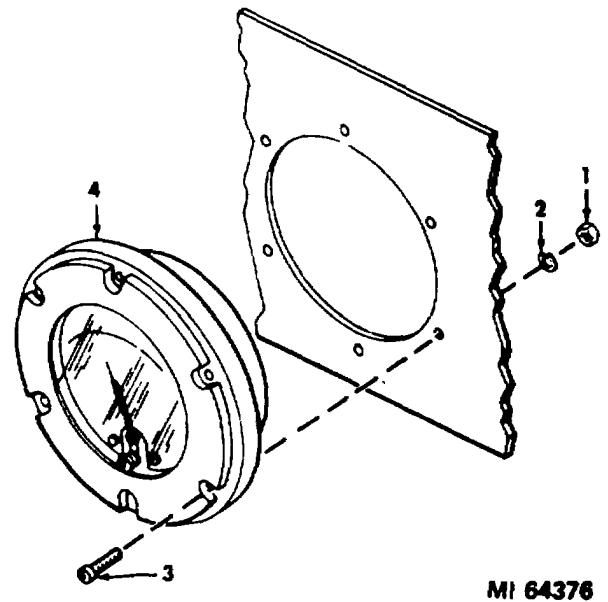


MI 64375

- A
 1-Self-locking nut
 2-Panhead screw
 3-Flat washer
 4-Reactor

- B
 1-Panhead screw
 2-Lockwasher
 3-Flat washer
 4-Reactor

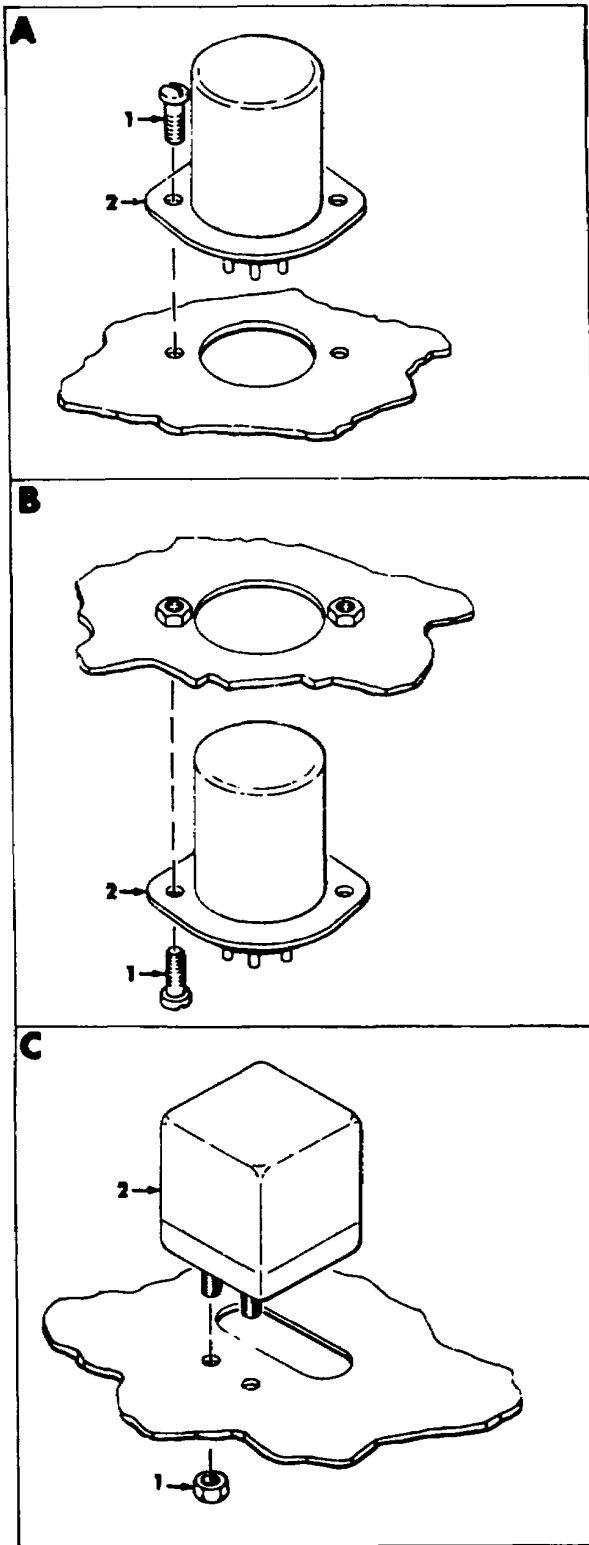
Figure 2-36. Reactor removal and installation - typical.



MI 64376

- 1-Hexagon nut
 2-Lockwasher
 3-Panhead screw
 4-Meter

Figure 2-37. Meter removal and installation - typical.



MI 64377

- A
 1-Panhead screw
 2-Relay
- B
 1-Panhead screw
 2-Relay
- C
 1-Self-locking nut
 2-Relay

Figure 2-38. Relay removal and installation - typical.

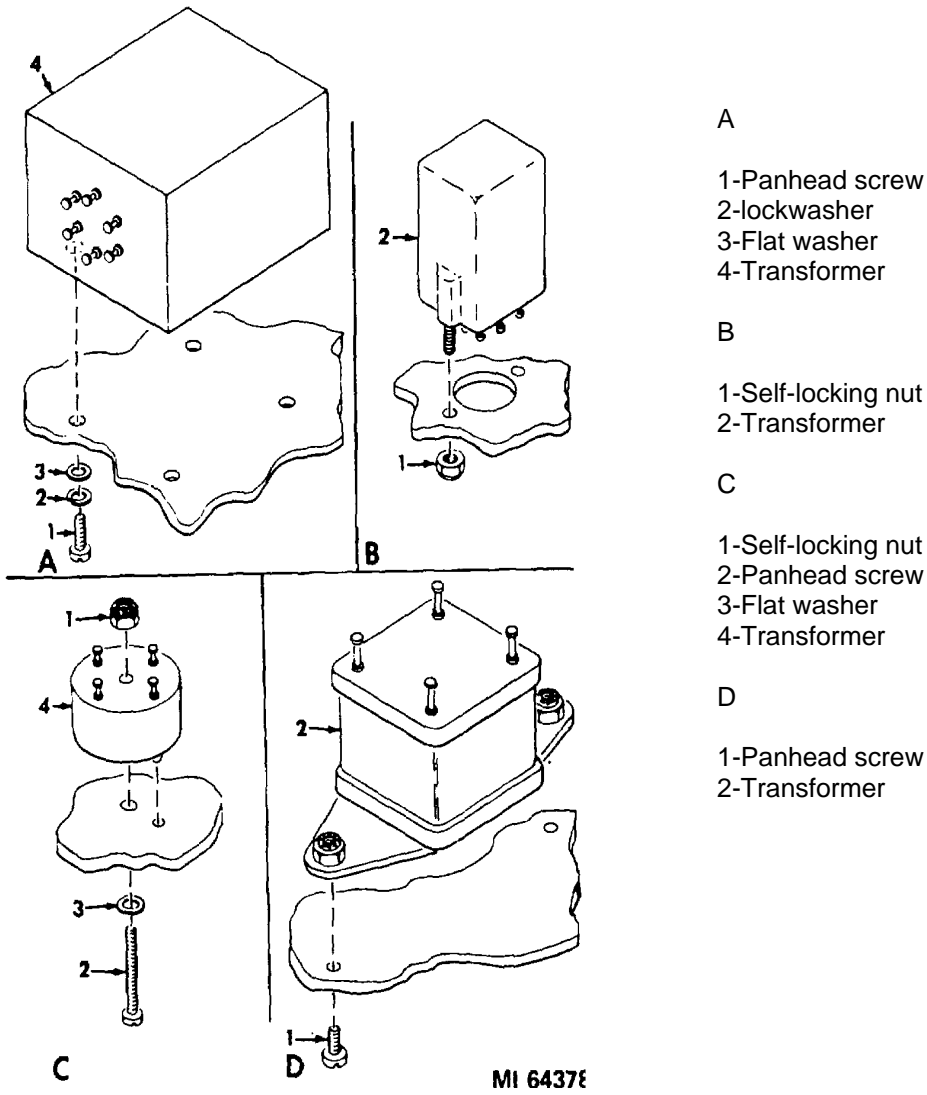


Figure 2-39. Transformer removal and installation - typical

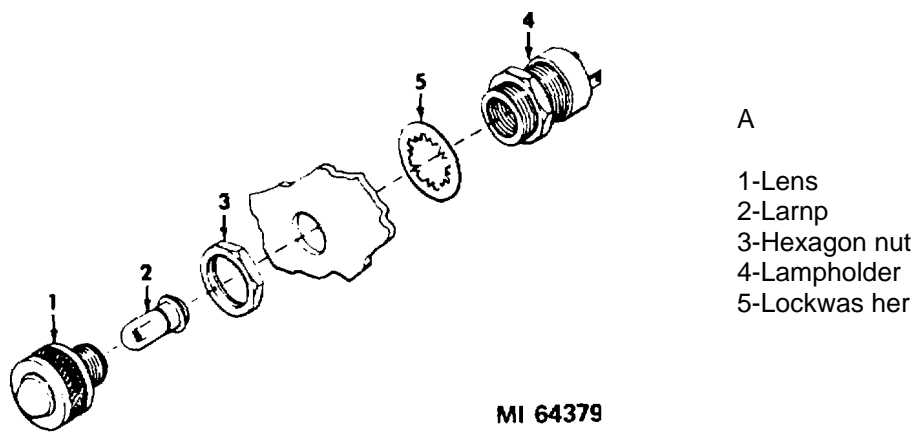
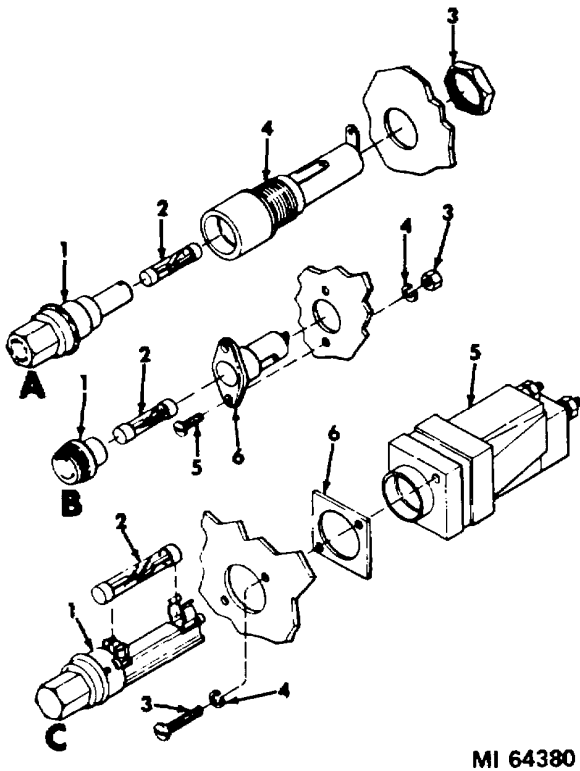


Figure 2-40. Indicator lamp and lampholder removal and installation - typical.



MI 64380

A

- 1-Indicator
- 2-Fuse
- 3-Hexagon nut
- 4-Fuseholder

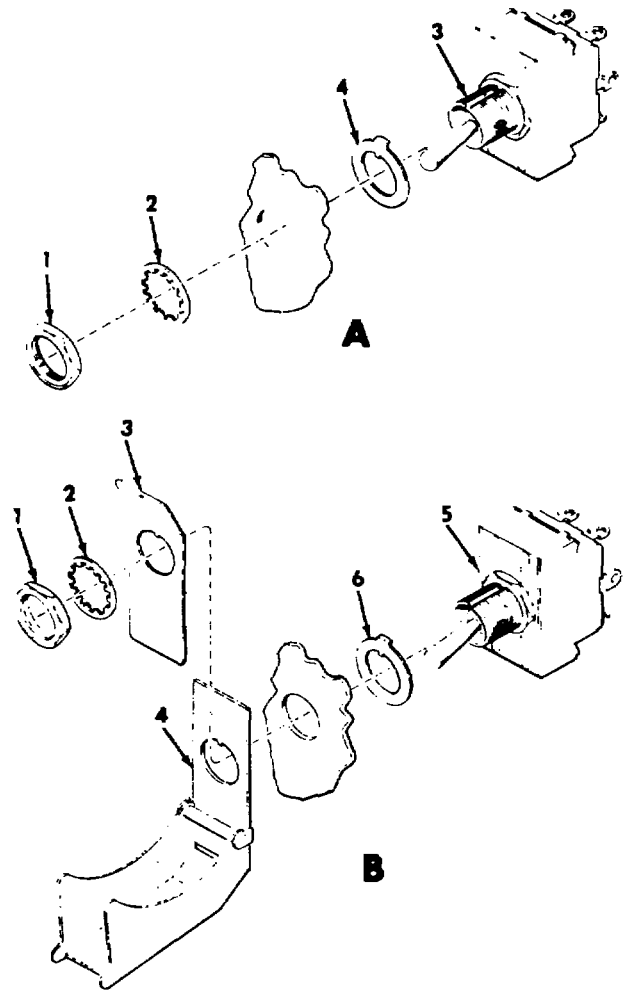
B

- 1-Cap
- 2-Fuse
- 3-Hexagon nut
- 4-Lockwasher
- 5-Panhead screw
- 6-Fuseholder

C

- 1-Fuseholder indicator
- 2-Fuse
- 3-Panhead screw
- 4-Lock washer
- 5-Fuseholder body
- 6-Gasket

Figure 2-41. Fuse and fuseholder removal and installation - typical.



MI 64381

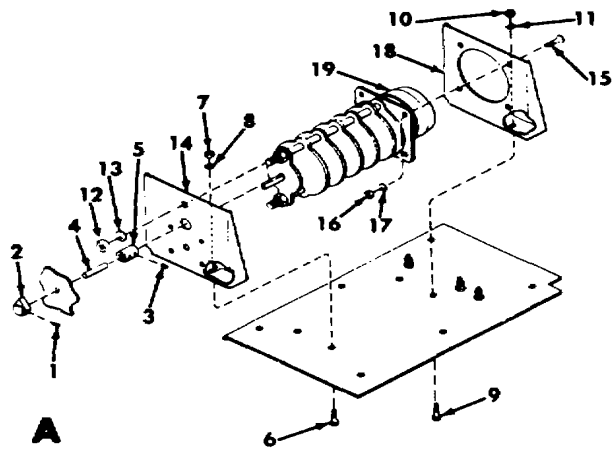
A

- 1-Hexagon nut
- 2-Lock washer
- 3-Toggle switch
- 4-Key washer

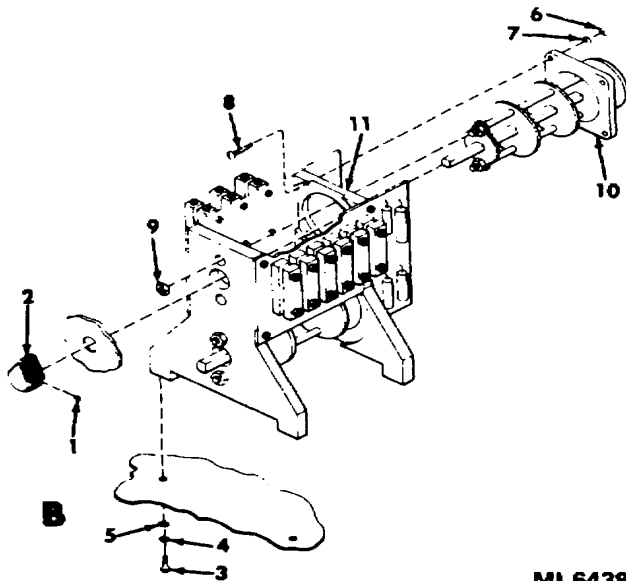
B

- 1-Hexagon nut
- 2-Lockwasher
- 3-Switch-guard stop
- 4-Switch guard
- 5-Toggle switch
- 6-Key washer

Figure 2-42. Toggle switch removal and installation - typical.



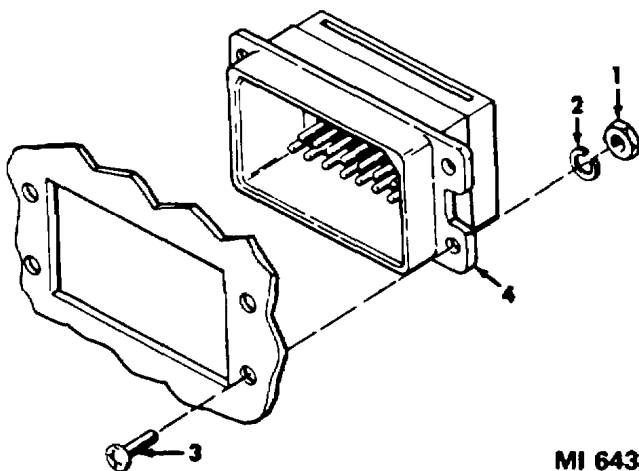
- A
- 1-Setscrew
 - 2-Knob
 - 3-Setscrew
 - 4-Straight shaft
 - 5-Cupling
 - 6-Panhead screw
 - 7-Hexagon nut
 - 8-Lockwasher
 - 9-Pinhead screw
 - 10-Hexagon nut
 - 11-Lock washer
 - 12-Hexagon nut
 - 13-Flat washer
 - 14-Bracket
 - 15-Panhead screw
 - 16-Hexagon nut
 - 17-Lockwasher
 - 18-Bracket
 - 19-Rotary switch



- B
- 1-Setscrew
 - 2-Knob
 - 3-Panhead screw
 - 4-Lock washer
 - 5-Flat washer
 - 6-Hexagon nut
 - 7-Lockwasher
 - 8-Pinhead screw
 - 9-Hexagon nut
 - 10-Rotary switch
 - 11-Rotary switch assembly

MI 64382

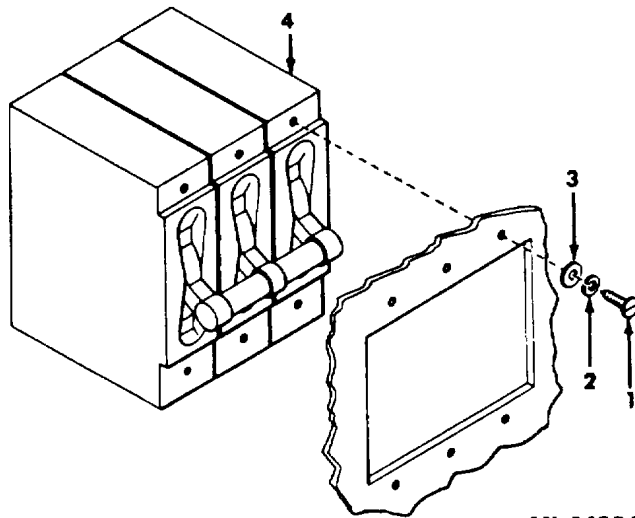
Figure 2-43. Rotary switch removal and installation - typical.



- 1-Hexagon nut
- 2-lockwasher
- 3-Panhead screw
- 4-Connector

MI 64383

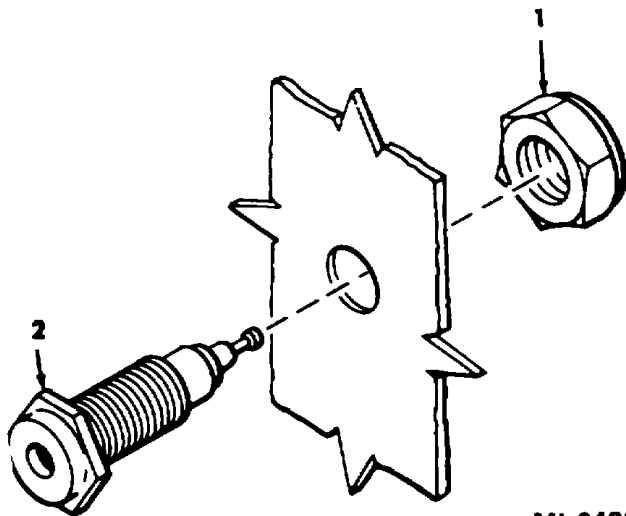
Figure 2-44. Connector removal and installation - typical.



- 1-Panhead screw
- 2-Lockwasher
- 3-Flat washer
- 4-Circuit breaker

MI 64384

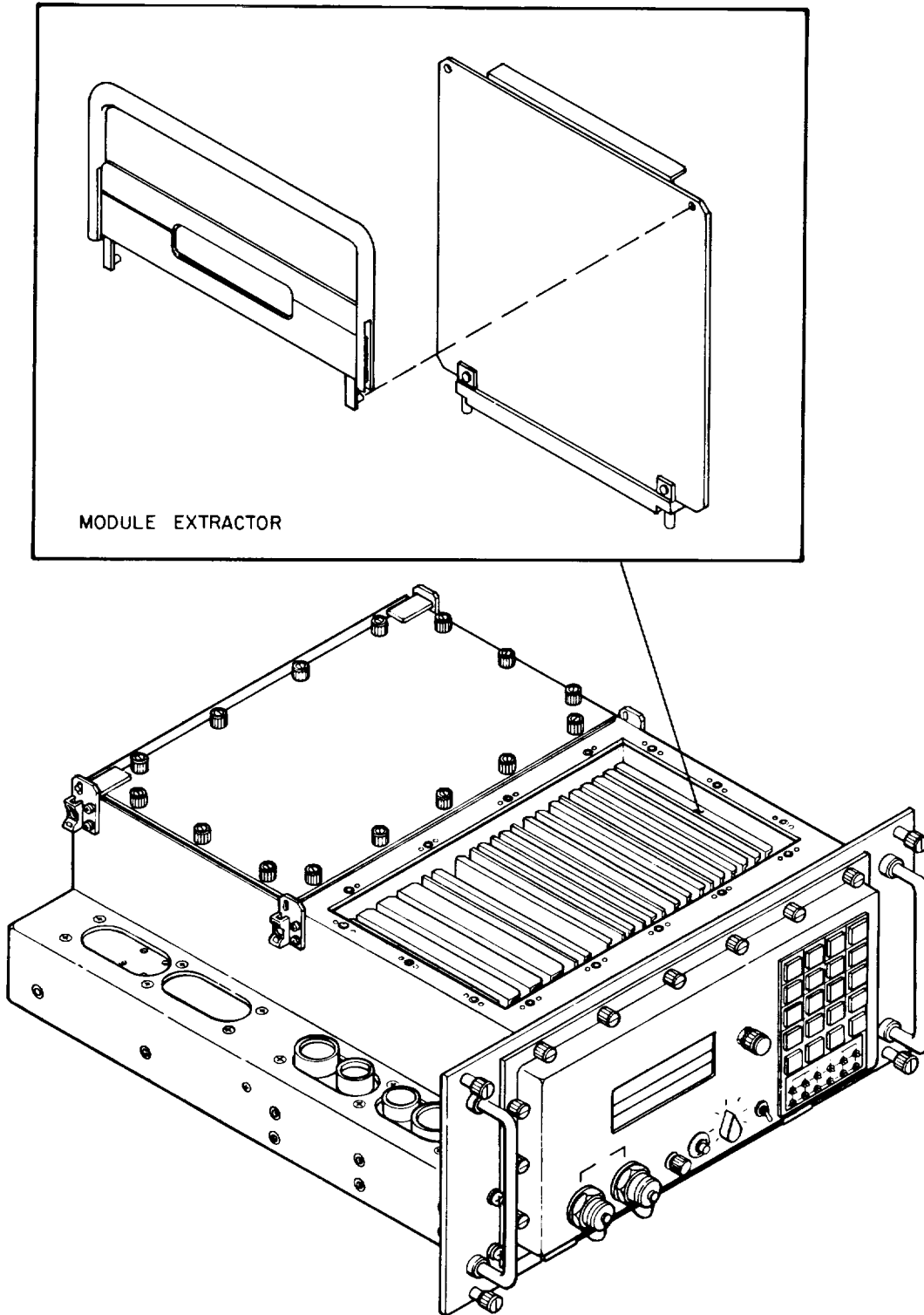
Figure 2-45. Circuit breaker removal and installation - typical.



- 1-Hexagon nut
- 2-Tip jack

MI 64385

Figure 2-46. Tip jack removal and installation - typical.



MODULE EXTRACTOR

Figure 2-46.1. Replacement of typical modules.

2-28.1 (2-28.2 blank)

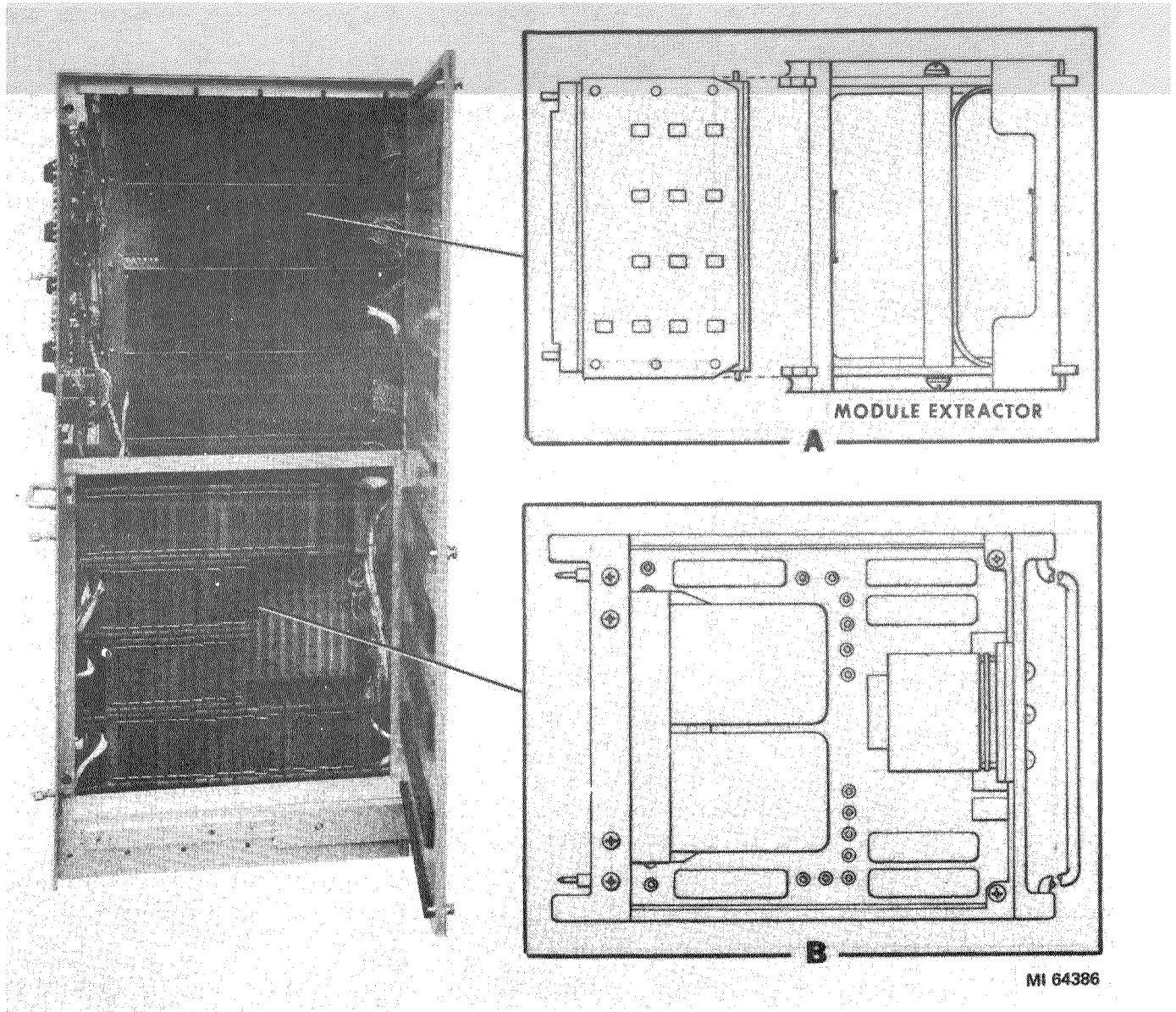


Figure 2-47. Replacement of typical modules.

2-7. Replacement of Headset Cable Assembly

a. General. This paragraph provides removal and installation procedures for replacing the coiled cable assembly used in the communication headset.

NOTE

The key numbers shown below in parentheses refer to figure 2-48 unless otherwise specified.

b. Removal.

(1) Remove and retain the four screws, cover, and preformed packing from the switch housing.

NOTE

Handle the switch with care while the cover is being removed to prevent the actuator (1) and plunger (2) from becoming disengaged from the switch housing (3).

(2) Unsolder the two red leads (4) from the switch terminals.

(3) Cut through the remaining five leads at the center of each heat shrink insulation sleeving (5) and conductor splice.

(4) Pull the insulation sleeving and conductor splice from the cut leads.

(5) Remove and retain the cable retainer (6) from each cable (7 and 8).

(6) Loosen the two nuts (9), and remove the cables from the switch housing.

(7) Remove and retain the flat washer, spring, and nut from coiled cable assembly 10176208 (8). Discard the cable assembly and preformed packing.

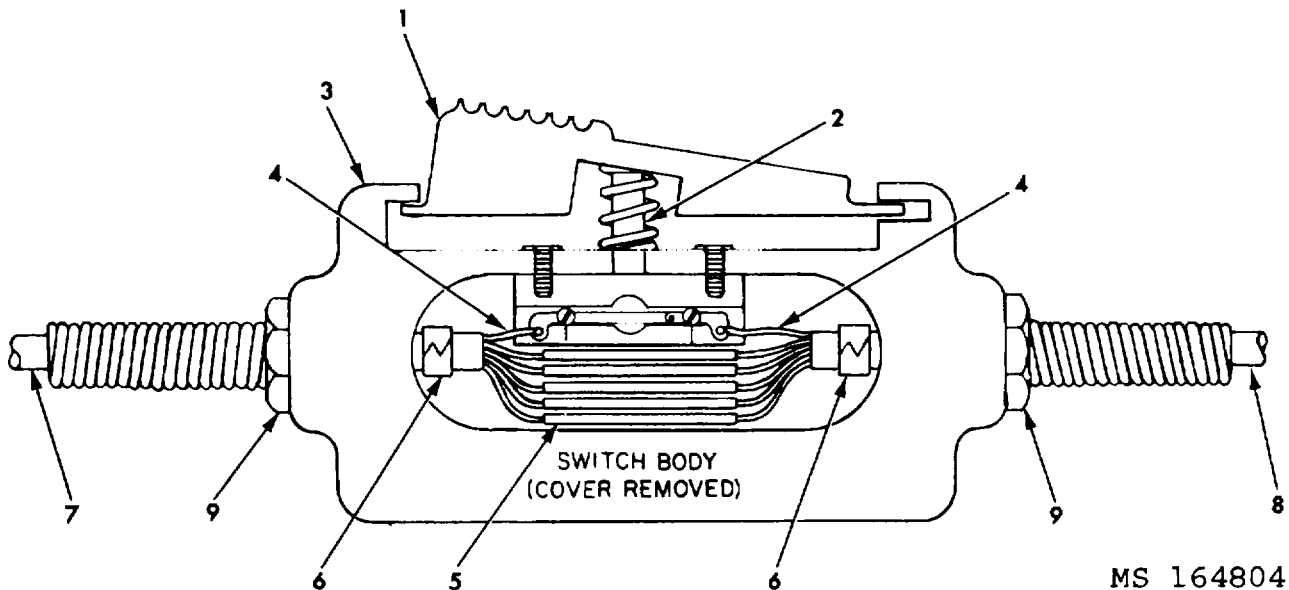
c. Installation.

(1) Dress the end of the straight cable (7), as necessary, for a 1.9 cm (3/4-inch) length of red lead and a 31.11 cm (1-1/4-inch) length for the remaining five leads. Clean and tin the ends of the six leads to 0.63 cm (1/4-inch).

(2) Insure that the nut, spring, flat washer, and preformed packing are installed on the straight cable, and insert the end of the cable (7) into the switch housing as shown on figure 2-48.

(3) Install the retained cable retainer (6) on the straight cable 0.63 cm (1-1/4-inch) from the end of the cable jacket

(4) Dress the end of new coiled cable assembly 10176208 for a 31.11 cm (1-1/4-inch) lead length. Cut the orange lead back to the cable jacket, and the red lead to a 1.9 cm (3/4-inch) length. Strip and tin the ends of the six leads to 0.63 cm (1/4-inch).



- 1-Actuator
- 2-Plunger
- 3-Switch housing
- 4-Red lead
- 5-Heat shrink insulation sleeving

- 6-cable retainer
- 7-Straight cable
- 8-Coiled cable assembly
- 9-Coiled cable assembly

Figure 2-48. Headset coiled assembly removal and installation - typical.

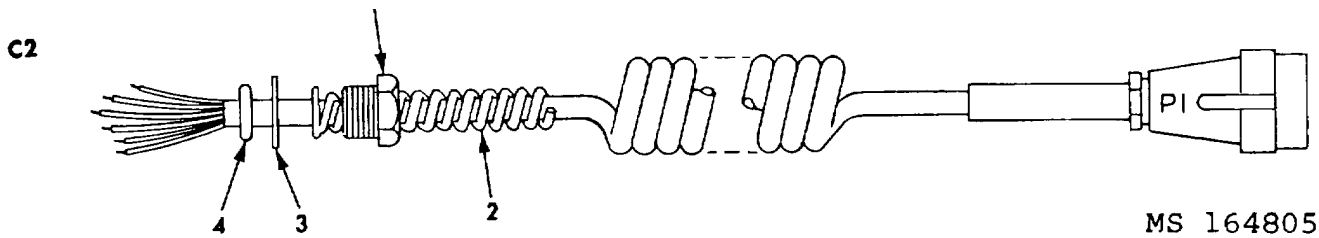


Figure 2-49. Replacement of headset coiled cable assembly - typical.

(5) Assemble the retained nut, spring, flat washer, and new preformed packing 10182406 (1 through 4, fig. 2-49) onto the coiled cable assembly.

(6) Insert the end of the new coiled cable assembly (8) into the switch housing.

(7) Install the retained cable retainer (6) on the coiled cable 0.63 cm (1/4-inch) from the end of the cable jacket.

(8) Slide a 1.9 cm (3/4-inch) length of heat shrink insulation sleeving onto each lead (except the red lead) on either cable.

(9) Solder together like - colored (except red) leads from each cable, using a lap joint.

(10) Position and install the heat shrink insulation sleeving centrally over the five soldered connections.

(11) Assemble and solder the two red leads (4) to the switch terminals.

(12) Gently pull on the two cables (7 and 8) until the cable retainers (6) butt against the inside wall of the switch housing, making sure that no strain is placed upon the leads.

(13) Secure each cable to the switch housing by installing the preformed packing, flat washer,

spring, and nut, being careful not to cross the threads.

(14) Check the switch by pressing on the actuator (1) and observing that the plunger (2) activates the switch mechanism. If the actuator cannot be fully depressed, or if the actuator and plunger have become disengaged from the switch housing, refer to figure 2-50 for realignment of the plunger. Remove any loose foreign matter from the housing.

(15) Assemble the retained preformed packing to the cover and install on the switch housing, carefully tightening the four retained soft brass screws.

d. Continuity Check. An ohmmeter connected between the specified pins of connector P1 (fig. 2-49) should produce the following normal resistance indications.

(1) 150 ohms between P1-A and P1-B (left ear).

(2) 150 ohms between P1-E and P1-F (right ear).

(3) 40 to 100 ohms between P1-C and P1-D (microphone) when the switch actuator (1, fig. 2-48) is pressed.

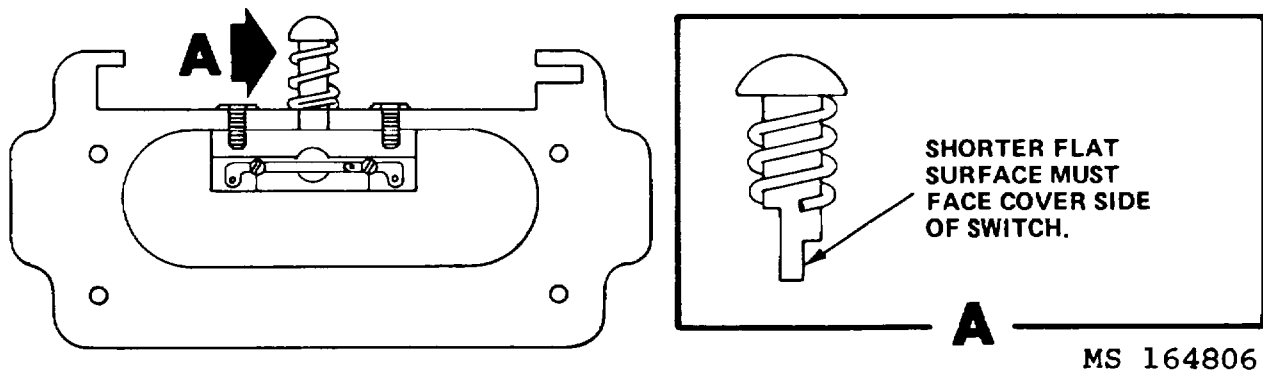


Figure 2-50. Headset switch plunger alignment - typical.

2-8. Replacement of Headset Boom Assembly-10668949

a. *General.* This paragraph provides removal and installation procedures for replacing the boom assembly used on communication headset 10673294-1, and 10673293-11.

NOTE

The key numbers shown below in parentheses refer to figure 2-51 unless otherwise specified.

b. *removal*

- (1) Disconnect the microphone cord plug (1) from the headset plug (2).
- (2) Remove and retain the machine screw (3) and unscrew the knurled nut (4).
- (3) Remove and retain the flat knurled washer (5), and the wedge-shaped grooved washer (6).

- (4) Remove and retain the boom assembly (7).

CAUTION

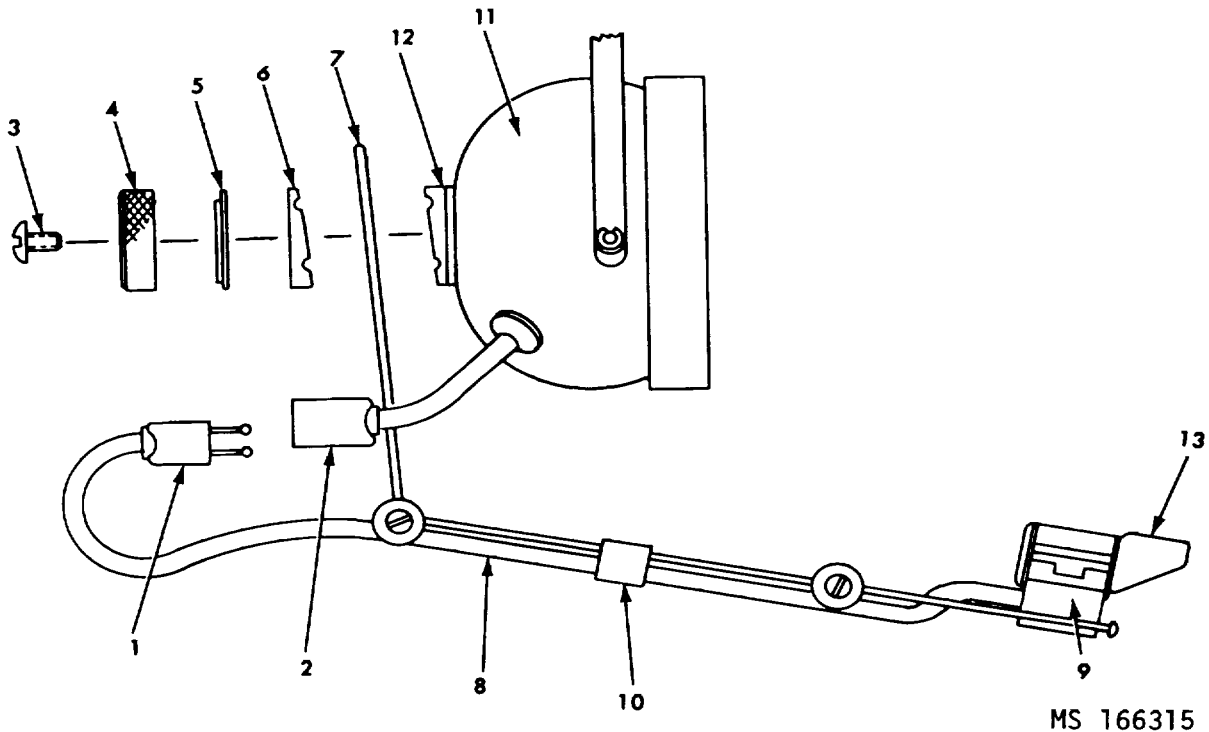
Handle the microphone cord assembly (8) with care when removing it from the boom assembly (7) to prevent damage to the microphone (13), and cord clip (10).

- (5) Remove and retain the microphone cord assembly (8) with microphone clip (9), and cord clip (10).

c. *Installation.*

NOTE

Figure 2-52 illustrates a headset with a completely assembled boom assembly (3, fig. 2-52) and microphone cord assembly (4, fig. 2-52).

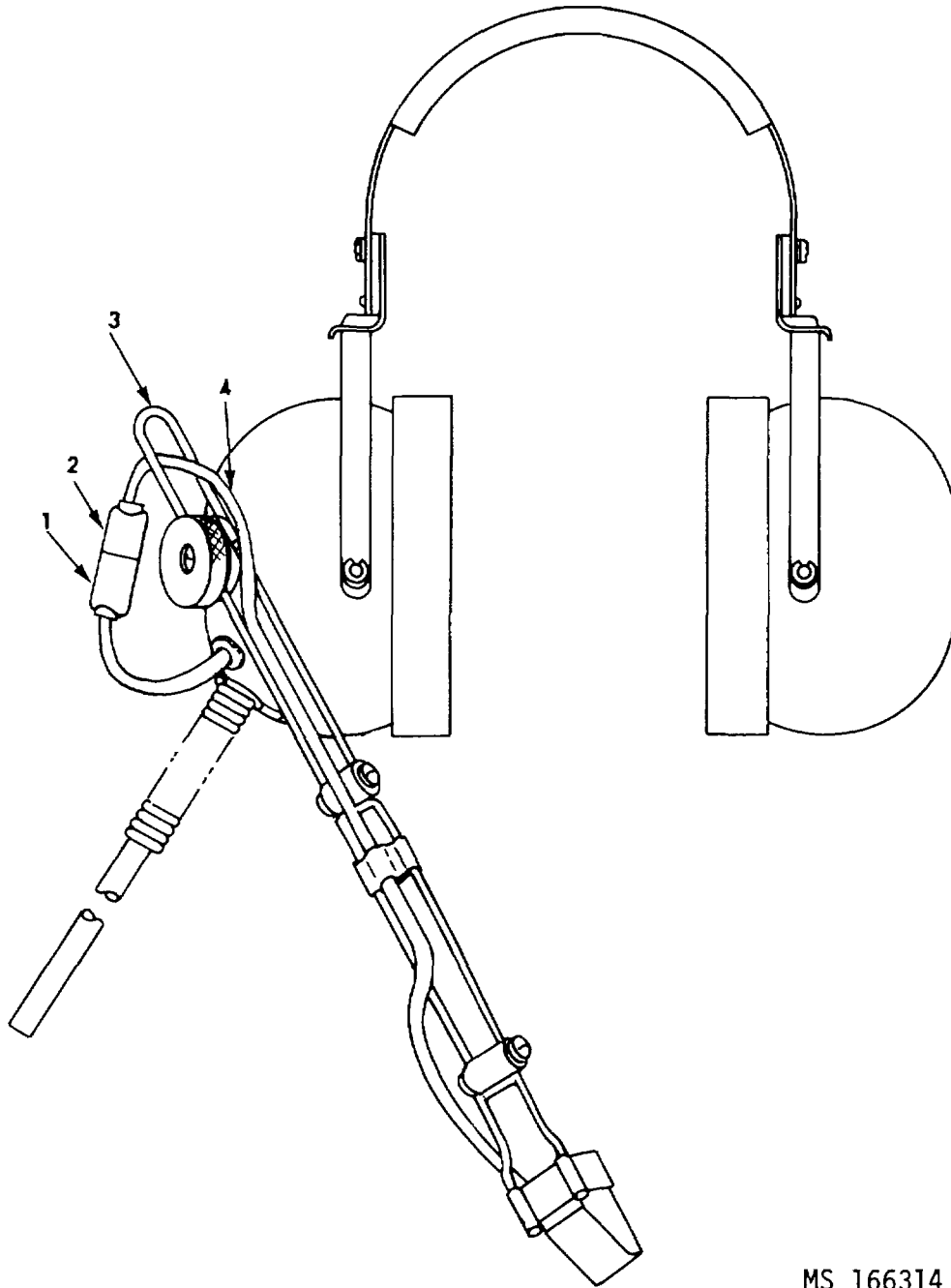


- 1-Microphone cord plug
- 2-Headset plug (microphone)
- 3-Machine screw
- 4-Knurled nut
- 5-Flat knurled washer
- 6-Wedge-shaped grooved washer
- 7-Boom assembly

- 8-Microphone cord assembly
- 9-Microphone clip
- 10-Cord clip
- 11-Dome assembly
- 12-Wedge-shaped grooved washer
- 13-Microphone

MS 166315

Figure 2-51. Headset, boom assembly, and microphone cord assembly-exploded view.



MS 166314

- 1-Headset plug (microphone)
- 2-Microphone cord plug
- 3-Boom assembly
- 4-Microphone cord assembly

Figure 2-52. Headset, and boom assembly-installed.

(1) Remount the microphone cord assembly (8) onto the new boom assembly (7).

(2) Mount the new boom assembly (7) onto the dome assembly (11).

(3) Replace the wedge - shaped grooved washer (6) as described in a and b below.

(a) To ensure proper replacement, make certain that the grooved side of the washer is facing the dome assembly (11).

(b) The thick part of the wedge is aligned with the thin part of the wedge-shaped grooved washer (12) already attached to the dome assembly (11).

(4) Replace the flat knurled washer (5) with the knurled side facing the wedge-shaped grooved washer.

(5) Replace the knurled nut (4), with the recessed side facing away from the flat knurled washer (5), and the machine screw (3).

(6) Reconnect the microphone cord plug (2, fig. 2-52) to the headset plug (1, fig. 2-52).

2-9. Repair and Maintenance of Coaxial Cables

a. *General.* This paragraph contains information concerning the type of connectors to be used, considerations to be made when selecting connectors, methods of coupling the connectors, and methods of attaching the cable shielding to the connectors. Instructions for terminating coaxial cables using various types of connectors are also provided.

b. *Types of Connectors.* The various types of connectors used for terminating and connecting coaxial cables are shown in figure 2-53.

c. *Selection of Connectors.* When selecting connectors to be used for terminating coaxial cables, three things must be considered: size of the cable to be used (no further mention will be made of cable size as this should be obvious), methods of coupling the connectors, and methods of attaching the cable shielding.

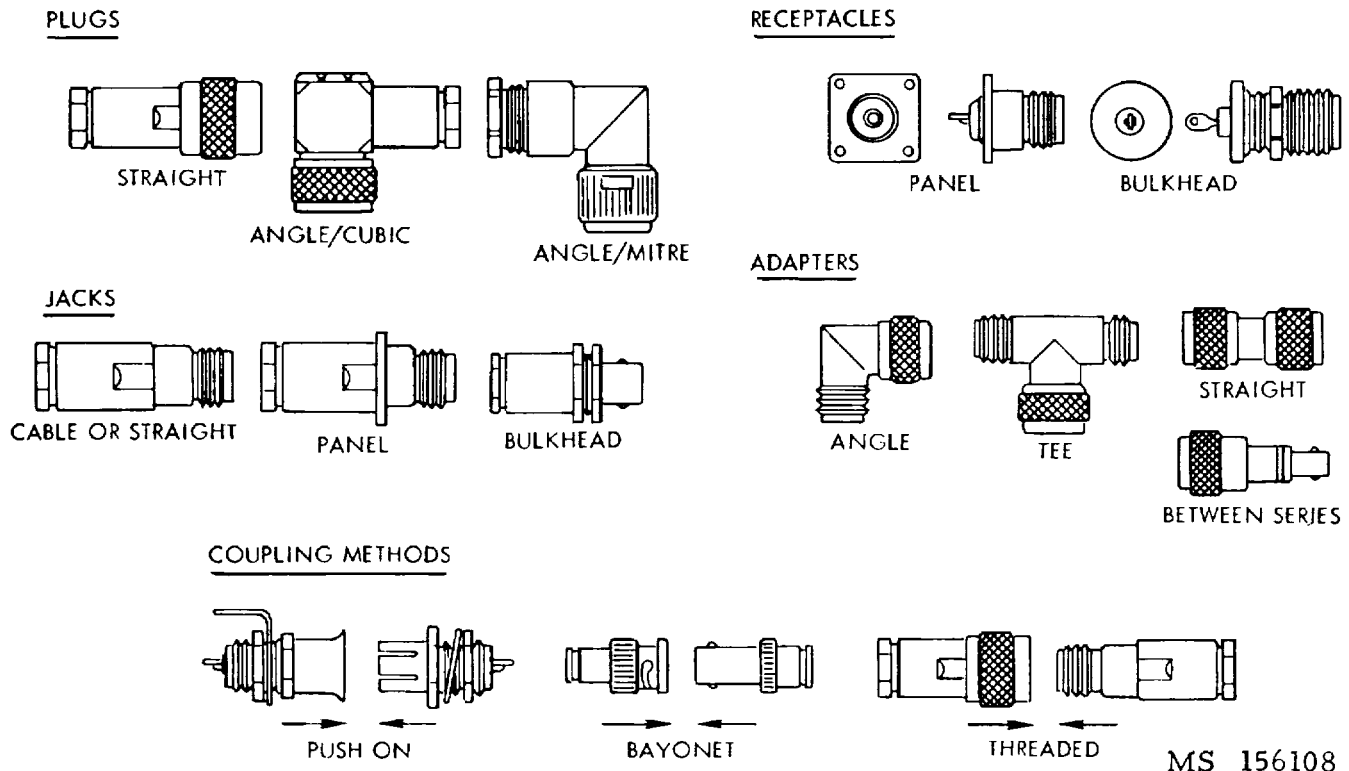


Figure 2-53. Connectors, adapters, and coupling methods.

(1) *Methods of coupling connectors.* When connecting or coupling the connectors, three methods are used:

(a) *Bayonet coupling method.* This method provides a push-on and twist-lock type connection. The jacks and receptacles have two or three external protrusions referred to as bayonet ears, while the plugs have coupling nut slots which receive the bayonet ears. When subjected to vibrations, bayonet couplings will generate excess circuit noise.

(b) *Threaded coupling method.* A threaded coupling provides a screw-type connection. The jacks and receptacles have external-threaded bodies, while the plugs have internal-threaded couplings nuts. This method supplies a positive connection with minimum noise generation.

(c) *Push-on coupling method.* This method provides a means for rapidly connecting and disconnecting the connectors. The connectors are held together by a press fit, retaining springs, or a spring-loaded ball bearing detent. The push-on coupling will separate easily when subjected to vibrations or excessive movement.

(2) *Methods of attaching cable shielding.* There are three methods of attaching the cable shielding to the connector: soldering, clamping, and crimping.

(a) *Soldering method.* The UHF series connector, almost exclusively, requires the soldering method.

(b) *Clamping method.* This is the technique most commonly employed for attaching the cable shielding to the connector. It has the advantage of providing a good moisture seal and also strong metal-to-metal cable retention.

(c) *Crimping method.* This is the easiest method used for attaching the cable shielding to the connector; however, it requires a ferrule clamp nut assembly to replace the braid clamp, gasket, washer and clamp nut used in the clamping method. This method also requires the use of special tools.

d. *Termination Procedures.* The following procedures explain the methods employed for terminating coaxial cables, using various types of connectors.

(1) *Termination procedure, using a BNC series connector.*

NOTE

When removing the cable jacket (insulation), be careful not to cut or nick the shielding.

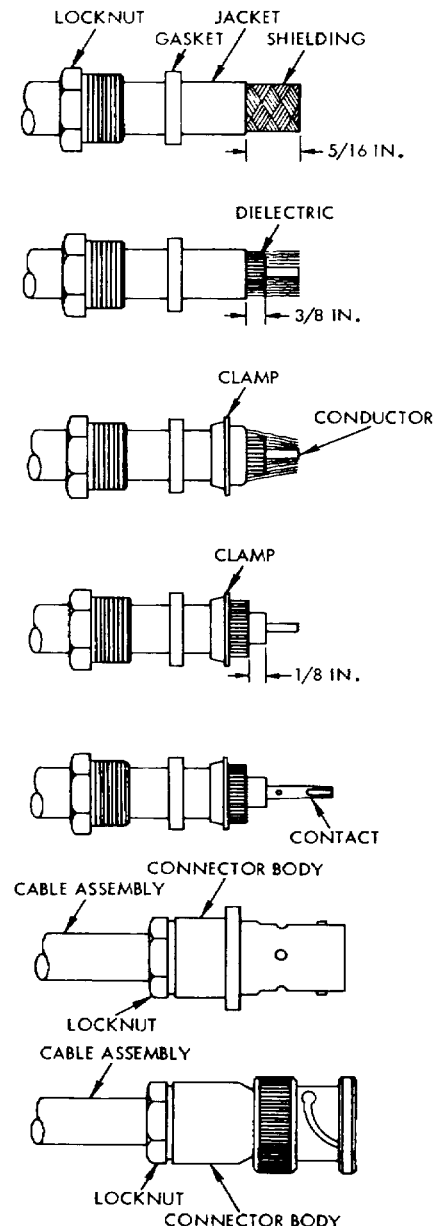
(a) Strip the cable jacket to the dimensions shown in figure 2-54.

(b) Slip the locknut and gasket on the cable, with the "V" groove of the gasket toward the end of the cable.

(c) Comb out the shielding and turn it back from the dielectric.

NOTE

When removing the dielectric, be careful not to cut or nick the conductor.



MS 156109

Figure 2-54. Terminating a coaxial cable, using an improved BNC series connector.

(d) Cut the dielectric to the dimensions shown in figure 2-54.

(e) Comb the shielding toward the end of the cable, and place the clamp over the shielding.

(f) Push the clamp on the cable until the clamp is seated against the cable jacket.

(g) Fold the shielding back over the clamp, and trim it to the length shown in figure 2-54.

CAUTION

Do not apply excess heat to the conductor thereby distorting the dielectric. Distortion may prevent proper mating with the bushing and the insulator.

(h) Tin the exposed conductor surface.

(i) Solder the contact onto the conductor, and remove the excess solder.

(j) Insert the cable assembly into the connector body, ensuring that the sharp edge of the clamp is seated in the gasket groove.

(k) Tighten the locknut securely.

(2) Termination procedure, using an MS9012-20-0001 connector.

NOTE

When removing the cable jacket (insulation), be careful not to cut or nick the shielding.

(a) Strip the cable jacket to the dimensions shown in figure 2-55.

(b) Slip the locknut, plain washer, and rubber washer over the cable.

(c) Comb out the shielding and turn it back from the dielectric.

NOTE

When removing the dielectric, be careful not to cut or nick the conductor.

(d) Cut the dielectric and the conductor to the dimensions shown in figure 2-55.

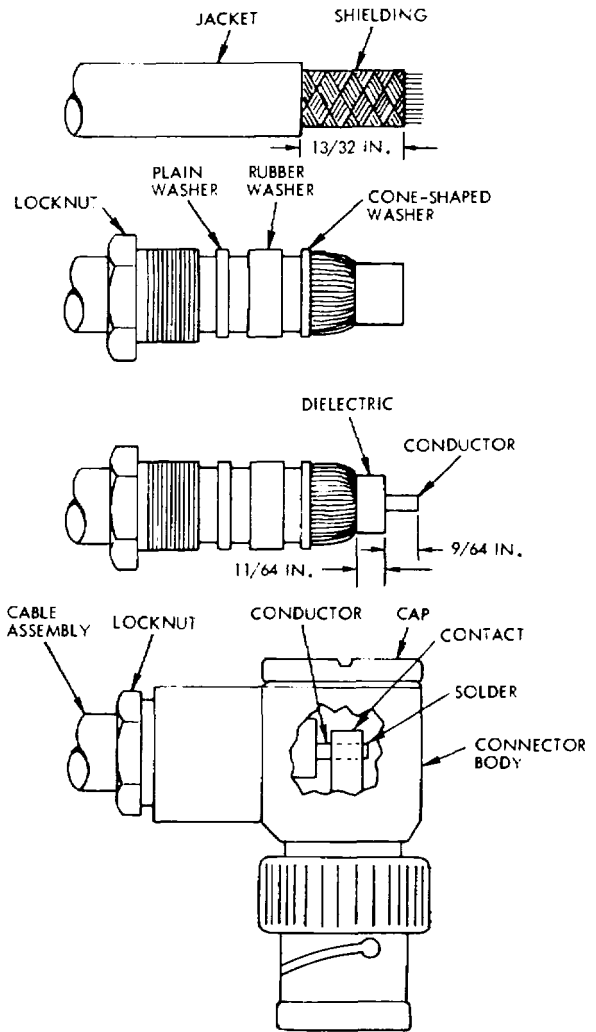
(e) Comb the shielding toward the end of the cable, and place the cone-shaped washer over the cable.

(f) Push the washer on the cable until the inside shoulder is seated against the cable jacket.

(g) Fold the shielding back over the cone-shaped washer, and trim it to the length as shown in figure 2-55.

CAUTION

Do not apply excess heat to the conductor thereby distorting the dielectric. Distortion may prevent proper mating with the connector body.



MS 156110

Figure 2-55. Terminating a coaxial cable, using an MS9012-20-0001 coaxial connector.

(h) Tin the exposed conductor surface, and remove the excess solder.

(i) Insert the cable assembly into the connector body, and tighten the locknut securely.

(j) Remove the cap on the connector body, and solder the contact onto the conductor.

(h) Install the cap on the connector body, and tighten it securely.

(3) Termination procedure, using an rf connector and fitting.

NOTE

When removing the cable jacket (insulation), be careful not to cut or nick the shielding,

- (a) Strip the cable jacket and conductor jacket as shown in figure 2-56.
- (b) Slip the locknut, plain and cone-shaped washers over the cable.
- (c) Comb out the shielding and turn it back from the dielectric.

NOTE

When removing the dielectric, be careful not to cut or nick the conductor.

- (d) Cut the dielectric and conductor to the dimensions shown in figure 2-56.
- (e) Fold the shielding back over the cone shaped washer, and trim it to the length shown in figure 2-56.

CAUTION

Do not apply excess heat to the conductor thereby distorting the dielectric. Distortion may prevent mating with the receptacle.

- (f) Tin the exposed conductor surface.
- (g) Solder the contact onto the conductor, and remove the excess solder,
- (h) Insert the cable assembly into the fitting, and tighten the locknut securely.

- (4) Termination procedure, using a threaded connector.

NOTE

When removing the cable jacket (insulation), be careful not to cut or nick the shielding.

- (a) Strip the cable jacket to the dimensions shown in figure 2-57.

NOTE

If using coaxial cable RG-59, 62 or 71/U, cut off and discard the narrow portion of the bushing.

- (b) Slip the clamp nut, washer, and bushing over the cable.

- (c) Comb out the shielding and turn it back from the dielectric.

NOTE

When removing the dielectric, be careful not to cut or nick the conductor.

- (d) Cut the dielectric and conductor to the dimensions shown in figure 2-57.

- (e) Comb the shielding toward the end of the cable, and place the clamp over the shielding.

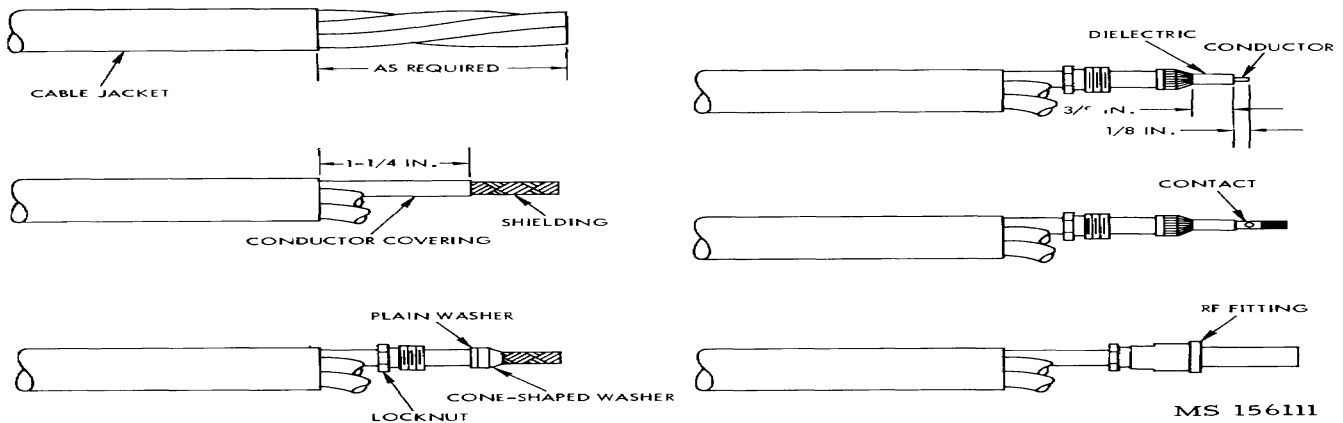


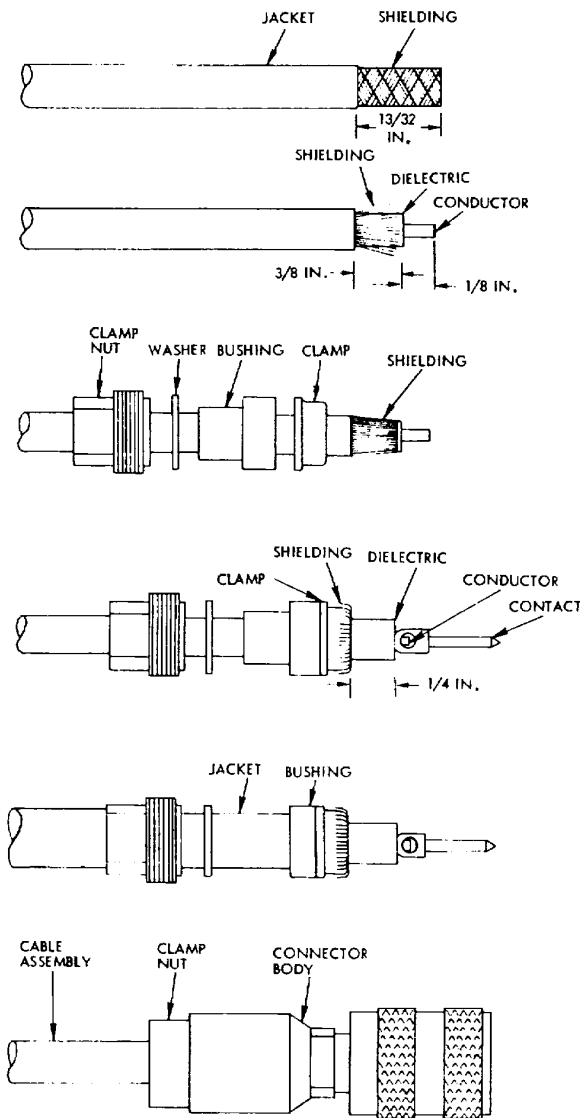
Figure 2-56. Terminating a coaxial cable, using an rf connector and fitting.

- (f) Push the clamp on the cable until the clamp is seated against the cable jacket.
- (g) Fold the shielding back over the clamp, and trim it to the length shown in figure 2-57.

CAUTION

Do not apply excess heat to the conductor thereby distorting the dielectric. Distortion may prevent proper mating with the connector body.

- (h) Tin the exposed conductor surface.



MS 156112

Figure 2-57. Terminating a coaxial cable, using a threaded connector.

NOTE

- The contact must be seated against the dielectric,
- (i) Solder the contact onto the conductor, and remove excess solder.
- (j) Insert the cable assembly into the connector body.
- (h) Tighten the clamp nut securely.
- (5) Termination procedures, using series N connector.

NOTE

When removing the cable jacket (insulation), be careful not to cut or nick the shielding.

- (a) Strip the cable jacket to the dimensions shown in figure 2-58.
- (b) Slip the locknut and gasket over the cable.
- (c) Comb out the shielding and turn it back from the dielectric.

NOTE

When removing the dielectric, be careful not to cut or nick the conductor.

- (d) Cut the dielectric and the conductor to the dimensions shown in figure 2-58.
- (e) Comb the shielding toward the end of cable, and place the clamp over the cable.
- (f) Fold the shielding back over the clamp, and trim it to the length as shown in figure 2-58.

CAUTION

- Do not apply excess heat to the conductor thereby distorting the dielectric. Distortion may prevent proper mating with the connector body.
- (g) Tin the exposed conductor surface.
- (h) Solder the contact onto the conductor, and remove the excess solder.
- (i) Insert the cable assembly into the connector body.
- (j) Tighten the locknut assembly.
- (6) Termination procedure, using an MS series connector.

NOTE

When removing the cable jacket (insulation), be careful not to cut or nick the shielding.

- (a) Strip the cable jacket to the dimensions shown in figure 2-59.
- (b) Slip the insulation sleeving over the cable.

CAUTION

Do not apply excess heat to the conductor thereby distorting the dielectric. Distortion may prevent proper mating with the connector body.

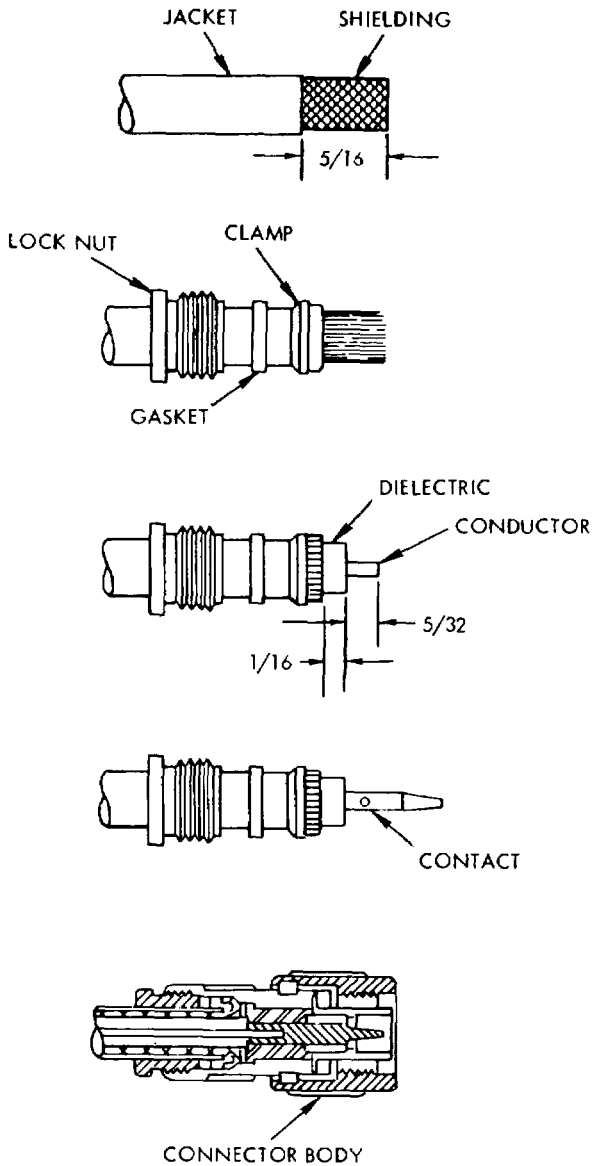
(e) Tin the exposed conductor surface.

(f) Solder the contact onto the conductor. and remove the excess solder.

NOTE

Be sure that the holes in the shield connector are nearest the connector body.

(g) Slip the shield connector over the collar of the connector body.



MS 156113

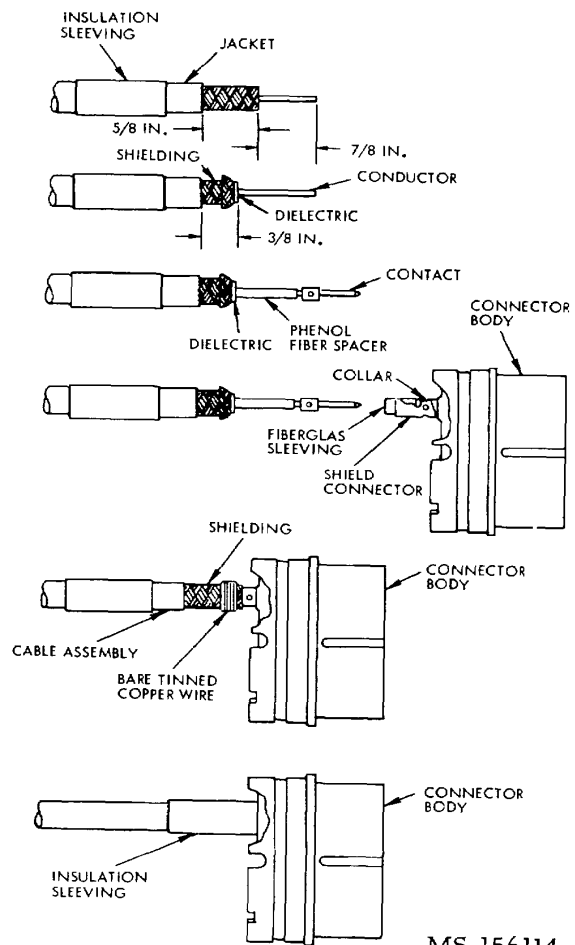
Figure 2-58. Terminating a coaxial cable, using a series N coaxial connector.

NOTE

When removing the dielectric, be careful not to cut or nick the conductor.

(c) Fold the shielding back to expose the dielectric, and cut the dielectric to the dimensions shown in figure 2-59.

(d) Slip the phenolic fiber spacer over the conductor, and ensure that the spacer is seated against the dielectric.



MS 156114

Figure 2-59. Terminating a coaxial cable, using an MS series connector.

(h) Solder the shield connector to the collar through the holes in the shield connector.

(i) Insert a 7/8-inch long fiberglass sleeving into the shield connector, and ensure that the sleeving is seated against the collar of the connector body.

(j) Insert the cable assembly into the connector body, and ensure that the contact is flush with the front of the connector body.

(k) Fold the shielding over the fiberglass sleeving and the shield connector.

(l) Whip the shielding to the shield connector with 30 AWG bare tinned copper wire (approximately eight turns).

(m) Solder the copper wire to the shielding.

(n) Trim the excess shielding that protrudes beyond the whipping.

(o) Push the insulation sleeving toward the connector body until the sleeving is seated against the connector body.

(7) *Termination procedures for special purpose electrical cable assembly coaxial cable (fig. 2-60).*

(a) Install a 7/8-inch length of shrinkable tubing on the coaxial cable.

(b) Install the nut and crimp the ferrule onto the coaxial cable.

(c) Remove 15/16 of an inch of outer sheath (cotton braid) from the end of the coaxial cable.

CAUTION

Avoid cutting or nicking of wire braid.

(d) Slide the wire braid back on the cable far enough to allow the inner retaining sleeve to be inserted over the dielectric and underneath the braid. Then position the inner retainer sleeve 7/16 of an inch under the braid.

(e) Smooth the wire braid over the inner sleeve, and cut the wire braid flush with the end of the inner sleeve.

(f) Slide the outer sleeve forward on the cable over the wire braid. Butt the rear edge of the sleeve against the cable outer sheath. Crimp the wire braid between the inner and outer sleeves, using the 100 nest on the crimping tool.

(g) Strip the dielectric from the conductor, leaving 5/32 of an inch of dielectric ferrule in front of the flange.

(h) Place the flat washer over the dielectric and slide it back against the flange of the ferrule.

(i) Place the back insulator over the dielectric and butt it against the flat washer.

(j) Tin the conductor.

(k) Cut the conductor 7/32 of an inch from the back insulator (fig. 2-60).

(l) Install the inner contact on the conductor with the slotted end out, ensure that it is butted against the back insulator, and solder.

NOTE

Use a 42-watt soldering iron and a 0.016 - diameter solder.

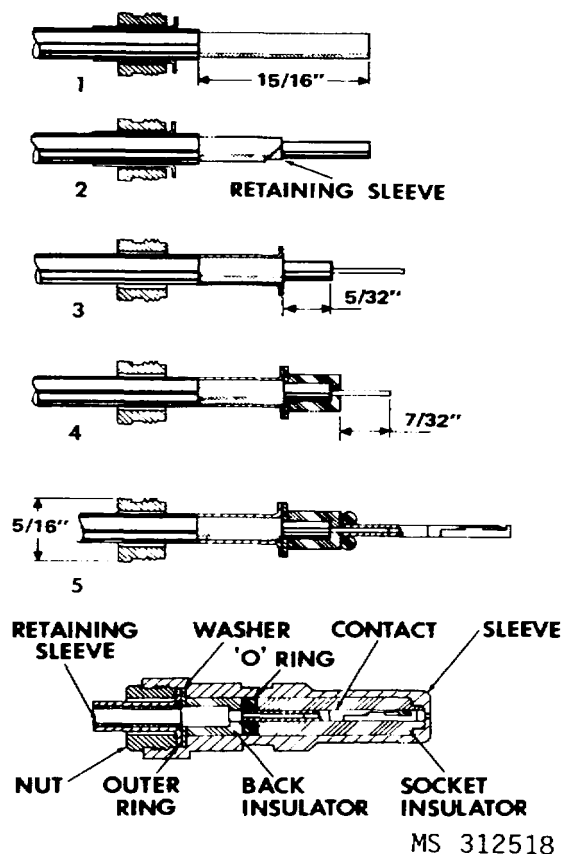


Figure 2-60. Assembly stage and contact point identification.

(m) Clean excess solder and flux from the face of the back insulator And inner contact.

(n) Slide the "O" ring and front insulator onto the inner contact

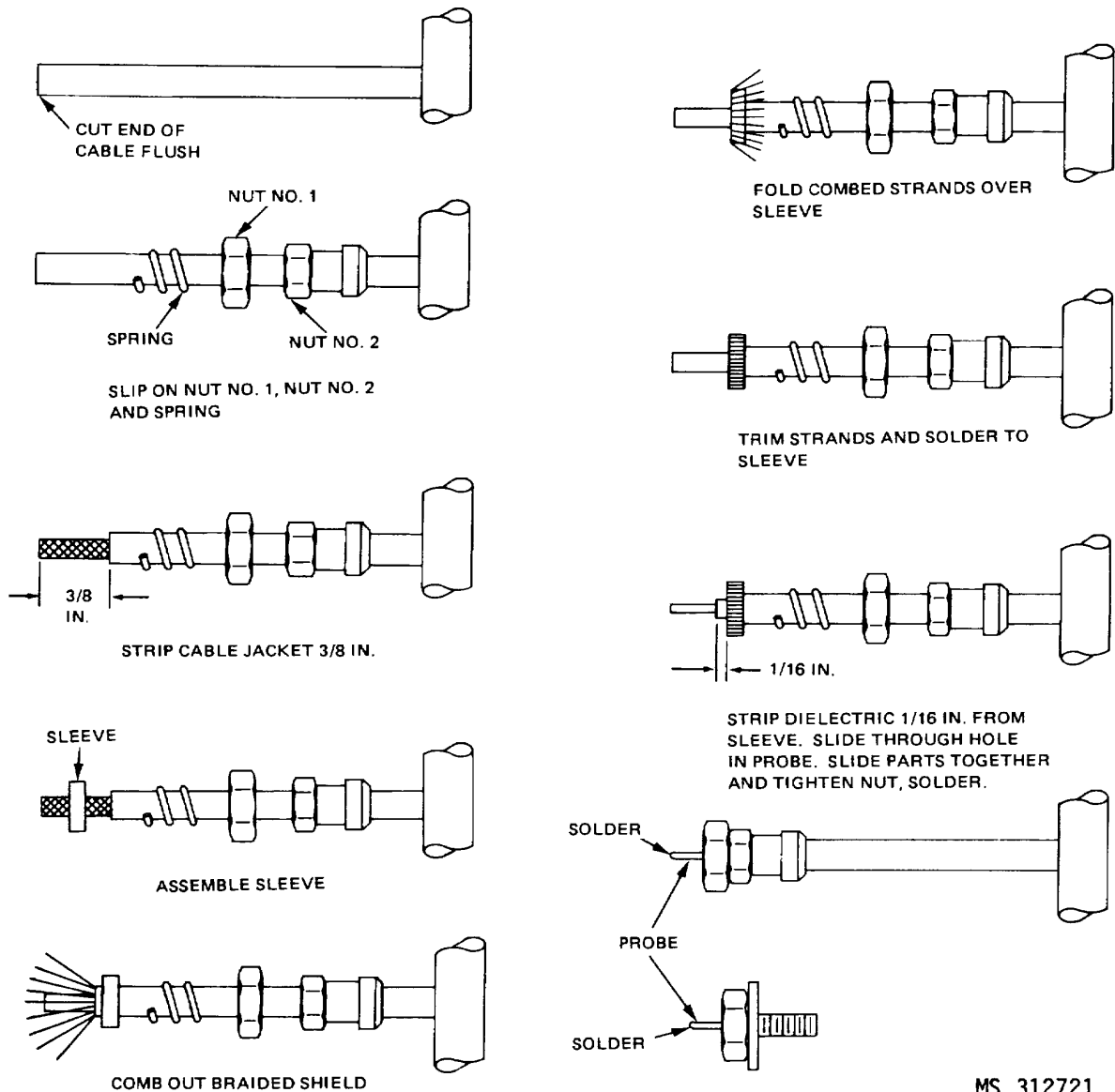
(o) Repair the other coaxial cable following steps (a) through (m) above.

e. Assembly Procedure for Rf Connector 9167003

(1) Cut the end of the coaxial cable flush before performing the connector procedure.

Note

Remove the front insulator after checking for a fit. Replace when the other coaxial cable has been repaired.



MS 312721

Figure 2-61. Assembly of rf connector 9167003.

(2) Slip nut no. 2 (small), nut no. 1 (large) and the plug connector spring over the coaxial cable.

(3) Strip the outer insulation back $\frac{3}{8}$ of an inch from the end of the coaxial cable. Be careful not to damage the shielding.

(4) Assemble the sleeve from the connector over the shielding and up against the coaxial insulation.

(5) Comb out the braided shield wire so that no strands are snarled or crossed.

(6) Fold all strands of the shield braid back over the sleeve making sure that no strands are crossed.

(7) Solder strands to the sleeve using a minimum of solder and heat. Do not damage the insulation under the sleeve.

(8) Trim the excess strand ends neatly from the sleeve.

(9) Trim the dielectric from the center conductor to within $\frac{1}{16}$ of an inch of the sleeve.

(10) Make certain that the center conductor wire strands are close together and tin them with a minimum of solder.

(11) Inspect all workmanship.

(12) Insert the center conductor through the hollow probe of the connector, and slide the spring, nuts, and probe together and assemble them. (Use retaining ring pliers 5120-00-293-0044 when tightening the assembly.) Solder the center conductor and probe end, leaving no excess solder on the probe.

(1.q) Trim off the protruding center conductor, if any.

(14) Using a multimeter, ensure that there is no continuity between the center conductor and the outer shell of the connector.

2-10. Lacing of Wiring Harness *a. Lacing.* To prevent damage to insulation and breaking of conductors caused by vibration and other movements, the wires must be tied together in bundles or harnesses and secured to the structure or to a tiebar. Various methods such as continuous lacing, spot ties, plastic cable ties, plastic tubing, and spiral-wrapped plastic tape are commonly used for lacing the cable trunk. Excessive tension, visible as a deformation of the outside diameter of the cable trunk, will

promote cold flow of the insulation under the tie. This condition can result in low insulation value or short circuits.

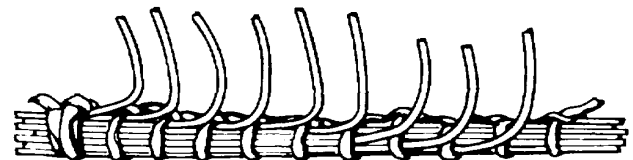
b. Methods.

(1) *Continuous lacing (figs. 2-62 and 2-63).* The materials commonly used for continuous lacing are lacing tape, cord, or small diameter tubing. The stitching should be equally spaced up to the point of branching or other termination. Where the harness ending consists of a single wire or a pair of wires, a clove hitch secured by a square knot is sufficient. In component assemblies where wires break from the cable trunk to a termination, the tie should be made a distance from the branch to provide a sufficient vibration bend.



MS 571222

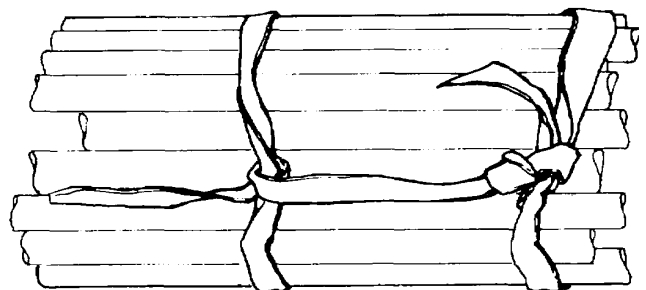
Figure 2-62. Equal Spacing



MS 571223

Figure 2-63. Vibration Bend

(2) *Terminating stitches and spot ties.* A clove hitch and a square knot are generally used for terminating stitches and spot ties (fig. 2-64).



MS 571224

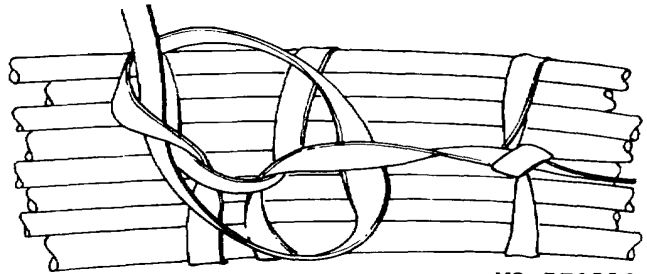
Figure 2-64. Clove stitch and square knot.

(3) *Running or single stitches (fig. 2-65).* Running or single stitches are successfully used on insulation that has high potential cold flow characteristics. They are made by passing the free end of the lacing material around the bundle, over the standing part, and through the loop.



MS 571225

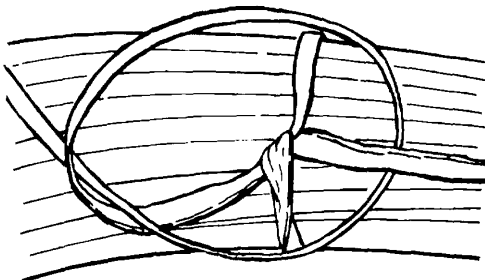
Figure 2-65. Running Stitch



MS 571228

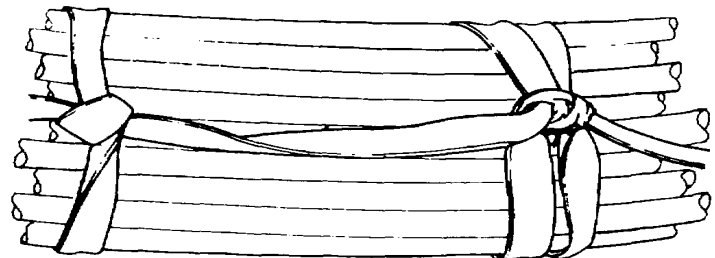
Figure 2-68. Double lock stitch.

(4) *Single lock stitch (figs. 2-66 and 2-67).* The single lock stitch is commonly used for continuous lacing. It is formed by making a single stitch, then passing the free end under the lacing between the two stitches and through the loop.



MS 571226

Figure 2-66. Single lock stitch method



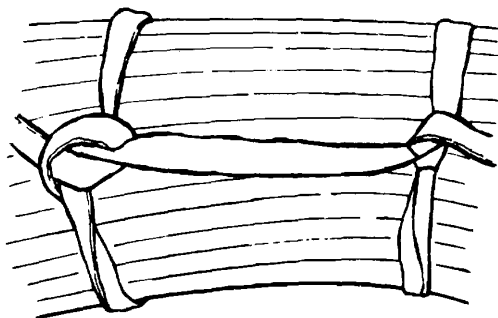
MS 571229

Figure 2-69. Double lock stitch completed.

(6) *Spacing of stitches.* The wires in a finished cable trunk should have a minimum number of crossovers. Crossovers, if necessary, should be at least 8 inches from the termination. Terminating stitches should be made at the end of each lacing. The type of stitch is determined mainly by the type of insulation and diameter of the bundle. The most commonly used stitch spacing is indicated in table 2-3.

Table 2-3. Stitch Spacing

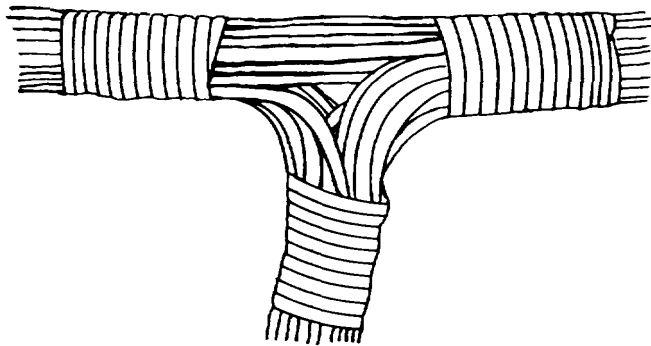
Lacing Internal inches approximate	Cable or harness diameter
1/2 inch or less	3/4 to 1 1/2
1 inch	2
Larger diameter	3



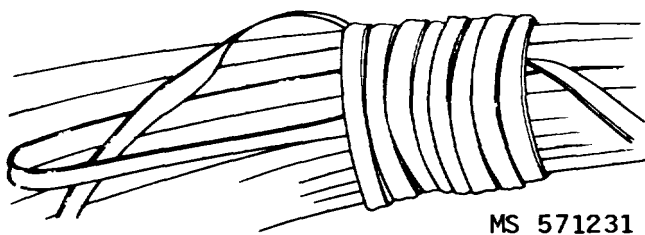
MS 571227

Figure 2-67. Single lock stitch completed.

(7) *Serve (fig & 2-70 and 2-71)*. The length of the serve or endless tie should be equal to approximately the outside diameter of the wire bundle and should not exceed 3/4 inch. To prevent the lacing from loosening, it should be served at the point of origin and at the point of termination of the lacing. The serve is used at bundle branches or breakouts and at all bundle end terminations. The serve is made by forming a loop along the bundle with the lacing tape, the ends of the tape toward the bundle end. Wrap the lacing end of the tape around the bundle and over the loop. Upon reaching the desired length of serve, pass the lacing end through the loop and pull the ends away from each other. Adjust by pulling until the cross is under the serve. Cut this excess tape from each end of the serve



MS 571230
Figure 2-70. Serve at point of origin



MS 571231

(8) *Spot ties (fig. 2-72)*. Spot ties are frequently used in place of continuous lacing. They are made exactly like the termination ties.

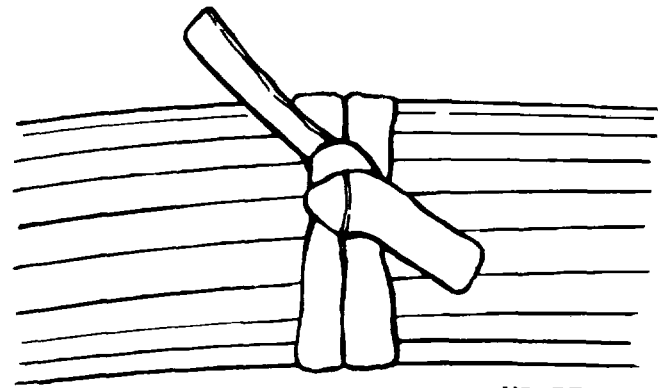


Figure 2-72. Spot Tie

MS 571232

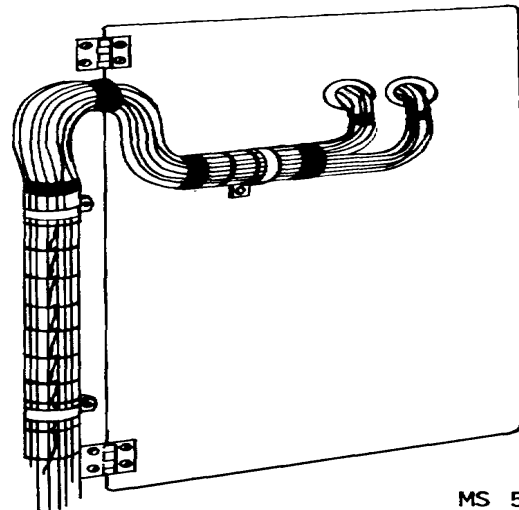
CAUTION

Cut the end of nylon straps off flush with the boss to avoid cuts to hands from the sharp edges. The plastic ties may also be used as cable clamps. Care should be taken that no cable clamp be placed over a cable tie.

(9) *Service loop (fig. 2-73)*. Where a loop must be provided to allow opening of an access door, the harness should be served at the start and end of the loop.

The loop should not be laced, but should be secured by spot ties or plastic cable ties.

Figure 2-71. Serve method of tying.



MS 571233

Figure 2-73.
Service loop
2-44

CHAPTER 3 MECHANICAL INSPECTION AND REPAIR

3-1. General

The purpose of mechanical inspection and repair is to detect the first signs of mechanical failures and to insure that appropriate corrective action is taken before expensive and time-consuming repairs or replacements are required. This system is based on frequent inspection and services accomplished by operators or maintenance personnel under active supervision of all commanders and leaders.

3-2. Inspection

The following procedures apply to preventive maintenance services and to all inspections, and are just as important as the specific procedures.

NOTE

Use table 3-1 as a visual inspection guide to determine the need for mechanical maintenance.

a. Inspections to see if items are in good condition, correctly assembled or stored, secure, not excessively worn, not leaking, and adequately lubricated apply to most items in the preventive maintenance and inspection procedures. Any or all of these checks that are pertinent to any item (including supporting, attaching, or connecting members) will be performed automatically, as general procedures, in addition to any specific procedures given.

b. Inspection for good condition is usually an external visual inspection to determine whether the unit is damaged beyond safe or serviceable limits. Good condition is explained further as meaning not bent or twisted, not chafed or burred, nor broken or cracked, not bare or frayed, not dented or collapsed, not torn or cut, not deteriorated.

c. Inspection of a unit to see that it is correctly assembled or stowed is usually a visual inspection to see if the unit is in its normal position in the materiel and if all its parts are present and in their correct relative position.

d. Inspection of a unit to determine if it is secure is usually an external visual examination or a check by hand or wrench for looseness. Such an

inspection must include any brackets, lockwashers, locknuts, locking wires, or cotter pins as well as any connecting tubes, hose, or electrical

e. Excessively worn means worn beyond serviceable limits or to a point likely to result in failure if the unit is not replaced before the next scheduled inspection. Excessive wear of mating parts or linkage connection is usually evidenced by too much play (lash or lost motion). It includes illegibility as applied to markings, data and caution plates, and printed matter.

f. Such expressions as "adjust if necessary" or "replace if necessary" are not used in the specific procedures. It is understood that whenever inspection reveals the need of adjustment, repair, or replacement, the necessary action will be taken.

3-3. Mechanical Troubleshooting

This paragraph provides information for locating and correcting troubles in the mechanical parts of the major items of the improved HAWK air-defense guided-missile system. Troubleshooting procedures, in a systematic step-by-step operation, are designed to aid the technician in isolating defective components in a minimum of time.

3-4. Removal and Installation of Mechanical Components

a. *General.* This section provides maintenance instructions for authorized organizational maintenance personnel of the improved HAWK air-defense guided-missile system. Maintenance consists of replacement of parts and detailed adjustments of parts listed in the Organizational, DS, GS, and Depot Maintenance Repair Parts and Special Tool Lists Illustration Supplement. Using troops will have the materiel sent to direct support maintenance personnel to perform all other replacements and adjustments.

b. *Repair of Hydraulic Leaks - Typical.*

(1) *Safety.* Relieve all pressure in a hydraulic unit before attempting to make repairs or before disconnecting hydraulic lines or couplings.

Table 3-1. Visual Mechanical Inspection Guide -- Typical

Part	Condition
Bearings	<p>Securely installed.</p> <p>No evidence of rust, corrosion, wear, chipping, cracks, burrs, breaks, and overheating.</p> <p>Inspect for proper installation, smoothness of operation, proper lubrication, and any other damage which might impair bearing operation.</p>
Bolts and nuts	<p>Securely installed.</p> <p>No missing bolts or nuts.</p> <p>No evidence of rust, corrosion, wear, cracks, breaks, bends, and damaged threads.</p>
Bulbs and lights	<p>Properly installed.</p> <p>Inspect for nonoperating lights and signals, missing bulbs, loose connections, and correct hookup.</p>
Cleanliness and general appearance	<p>Visually inspect for the presence of dirt, sand, grime, and excessive accumulations of oil, grease, or hydraulic fluid.</p>
Connectors	<p>Properly installed.</p> <p>No evidence of rust, corrosion, cracks, breaks, bends, damaged pins, damaged threads, gaskets, and covers.</p>
Desiccants	<p>Properly installed.</p> <p>Inspect for discoloration (including moisture saturation), proper location, and general condition.</p>
Dials and scales	<p>Properly installed.</p> <p>No evidence of chipped paint, scratches, and bends.</p> <p>Inspect for correct adjustment, security, legibility, and proper type.</p>
Distribution boxes	<p>Properly installed.</p> <p>No evidence of scratched paint, rust, corrosion, <i>cracks</i>, and <i>dents</i>.</p> <p>Inspect for correct safety wire, damaged switches, cleanliness, missing parts, security and legibility of nameplates, markings, and equipment placards.</p>
Electrical cables	<p>Properly installed.</p> <p>No evidence of cracked, frayed, or worn insulation.</p> <p>Inspect for presence of dust caps, proper potting of connectors, and for external damage to connectors.</p>
Fittings	<p>Properly installed.</p> <p>No evidence of rust, corrosion, damaged or missing gaskets and seals, damaged threads, cracks, dents, burrs, and leaks.</p>
Gages	<p>Proper type and properly installed.</p> <p>No evidence of rust, corrosion, cracks, breaks and leaks.</p> <p>Inspect legibility of markings, completeness, and cleanliness.</p>
Gears	<p>Properly installed.</p> <p>No evidence of rust, corrosion, wear, missing or damaged teeth, burrs, cracks, or excessive backlash.</p>

Table 3-1. Visual Mechanical Inspection Guide - Typical - Continued

Part	Condition
Hinges	<p>Proper finish and ease of operation. No evidence of rust, corrosion, sag, bent pins, cracks, bends, or wedr. No loose or missing hardware.</p>
Hoses	<p>Proper cure dates. No evidence of wear, kinks, cracks, weathering, or leaks. Make sure connections and clamps are secure.</p>
Latches and catches	<p>Proper finish and ease of operation. No evidence of rust, corrosion, cracks, breaks, burrs, dents, and bent pins. No loose or missing hardware.</p>
Levels	<p>Properly installed. No evidence of corrosion, cracks, broken glass and rust. Inspect for security of mounting, liquid level, bubble size, and correct adjustment.</p>
Lubrication points	<p>Properly installed. Check for insufficient or excessive lubricant. Inspect for missing or broken fittings.</p>
Motors	<p>Properly installed. No evidence of rust, corrosion, scratches or cracks. Inspect for correct attachment, overheating, missing parts, cleanliness, security and legibility of nameplates, markings, and equipment placards.</p>
Mounting hardware	<p>Properly installed. respect equipment for secure attachment and for loose or missing nuts, bolts, screws, washers, rivets, clamps, lockwiring, etc.</p>
Nameplates, markings and placards	<p>Properly installed. Inspect for clarity, legibility, and secure attachment. Insure that information is correct and up to date.</p>
Painted or finished surfaces	<p>Properly painted or finished surfaces. No evidence of cracks, chips, scratches, blisters, or peeling. Inspect for proper color, and general condition around welded areas and areas likely to be damaged during handling.</p>
Pins	<p>Securely installed. Inspect for missing or improperly installed pins. Inspect all alinement, attachment, and holding pins for rust, corrosion, wear, burrs, cracks, bends, chafing, and general condition.</p>
Preservation	<p>Inspect for adequate preservation against rust, corrosion, dirt, fungus, and damage from handling, shipping, or storage. Consult MIL-P-116 if unit is to be placed in shipment or storage.</p>
Retaining-ring grooves	<p>No evidence of rust, corrosion, burrs, nicks and dents.</p>

Table 3-1. Visual Mechanical Inspection Guide - Typical - Continued

Part	Condition
Safetywiring	<p>Properly installed. No evidence of rust, corrosion, broken wires, and damage which could affect security. Inspect for proper orientation and proper tension.</p>
Seals and gaskets	<p>Proper cure dates (where applicable) and installation. No missing seals or gaskets. No evidence of breaks, leaks, wear, or resiliency.</p>
Shafts	<p>Securely installed. No evidence of rust, corrosion, wear, chafing, cracks, burrs, and bends. Pay special attention to the finish of bearing surfaces.</p>
Shields	<p>Properly installed. No evidence of paint or finish cracks, chips, scratches, rust, corrosion, peeling, or oxidation. Inspect for bends, cracks, breaks (especially on welds), security, correct adjustment, and hardware.</p>
Springs	<p>Properly installed. No missing springs. No evidence of cracks or breaks. Proper tension, compression or torque.</p>
Stops and limiting devices	<p>Proper assembly and adjustment. Any condition which might affect spring operation. No evidence of rust, corrosion or missing parts.</p>
Threaded holes	<p>No evidence of rust, corrosion, plugged holes, stripped or damaged threads. Proper inserts are used.</p>
Tubing	<p>Properly installed. No evidence of rust, corrosion, cracks, leaks, clamps, fittings and bends are properly installed.</p>
Valves and manifolds	<p>Proper finish and installation. No evidence of rust, corrosion, missing parts, leaks, nicks, burrs, damaged threads or fittings.</p>
Windows	<p>Properly installed. No evidence of cracked or broken glass, missing or broken seals, and discoloration. Inspect for cleanliness and general condition.</p>
Wire cables	<p>Properly installed. No evidence of rust, corrosion, broken strands, kinks, flat spots, necked -down areas, and separations. Inspect for security of attachment, and lubrication.</p>

(2) *Cleanliness.* Take the necessary precautions to prevent contamination of the hydraulic fluid. Keep storage and handling containers sealed and clean. Use storage and handling containers only for hydraulic fluid. Filter fluid that has been exposed to dust or other impurities. Do not reuse badly contaminated hydraulic fluid. (3) *Dust plugs.* Install the dust plugs immediately upon removal of the hydraulic lines or couplings. Keep the dust plugs in a clean, closed container until ready for use. Check the dust plugs for cleanliness and condition of threads before using.

(4) *Contamination.* Impurities in the hydraulic fluid affect the performance of a hydraulic unit in the following ways:

- (a) Contamination causes the pumps to score or seize.
- (b) Contamination lodges in the valves, retarding or preventing their proper function.
- (c) Contamination collects in the fluid lines, restricting normal flow.
- (d) Solid particles clog small openings, preventing development of required operating pressures.
- (e) Sediment fills the grooves of the pistons and spools, increasing static friction between moving parts and impairing the operation of the unit.

(5) *Preformed packings and seals.* Discard all reformed packings and seals immediately upon disassembly of the hydraulic components. Use only new ones when assembling the hydraulic components. Coat them with a thin film of hydraulic oil before installation. Use a preformed packing installation tool when available; otherwise slip a tube of paper over the threads or grooves to protect the preformed packing or seal during installation.

(6) *Containers.* Use clean, plastic parts containers to hold and protect the parts from damage or loss during the repair or replacement of the hydraulic components. Prevent parts from striking against each other. Completely immerse the metal parts in the hydraulic fluid when they must remain in a container for more than four hours.

(7) *Female fittings.* Install a male fitting or a rigid plug to prevent collapse or distortion of the shoulder when using a wrench on an extended shoulder of a female fitting.

(8) *Removal and replacement of hydraulic lines.* Replace defective hydraulic lines immediately

with lines of the same size, material, and configuration as those removed. Inspect the shoulders of the fittings for scoring and grit before installing a new line. Use lubricant only on male threads when installing lines. Do not tighten fittings more than prescribed for their specific size (table 3-2). Over-tightening will weaken the joint or cause leakage.

c. *Backlash Measuring.* Use two thickness gages (3, fig. 3-1), one on either side of the gear tooth as shown in figure 3-1, to determine the backlash. Add the thickness of the two gages for the total backlash clearance.

Table 3-2. Tubing F7ared-Fittigl Torque Specifications

Tube od (inches)	Torque (inch-pounds) (max)	
	Aluminum alloy	Steel
3/16	55	65
1/4		65 90
5/16	100	120
3/8	125	150
1/2	250	250
5/8	350	
3/4	500	
1.00	750	

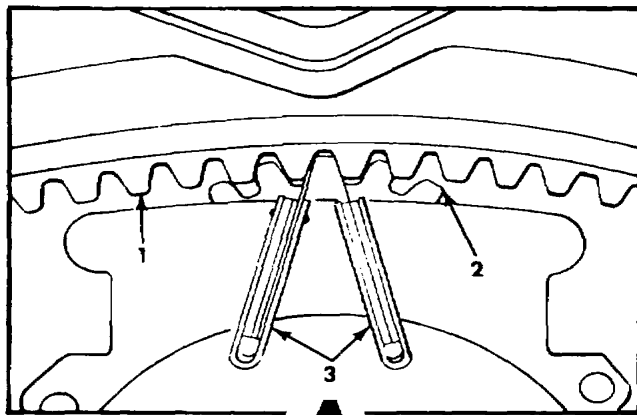
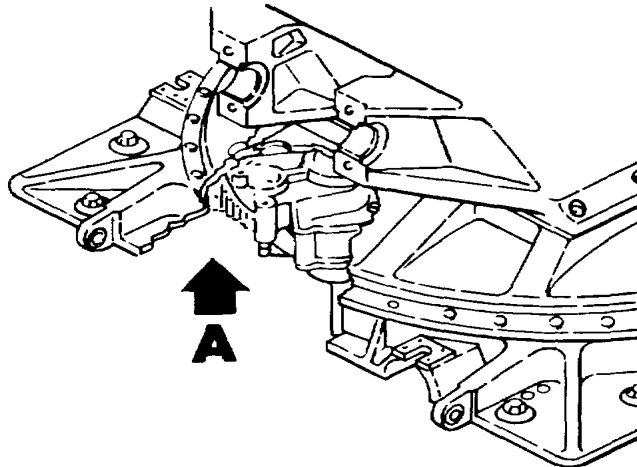
3-5. Spot Painting

CAUTION

Do not paint weather seals, gaskets, or any other sealing material. Paint causes sealing material to deteriorate and leak.

a. *Painting Don'ts.* Certain basic precautions in the application of paint, varnish, enamel, and lacquer are generally applicable. The following should be observed at all times:

- (1) Don't paint over an unclean surface. Be sure that all dirt, rust, scale, etc. Are removed.
- (2) Don't fail to stir paint thoroughly.
- (3) Don't mix one paint with another unless instructed to do so.
- (4) Don't fail to follow instructions which may appear on containers, particularly with respect to the addition of thinner and application instructions
- (5) Don't apply paint or varnish unless the drying conditions are satisfactory.
- (6) Don't paint in wet or extremely cold weather (below 50 F).



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- 1—Ring gear
- 2—Drive gear
- 3—Thickness gages

- (15) Don't use electrical connections that show any inclination to become loose or to arc.
- (16) Don't pour paint out of a container in a manner that obscures the label.
- (17) Don't fail to strain paint before using if needed.
- (18) Don't fail to remove all traces of wax from surfaces where paint or varnish is to be used.
- (19) Don't paint without proper ventilation.
- (20) Don't waste paint by spraying beyond the item being coated.
- (21) Don't paint over a moist or wet surface.
- (22) Make sure paint does not come between the ground strap and the chassis.
- (23) Avoid paint on operator-instruction plates and faces of gages and meters.

b. Touchup Painting.

(1) *General.* When material has spots from which the protecting paint has disappeared and the rest of the paint surface is in a satisfactory condition, it is often advantageous to do a touchup rather than a complete painting job. The bare spots may have been caused by natural wear or abrasion, mechanical injury, rust or corrosion of the surface under the original paint, or other causes. In such cases, it is necessary to clean the material beneath the spots and repaint, using a method as near as possible to that used on the original paint job.

Figure 3-1. Backlash measuring - typical.

Figure 3-1. Backlash measuring - typical

typical

- (7) Don't apply abnormally heavy coats.
- (8) Don't add too much thinner.
- (9) Don't use paint buckets, cans, paint rollers, spray guns, or brushes which are not clean.
- (10) Don't apply cold paints or varnishes.
- (11) Don't leave old paint- and oil-soaked clothes lying around in the paint shop. They are a fire hazard.
- (12) Don't fail to clean brushes, paint rollers, and spray guns immediately after using.
- (13) Don't smoke when painting.
- (14) Don't release the tops of pressure-feed material containers before releasing the air pressure.

(2) *Cleaning.* The spots to be painted must be thoroughly cleaned so that no decay, dirt, rust, corrosion, etc., remains. The remaining paint should also be worked down to a feather-edge if it is desirable to hide the lap.

(3) *Painting.* While touchup painting may be done by the brush method, spraying is superior, because the edges of the new paint can be feathered out to blend with the old surface and, if the old and new colors match, the areas of new paint will not be noticeable. In touchup work, it is of course necessary to use such fillers, undercoats, finish coats, etc., as are required by the material being painted and to insure that the composition of the paint coating is the same.

c. Touchup and Refinishing Procedure.

(1) When touching up damaged areas, the procedure should be as similar to the original method of finishing as possible. A very clean surface is imperative. A spray gun will blend

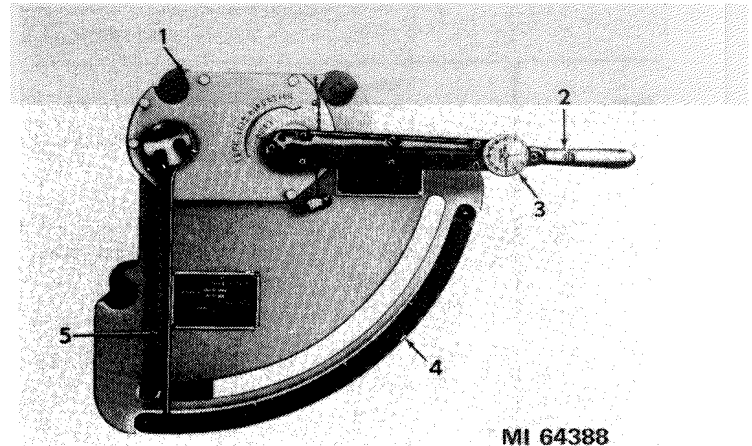
painted areas better than a brush. However, touch-up by brushing usually will be satisfactory on assemblies.

(2) If the undercoat has been damaged, carefully wipe the area to be refinished with dry-cleaning solvent or mineral spirits paint thinner, apply primer, and allow to dry.

(3) When an invisible lap is required, the edges of the damaged area should be smooth or "feathered in" with flint paper to remove all ridges and carefully wiped with solvent or thinner before the primer and top coat are applied.

(4) If the old finish is in generally good condition, carefully clean the surface with a cleaning solvent or thinner and apply the top coat.

(5) Where general disintegration of the surface is evident or the under surface is corroded, the film must be stripped clean from the start. Corrosion must be removed or neutralized by *typical* mechanical or chemical treatment or by utilizing both methods. If necessary, the surfaces must be pretreated (anodized or phosphatized) before the required finish is applied.



- 1—Torque wrench and tensiometer tester
- 2—Torque wrench
- 3—Torque wrench meter
- 4—Scale
- 5—Pointer

Figure 3-2. Operation of torque Wrench and tensiometer tester - typical.

CAUTION

Optical elements, bearings, rubber, or other components, which might be damaged by stripping materials or procedures, must be removed from the instrument before stripping the coatings.

3-6. Operation of the Torque Wrench and Tensiometer Tester

NOTE

The key numbers shown below in parentheses refer to figure 3-2.

- a. Place the torque wrench (2) on the torque wrench tensiometer tester (1), and adjust the torque wrench meter (3) to the desired setting. In mind the direction of rotation which tightens
- b. Pull the torque wrench slowly and smoothly in a clockwise direction until the pointer (5) of the tester reads within 2 percent of the preset value.
- c. The torque wrench meter should now indicate 0; if not, record the difference.
- d. Repeat the above steps two times.

NOTE

A large variation between readings indicates that the operator is not pulling the torque wrench correctly.

- e. Average three or more of the differences recorded to find the amount of error in the torque wrench.
- f. Refer to table 3-3 for the torque wrenches used in the improved HAWK system.

3-7. Drills, Countersinks, Extractors, and Pipe Thread Sizes

Refer to table 3-4 for the types and capacities.

3-8. Safetywiring

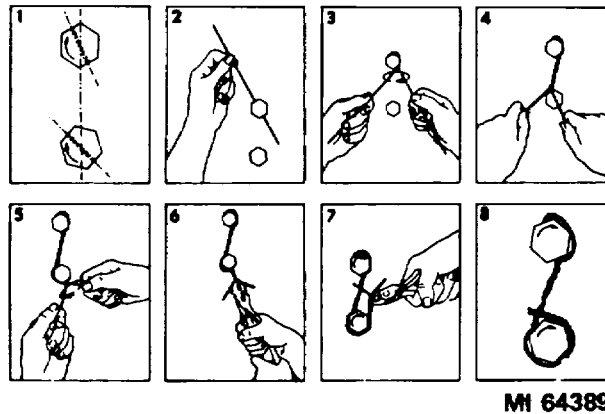
Certain structural fasteners undergo extreme stress. These fasteners must be safety wired to prevent the slightest rotation. Figure 3-3 illustrates a common technique for safety wiring two hexagon-head capscrews together. The safety wire (9505-00-555-8648) can also be secured through a hole in some convenient structural member. Keep the fastener, and wire accordingly.

CAUTION

If structural fasteners are wired in the wrong direction, they will loosen and serious damage may result.

Table 3-3. Torque Wrenches

Item	Where carried	Part number	Description	Values
1. Electro-mechanical shops 6, 8	5120-585-8434		Rigid frame end drive style, w/visual dial indicating torque mechanism, 1/4-in. male square drive	0-75 pound-inches
2. Ground	5120-776-1841		Rigid frame end drive style, w/visual dial indicating torque mechanism 3/8-in. male square drive	0-300 pound-inches
3. Electro-mechanical shops 6, 8	5120-640-6364		Rigid frame end drive style, w/right adapter, w/visual dial indicating torque mechanism, 1/2-in. square drive	0-175 pound-feet



MI 64389

Figure 3-3. Safetywiring of structural fasteners - typical.

Table 3-4. Drills, Countersinks, Extractors, and Pipe Thread Sizes

Item	Fraction or drill size	Decimal equivalent	Tap	Thread size	Diameter body	Included angle	Screw	Drill	Extractor	Guide
1. Drills	Number site drills									
	80	0.0135								
	79	0.0145								
	1/64	0.0156								
	78	0.0160								
	77	0.0180								
	76	0.0200								
	75	0.0210								
	74	0.0225								
	73	0.0240								
	72	0.0250								
	71	0.0260								
	70	0.0280								
	69	0.0292								
	68	0.0310								
	1/32	0.0312								
	67	0.0320								
	66	0.0330								
	65	0.0350								
	64	0.0360								
	63	0.0370								
	62	0.0380								
	61	0.0390								
	60	0.0400								
	59	0.0410								
	58	0.0420								
	57	0.0430								
	56	0.0465								
	3/64	0.04690	.80							
	55	0.0520								
	54	0.0550	1-56							
	53	0.0595	1-64, 72							
	1/16	0.0625								
	52	0.0635								
	51	0.0670								
	50	0.07002-								
		56, 64								
	49	0.0730								
	48	0.0760								
	5/64	0.0781								
	47	0.07853-48								
	46	0.0810								
	45	0.08203-								
		56,								
	4-32									
	44	0.0860	4-36							
	43	0.0890	4-40							
	42	0.0935	4-48							
	3/32-	0.0937								
	41	0.0960								
	40	0.0980								
	39	0.0995								
	38	0.1015	5-40							
	37	0.1040	5-44							
	36	0.1065	6-32							
	7/64	0.1093								
35	0.1100									
34	0.1110	6-36								
33	0.1130	6-40								
32	0.1160									
31	0.1200									

Table 3-4. Drills, Countersinks, Extractors, and Pipe Thread Sizes - Continued

	Fraction or drill size	Decimal equivalent	Tap body	Thread angle	Diameter	Included	Screw	Drill	Extractor	Guide
1. Cont	Number size drills									
	1/80.1250									
	30	0.1285								
	29	0.1360	8-32,							
			36							
	28	0.1405	8-20							
	9/64	0.1406								
	27	0.1440								
	26	0.1470								
	25	0.1495	10-24							
	24	0.1520								
	23	0.1540								
	5/32- -	0.1562								
	22	0.1570	10-30							
	21	0.1590	10-32							
	20	0.1610								
	19	0.1660								
	18	0.1695								
	11/64	0.1719								
	17	0.1730								
	16	0.1770	12-24							
	15	0.1800								
	14	0.1820	12-28							
	13	0.1850	12-32							
	3/16	0.1875								
	12	0.1890								
	11	0.1910								
	10	0.1935								
	9	0.1960								
	8	0.1990								
	7	0.2010	1/4-20							
	13/64	0.2031								
	6	0.2040								
	5	0.2055								
	4	0.2090								
	3	0.2130	1/4-28							
	7/32-	0.2187								
	2	0.2210								
	1	0.2280								
	Letter size drills									
	A	0.2340								
	15/64	0.2344								
	B	0.2380								
	C	0.2420								
	D	0.2460								
	1/4 -E	0.2500								
	F	0.2570	5/16-18							
	G	0.2610								
	17/64	0.2656								
	H	0.2660								
	I	0.2720	5/16-24							
	J	0.2770								
	K	0.2810								
	9/32-	0.2812								
	L	0.2900								
	M	0.2950								
	19/64	0.2968								
	N	0.3020								

Table 3-4. Drills, Countersinks, Extractors, and Pipe Thread Sizes - Continued

Item	Fraction or drill size	Decimal equivalent	Tap	Thread size	Diameter body	Included angle	Screw	Drill	Extractor	Guide
1. Cont.	Letter size drills									
	5/16-	0.31253/8-16								
	O	0.3160								
	P	0.3230								
	21/64	0.3281								
	Q	0.33203/8-24								
	R	0.3390								
	11/32-	0.3437								
	S	0.3480								
	T	0.3520								
	23/64	0.3594								
	U	0.36807/16-14								
	3/8	0.3750								
	V	0.3770								
	W	0.3860								
	25/64	0.39067/1t"-20								
	X	0.3970								
	Y	0.4040								
	13/32-	0.4062								
	Z	0.4130								
	27/64	0.42191/2-13								
	7/16	0.4375								
	29/64	0.45311/2-20								
	15/32-	0.4687								
	31/64	0.48449/16-12								
	1/2	0.5000								
	33/64	0.5153	9/16-18							
	17/32-	0.5312	5/8-11							
	35/64	0.5469								
	9/16-	0.5625								
	37/64	0.5781	5/8-18							
	19/32-	0.5937	11/16-11							
	39/64	0.6094								
	5/8-	0.625011/16-16								
	41/64	0.6406								
	21/32-	0.65623/4-10								
	43/64	0.6729								
	11/16-	0.68253/4-16								
	45/64	0.7031								
	23/32-	0.7187								
	47/64	0.7344								
	3/4-	0.7500								
	49/64	0.76567/8-9								
	25/32-	0.7812								
	51/64-	0.7969								
	13/16-	0.81257/8-14								
	53/64 -	0.8281								
	27/32-	0.8437								
	55/64 -	0.8594								
	7/8	0.87501-8								
	57/64 -	0.8906								
	29/32-	0.9082								
	59/64	0.9219								
	15/16-	0.93751-12, 14								
	61/64 -	0.9531								
	31/32-	0.9687								
	63/64 -	0.98441-1/8-7								
	1	1.0000								

Table 3-4. Drills, Countersinks, Extractors, and Pipe Thread Sizes - Continued

Item	Fraction r drill size	Decimal equivalen t	Tap size	Thread	Diameter body	Included angle	Screw	Drill	Extractor	Guide
1. Cont.	Letter size drills 1-3/64	1.0469	1-7/8- 12							
	1-7/64	1.1093	1-1/4-7							
	1-1/8	1.1250								
	1-11/64-	1.1719	1-11/4- 12							
	1-7/32-	1.2187	1-3/8-6							
	1-1/4	1.2500								
	1-16/64-	1.2968	1-3/8- 12							
	1-11/32-	1.3437	1-1/2-6							
	1-3/8	1.3750								
	1-27/64-	1.42191-								
	1/2-12									
	1-1/2 -	1.5000								
2. Counter- sinks					3/8"	60 degrees				
					3/8"	82 degrees				
					3/8"	100 degrees				
3. Extrac- tors							1/4" 5/16" 3/8" 7/16" 1/2"	1/8" 3/16" 1/4" 5/16" 11/32"	1/4" 5/16" 3/8" 7/16" 1/2"	9/32" 5/16" 3/8" 7/16" 1/2"
4. Pipe thread sizes				1/8-27 2/8-18 3/8-18				R 7/16" 37/64"		
				1/2-14 3/4-14				23/32" 56/64"		
				1- 11-1/2 1-1/8-1- 1/2"				1- 5/27"		
				11-1/2 1-1/2- 11-1/2				1- 47/64" 2-7/32"		
				2- 11-1/2 2-1/8-8				2-5/8" 3-1/4" 3-3/4" *4-1/4"		
				3-8 3-1/2-8 4-8						

CHAPTER 4 EQUIPMENT SERVICING

4-1. General

When a new or reconditioned major item of the HAWK air-defense guided-missile system is first received by the using organization, it is the responsibility of the officer-in-charge to determine whether the materiel has been properly prepared for service, and to ensure that it is in condition to perform its assigned mission when placed in service. For this purpose, a visual inspection will be made of all major components, assemblies, subassemblies, and accessories to make sure that they are present, properly assembled, secured, and clean. Equipment records will be checked to determine that the major item has been correctly adjusted and lubricated.

4-2. Air Conditioner Filter Servicing

a. The air filter may be checked by noting the air flow in the shelter during operation of the air conditioner. If the air flow appears to be dropping, check the filter for sand or dust.

b. The air filter may be cleaned by using the following method:

NOTE

Refer to figure 4-1 for removal of the air filter from the air conditioner.

WARNING

Failure to perform steps (1) and (2) below may cause injury to personnel.

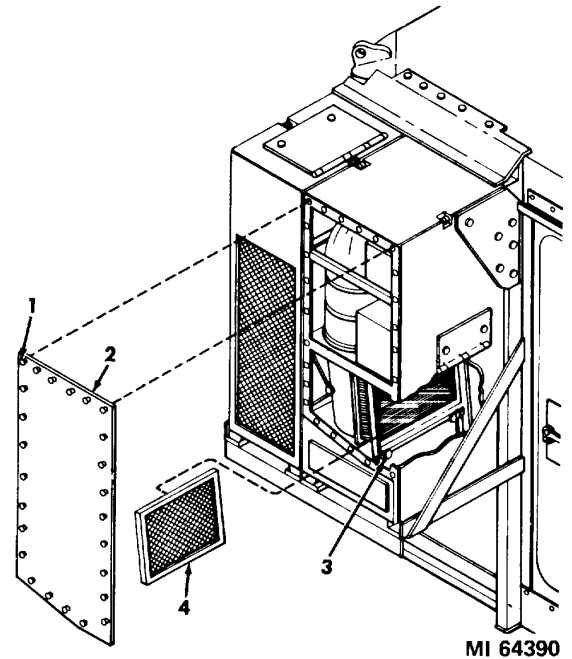
(1) Provide adequate ventilation when using the dry-cleaning solvent.

(2) Wear protective rubber gloves during the cleaning operation, and avoid contact with the eyes.

(3) Immerse the air filter in dry-cleaning solvent (TM 740-1525, table D-1), and wash thoroughly.

(4) Place the filter face down until dry.

(5) Apply a light coat of lubricating oil (TM 740-1525, table D-1) to the filter.



- 1-Turnlock fastener
- 2-Front panel
- 3-Filter clip
- 4-Filter

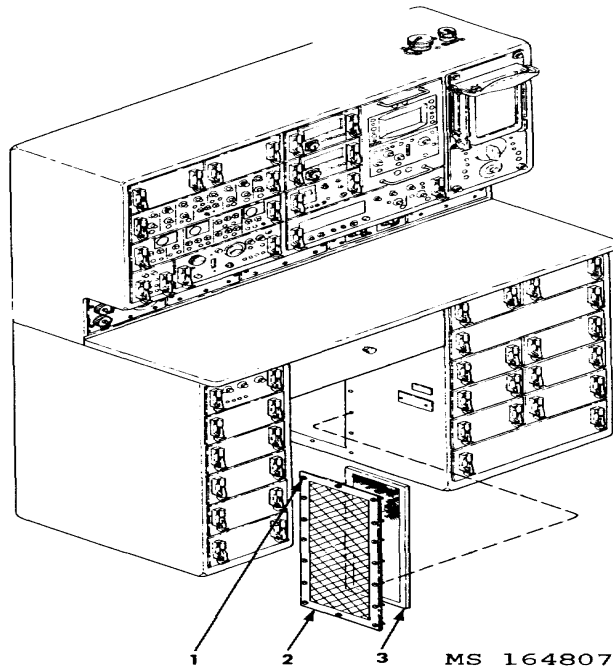
Figure 4-1. Replacement of the air conditioner filter typical.

4-3. Servicing the Radar, Launcher, and High-Frequency Console Air Filter

Clean the air filter as described in paragraph 4-2b above.

NOTE

Refer to figure 4-2 to remove the air filter from the high-frequency console.



d. Fill the cooling system.

- 1-Turnlock fastener
- 2-Grille'- /
- 3-Filter

Figure 4-2. Replacement of the high-frequency console air filter - typical.3

CAUTION

Replace with stainless steel type filters

NOTE

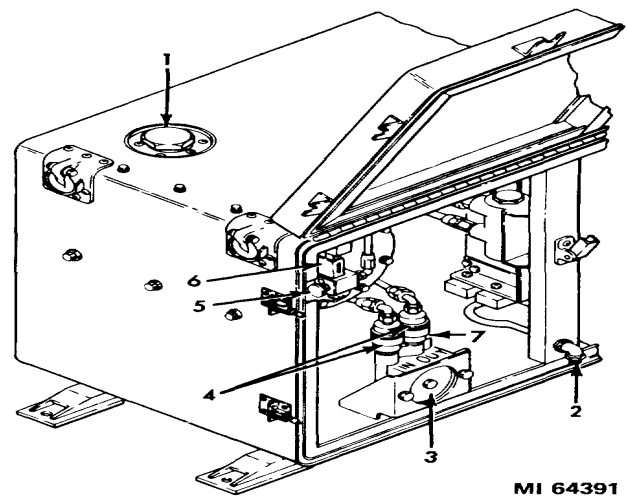
The filter elements must be inspected for damage. If damaged, they must be replaced. Spare elements are contained in filter assembly repair kit 5959133.

NOTE

The filter assembly (3) need not be removed from its mount to clean the filter elements.

b. Clean the filter elements as shown in figure 4-4.

c. Connect the quick-disconnects (4) to the filter assembly (3).



4-4. Servicing the Filter Elements of the Liquid Coolant Filter Assembly

NOTE

The key numbers shown below in parentheses refer to figure 4-3.

a. Disconnect the quick-disconnects (4) from the filter assembly (3).

- 1--Filler cap
- 2-Draincock
- 3-Filter assembly
- 4--Quick-disconnects
- 5-Indicator valve knob
- 6--Sight tube
- 7-Bypass indicator

Figure 4-3. Cooling system filler cap and indicator valve - typical.

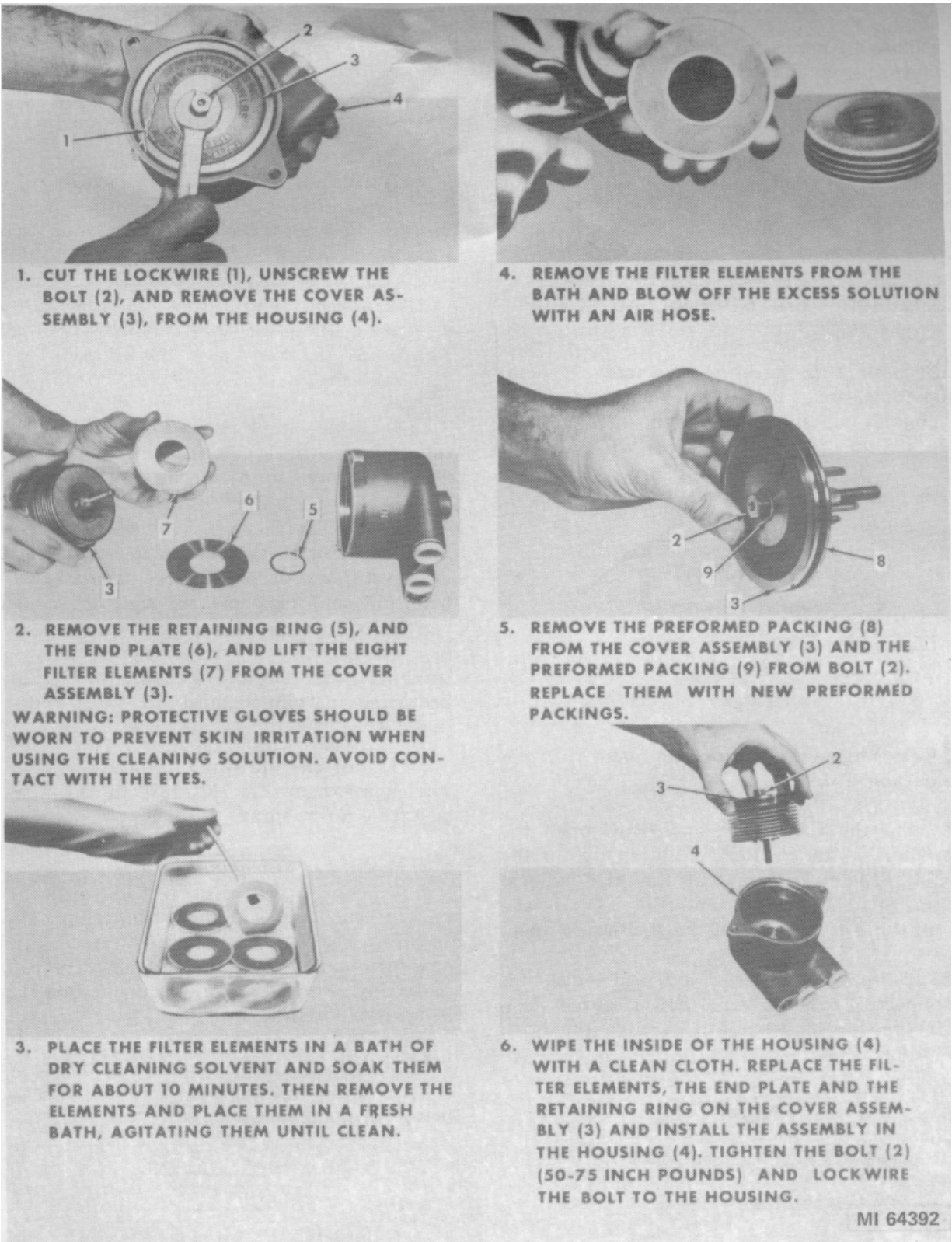


Figure 4-4. Cleaning the filter elements in the liquid coolant filter assembly - typical.



Failure to perform the following four

e. Check for proper coolant flow through the filters while the system is operating by pressing and releasing the bypass indicator (7) and noting that it does not move more than 1/8-inch upward.

4-5. Cleaning Parent Plates and Circuit Card Modules

a. *General.* This paragraph provides a general method for cleaning the parent plates and circuit card modules contained in the major items of the HAWK system.

b. *Preparation.*



Failure to perform step (1) below may cause injury to personnel.

(1) Deenergize the appropriate major item per the applicable *TM*.

(2) For the ICC, PCP, and BCC open the shelter main entrance door. Additionally for the ICC and PCP make sure that the ADP exhaust vent on the shelter roof and the ADP intake vents on the rear and side of the shelter are open. assembly exercising caution to avoid damaging (3) Place a portable electric fan in the shelter and connect it to an external power source. Position the fan to blow air out through the open shelter door.

NOTE

If paint spraying equipment is not available, 12-ounce aerosol containers of 1, 1, 1-trichloroethane (TM 740-1525, table D-1) may be used.

(4) Turn on the electrically driven air compressor for the paint sprayer, and adjust the pressure from 18 to 40 psi maximum.



Failure to perform the following four steps may cause injury to personnel.

(5) Do not smoke in the vicinity of 1, 1, 1-trichloroethane fumes. Hot glowing ash causes breakdown and resultant hazardous gaseous products.

(6) Do not allow 1, 1, 1-trichloroethane to vaporize in the presence of hot surfaces or ignition sources as this can cause the emission of toxic fumes.

(7) Do not allow pockets of 1, 1, 1-trichloroethane fumes to accumulate. Blow-dry the area using the spray gun to blow air only.

(8) Provide adequate ventilation as 1, 1, 1-trichloroethane vapors are anesthetic and can cause stupor, sleepiness, or unawareness. Eye irritation and dizziness are signs of inadequate ventilation. Respiratory protection must be provided in event of spillage in closed spaces. Avoid prolonged or repeated contact with skin. Unprotected personnel must be evacuated immediately.

(9) Fill the spray gun container with 1, 1, 1-trichloroethane (TM 740-1525, table D-1) and adjust it for a fine spray.

c. Parent Plate Cleaning

(1) Gain access to the particular parent plate assembly exercising caution to avoid damaging any surrounding assemblies. If a parent plate can be readily removed to an open work area, it would be advisable to do so.

(2) Place a highly absorbent cellulose wiping towel (TM 740-1525, table D-1) or equivalent, at the bottom of the parent plate to be cleaned.



Failure to perform steps (3) and (4) below may cause equipment damage.

(3) Do not use a brush or wipe areas of the parent plates as this may cause damage to pins or wirewraps.

(4) Keep 1, 1, 1-trichloroethane away from the blower bearings or drawer slides as the lubricant may dissolve.

(5) Spray an even coat of 1, 1, 1-trichloroethane over a small section (about six inches square) of the parent plate allowing each section to become reasonably dry before proceeding. This become reasonably dry before proceeding. This is necessary when working inside a shelter to prevent an excessive concentration of vapors. When working on an unenclosed major item, e.g. the IHIPR, this requirement may be relaxed. Spray the plate from top to bottom.

d. Circuit Card Module Cleaning.



Failure to perform steps (1), (2), and (3) below may cause injury to personnel.

(1) Wear Buna-N rubber gloves, or equivalent, during the cleaning operation.

(2) Avoid contact with the eyes and inhalation of fumes when working with 1, 1, 1-trichloroethane.

(3) Pouring of solvent and cleaning of modules should be performed outside the shelter, or as close to the open shelter door as possible, for optimum ventilation.

(4) Pour 1, 1, 1-trichloroethane into two four gallon, corrosion-resistant, steel buckets (TM 740-1525, table D-1) or equivalent, to a depth sufficient to cover a typical circuit card module. The contents of the first bucket will be used as a cleaning solution while the contents of the second bucket will be used as a rinsing solution.

NOTE

Refer to paragraph 2-6 for removal and installation of typical modules.

(5) Remove the circuit card module from the area being cleaned, such as the DTO No. 1 drawer, noting the manner in which the modules are removed to ensure proper replacement.

(6) Dip the module into the first bucket of 1, 1, 1-trichloroethane.

(7) Brush the module clean using a one-inch soft nylon bristle varnish brush (TM 740-1525, table D-1), or equivalent, being careful to avoid component damage. Immersion time should be limited to about one minute. Remove and examine the module. Reclean, as required, restricting additional immersion time to 30 seconds.



Failure to perform the following step may cause equipment damage.

(8) Do not immerse a circuit card module in the solvent for extended periods of time. If not thoroughly cleaned within a two-minute process time, allow the module to dry for a minimum of three hours, preferably 24 hours, before recleaning.

(9) Immerse the cleaned module in the second bucket and gently agitate it to assure thorough rinsing. Immersion time should be about 30 seconds.

(10) Allow the module to dry on a suitable rack or fixture.

(11) While the module is drying, remove the next module, and perform steps (6) through (10).

(12) Replace the previously dried module and repeat the steps sequentially so that only two modules are removed at one time, the module being dried and the module being cleaned.

(13) When the first bucket containing the initial cleaning solution becomes very dirty, as evidenced by the amount of dirt being carried into the second bucket, safely discard the solution. Rinse the bucket with a small amount of fresh 1, 1, 1-trichloroethane, and discard the solution. Refill the bucket with the proper amount of clean 1, 1, 1-trichloroethane. This bucket now contains the rinse solution while the former second bucket now contains the initial cleaning solution.

4-6. Drawer Slide Cleaning and Lubrication

a. General. This paragraph provides a general method for cleaning and lubricating the drawer slides contained in the major items of the HAWK system.

Materials Required

1, 1, 1	1-gal. can	6810-00-664-0387
Trichloroethane	5-gal. can	6810-00-664-0388
Lubricant,	55-gal. drum	6810-00-551-1487
6431	6-oz. spray can	9150-00-903-
Dry Film		
Brush,	2 1/2 in. round	7290-00-685-3980
	14 1/2 in. long	7290-00-178-8315
Brush, Varnish	2 in. wide	8020-00-889-7918
(or Equivalent)	1 in. wide	8020-00-260-1306

Absorbent material, rubber gloves, protective eye covering and respirators as required.

WARNING

The fumes of trichloroethane are toxic. Refer to the trichloroethane warning located below for handling procedures and corrective actions.

Item (NSN/APN)	Care and handling procedures	Corrective action
Methyl chloroform 1, 1, 1- trichloroethane	Flammable. Avoid heat, sparks, and open flames. Excessive inhalation can cause drowsiness, dizziness, drunkenness, unconsciousness, and death at extreme doses. Avoid prolonged or repeated contact with skin. Wear protective gloves. to 15 minutes. Avoid contact with eyes. Do not wear contact lenses when working with this material. Wear safety goggles. Avoid swallowing. Do not induce vomiting.	Use CO ₂ or dry chemical extinguisher. Remove victim to fresh air. If not breathing, perform artificial respiration. If breathing is difficult, give oxygen. Get medical attention. Wash skin promptly and thoroughly with flowing water or shower for 5 to 15 minutes. Flush eyes promptly with water for 5 to 15 minutes. Get medical attention.

CAUTION

The following procedure must be performed in a dry, dust-free environment.

NOTE

This procedure is not intended to be used on those slides located inside shelters that have filtered air inputs, i.e., the BCC, ICC/PCP and the shops.

b. Preparation.

WARNING

Failure to perform the following five steps may cause injury to personnel.

(1) Deenergize the appropriate major item per the applicable TM.

(2) Do not smoke in the vicinity of 1, 1, 1-trichloroethane fumes. Hot glowing ash causes breakdown and resultant hazardous gaseous products.

(3) Do not allow 1, 1, 1-trichloroethane to vaporize in the presence of hot surfaces or ignition sources as this can cause the emission of toxic fumes.

(4) Do not allow pockets of 1, 1, 1-trichloroethane fumes to accumulate. Blow-dry the area using the spray gun to blow dry air only.

(5) Provide adequate ventilation as 1, 1, 1-trichloroethane vapors are anesthetic and can cause stupor, sleepiness, or unawareness. Eye irritation and dizziness are signs of inadequate ventilation. Respiratory protection must be provided in the event of spillage in closed spaces. Avoid prolonged or repeated contact with skin. Unprotected personnel must be evacuated immediately.

c. Drawer Slides Cleaning and Lubrication.

(1) Remove the drawer from the major item in accordance with the applicable TM's or accepted procedures.

WARNING

The following procedure uses trichloroethane in a confined space. Use gloves, sleeves, aprons, eye protection, and respirators as necessary.

NOTE

On those slide components that are impractical to remove from either the major item or the drawer, follow the same procedure, but do not remove the slide components. Use a paint or varnish brush, or equivalent, and a sufficient amount of trichloroethane to ensure proper cleaning. Use highly absorbent material to ensure proper cleaning. Use highly absorbent material (e.g., a cellulose wiping towel, TM 740-15²⁵, table D-1), or equivalent, to ensure that excessive trichloroethane does not collect inside the major item or drawer.

(2) Remove the slide components of the drawer and major item.

(3) Pour a sufficient amount of 1, 1, 1-trichloroethane (TM 740-1525, table D-1) into the corrosion-resistant metal containers to cover the slide components.

(4) Thoroughly wash the slide components in the first container and rinse in the second container. When the trichloroethane in the first container becomes contaminated, properly discard it. Rinse the container with fresh trichloroethane and refill. Use the new trichloroethane as the rinse and the previous rinse solution as the wash solution.

(5) Ensure that all components are thoroughly dry by either allowing sufficient time for air drying or blow dry using clean dry air.

(6) Spray on a coat of the dry film lubricant, ensuring that all track surfaces are coated. Ensure that all ball or roller bearing surfaces are coated. Allow lubricant to dry per instructions on the dry film lubricant container or until completely dry to the touch.

(7) Reassemble the slide components on the drawer and major item.

(8) Replace the drawer in the major item.

(9) Once this procedure has been performed, further cleaning should be limited to blowing with dry compressed air. If compressed air is not available, clean with a soft brush.

(10) Slides should be cleaned with compressed air or a soft brush: (1) after field movement, (2) after

dust or sand storms, (3) after prolonged non-environmentally controlled storage and (4) whenever abrasive contaminants are visible on slide components.

(11) This procedure should be repeated only when necessary. Inspect slide components at least semiannually. If defective, replace slide. If there is insufficient lubricant or mechanical operation of the slide is difficult, clean and lubricate per this procedure.

4-7. Cleaning Procedure for LED Contacts

a. General This paragraph provides a general method for cleaning light emitting diodes (LED) contacts. This cleaning procedure should be performed whenever a new LED is installed or if an LED flickers.

b. Preparation.

WARNING

Failure to perform the following four steps may cause injury to personnel.

(1) Deenergize the appropriate major item console per the applicable TM.

(2) Do not smoke in the vicinity of 1, 1, 1-trichloroethane fumes. Hot glowing ash causes breakdown and resultant hazardous gaseous products.

(3) Do not allow 1, 1, 1-trichloroethane to vaporize in the presence of hot surfaces as this can cause the emission of toxic fumes.

(4) Provide adequate ventilation as 1, 1, 1-trichloroethane vapors are anesthetic and can cause stupor, sleepiness, or unawareness. Eye irritation and dizziness are signs of inadequate ventilation. Respiratory protection must be provided in event of spillage in closed spaces. Avoid prolonged or repeated contact with skin. Unprotected personnel must be evacuated immediately.

c. Procedure.

CAUTION

Not all indicator holders are interchangeable with indicator receptacles. Failure to use the correct parts may cause damage to either indicator holder or indicator receptacle.

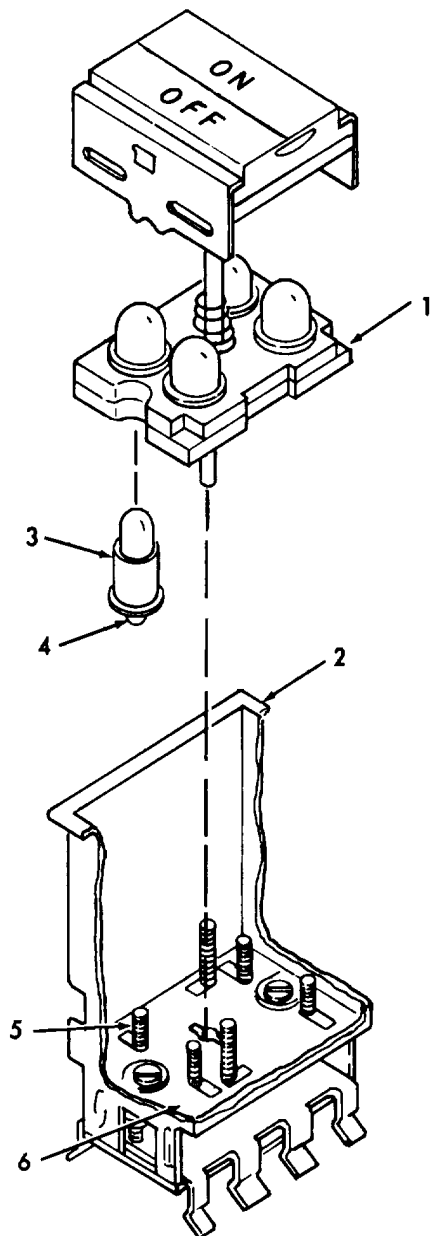


Once the LED contact button (4, fig. 4-5) and LED contact (5, fig. 4-5) are spray cleaned with 1, 1, 1-trichloroethane, prevent contact with your fingers.

NOTE

The key numbers shown below in parentheses refer to figure 4-5.

- (1) Remove indicator holder (1) from the indicator receptacle (2).
- (2) Remove burnt-out or flickering LED(s) (3) from indicator holder.
- (3) Clean the new or flickering LED contact button (4) by stroking it with 600 grit emery cloth eight to 10 times.
- (4) Check the LED contact button for any pointed surfaces. If any pointed surface is found, round off using 600 grit emery cloth.
- (5) Spray clean the LED contact button using 1, 1, 1-trichloroethane (TM 740-1525, table D-1).
- (6) Visually examine LED contacts (5) for evidence of wear. LED contacts that do not have defined contact cup edges must be replaced.
- (7) Spray clean the LED contacts using 1, 1, 1-trichloroethane.
- (8) Visually examine LED contacts for discoloration. LED contacts that are discolored must be cleaned using a contact file.
- (9) Spray clean the LED contact assembly (6) (both top and bottom sides) using 1, 1, 1-trichloroethane.
- (10) Install LED(s) into indicator holder (1).
- (11) Install indicator holder into indicator receptacle.
- (12) Press the appropriate console LAMP TEST indicator-switch to ensure proper operation of LED.
- (13) If LED still flickers, replace LED and perform steps c(1) through (5) and (10) through (12) above.
- (14) If LED still flickers after performing step (13) above, replace LED contact assembly (6).



- 1 – Indicator holder
- 2 – Indicator receptacle
- 3 – LED
- 4 – LED contact button
- 5 – LED contact
- 6 – LED contact assembly

Figure 4-5. Indicator-switch assembly-typical,

CHAPTER 5

HANDLING PROCEDURES FOR ELECTROSTATIC DISCHARGE SENSITIVE ITEMS

5-1. General

a. This chapter provides general instructions on the proper handling of electrostatic discharge sensitive (ESDS) items (modules) used in the HAWK system. Electrostatic discharge (ESD) is the transfer of electrostatic charge between items at different electrostatic potentials, either by direct contact or indirectly via an electronic field. Modules containing ESDS devices can be damaged or destroyed by ESD voltages as low as 20 volts. Materials that are prime generators of electrostatic voltages include common plastics such as polyethylene, vinyls, foam, polyurethane, synthetic textiles, fiberglass, glass, rubber, and numerous other commonly used materials. Sliding, rubbing or separation of these materials may cause them to generate electrostatic voltages of up to 15,000 volts. Personnel can also generate electrostatic charges (up to 30,000 volts) depending on the nature of the ground, the presence of paint or carpets, and the type of clothing and shoes worn.

b. The effects of ESD on electrical and electronic items are not generally recognized because: assembly or system. The power must be off during

(1) Failures due to ESD are often analyzed as removal or installation to prevent transient voltages being caused by electrical overstress due to transients other than static;

(2) Failures caused by ESD are often incorrectly categorized as random, unknown, infant mortality, manufacturing defect, or other, due to improper depth of failure analysis;

(3) Few failure analysis laboratories are equipped with scanning electron microscopes or other equipment and technology required to trace failures to ESD.

5-2. Handling Procedures for ESDS Items

a. The personnel responsible for handling ESDS items must receive training for proper handling.

b. When transporting or storing ESDS items or assemblies containing ESDS items, antistatic bags, antistatic trays, or tote boxes lined with conductive cushioning must be used, and an ESD label must be attached to the outer surface. The paper-

work that accompanies the ESDS item or assembly must stay outside the protective container or be placed inside its own antistatic container. The ESDS item must remain in its protective container until ready for use or inspection. When storing ESDS items, the storage site selected must be well away from sources of electromagnetic and electrostatic fields. Table 5-1 lists materials required for proper handling of ESDS items.

c. All packaging of completed assemblies containing ESDS items must be clearly marked with a cautionary label. The materials used for the cautionary label must neither generate nor store electrostatic charges (refer to table 5-1).

5-3. Test and Installation of ESDS Items

During test and installation of ESDS items, it is important to follow these guidelines.

a. When removing or installing printed wiring assemblies containing ESDS items, antistatic personnel wrist-straps must be grounded to the equipment

b. ESDS item leads or connector terminals should not be probed by multimeters. When a multimeter must be used, touch ground with electrical test equipment probes before probing the ESDS item.

c. Both complete and incomplete assemblies containing ESDS items must be wrapped, covered or bagged with antistatic material and have an ESD label or tag attached whenever they are not being worked on.

Table 5-1. Materials Required for Handling ESDS Items

Item	National Stock Number (NSN)
Personnel wrist strap	5895-01-134--9623
Cushioning (roll)	8135--01-057--3607
Antistatic bags	8105-01-120-3373
Label (MIL-STD-129)	7960-01-077-4894
Label (MIL-STD-129)	7960-01-077-1156

APPENDIX B
EXPENDABLE SUPPLIES AND MATERIALS LIST

B- . Scope

This appendix lists expendable supplies and materials you will need to operate and maintain the HAWK Missile System. These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

B-2. Explanation of Columns

a. Column 1 - National Stock Number. This is the National Stock Number assigned to the item; use it to request or requisition the item.

b. Column 2-- Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the part number followed by the Federal Supply Code for Manufacturer (FSCM) in parentheses, if applicable.

c. Column 3 - Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Expendable Supplies and Materials List

TM 9-1425-525-12-4

(1) National stock number	(2) Description	(3) U/M
8040-00-290-4301	Adhesive, MIL-A-5092 Type II (81349)	qt
8040-00-270-8136	Adhesive, Epoxy, 1 qt, MIL-A-8623 Type 2 (81349)	kt
8040-00-515-2246	Adhesive, MIL-A-5540 Type 2 (81349)	kt
8040-00-664-4318	Adhesive, Syn-ru, Liquid Form, MIL-A-5092 Type 2 (81349)	pt pt
8040-00-543-7170	Adhesive, Syn-ru, Liquid Form, 1 pt cn, MMA189 (81348)	pt
8040-00-721-9091	Adhesive, Syn-ru, Liquid Form, 1 pt cn w/separate catalyst, MIL-A-25457 (81349)	kt
6810-00-205-6786	Alcohol, Denatured Type 111 O-E 760 (81348)	qt
6810-00-286-5435	Alcohol, Isopropyl, Technical, 1 gl cn, TT1735 Grade A (81348)	gl
8020-00-051-7098	Brush, Photo (19139)	ea
8020-00-889-7920	Brush, Varnish, Nylon Bristle, one-inch, .375 in. thick, H-B-695 (81348)	ea
8305-00-965-1654	Cloth, Coated Nylon, OD ru ctd both sides, oil, water, flame, and weather resistant, .007 x 39 x 100 yd rl, MIL-C-20696 (81349)	yd
8305-00-943-0981	Cloth, Satin, MrL-C-20296 (81349)ea	
8030-00-292-1102	Compound, antiseize, Petrolatum Zinc Dust, 8 oz MIL-T-22361 (81349)	tu, oz
5350-00-221-0872	Cloth, Abrasive, Crocus P-C-458 (81348)	sh
8030-00-850-7076	Compound, Coating, Metal Pretreatment, MIL-P-15328 (81349)	kt
8010-00-225-7000	Compound, Coating, MIL-L-3891F1 yel (81349)	qt
8030-00-919-9204	Compound, Coating, 5 oz bt, MIL-S-14735 (18876)	oz
6850-00-174-9672	Compound, Corrosion Removing, 1 gl bt MIL-M-10578 Type 2 (81349)	gl

Expendable Supplies and Materials List - Continued

(1) National stock number	(2) Description	(3) U/M
8030-00-081-2339	Compound, Sealing, Liquid Form, Red, 10 cc bt MIL-S-22473GRA (81349)	cc
8030-00-664-4019	Compound, Sealing, Liquid Syn-ru Base, Red, 1 pt cn, MIL-S-4383 (81349)	pt
8030-00-297-6677	Compound, Sealing, Semi-solid Syn-ru, w/separate catalyst, 24oz base/lqt catalyst, MIL-S-8516-2 Method B (81349)	kt
8030-00-262-9041	Compound, Sealing, Syn-ru, Paste Form, Black, MIL-S-7124 (81349)	kt
8030-00-723-2746	Compound, Sealing, Syn-ru, Paste Form, 1 pt cn base w/jar catalyst, MIL-S-8802CLB2 (81349)	ea
6850-00-927-9461	Compound, Silicone, 5 oz tu, MIL-L-11137 (18876)	oz
7690-00-824-0501	Decal, 9167662 (18876)	ea
6850-00-835-0484	Deicing-Defroster Fluid, 0-D-00190 (81348)	cn
6850-00-856-7955	Desiccant, Activated, MIL-D-3464 (81349)	cn
6850-00-290-0042	Desiccant, Activated, 5 lb cn, MIL-D-3716 Type 4 Grade H (81349)	cn
6850-00-984-5853	Cleaning Compound Solvent, 5 gl cn, MIL-C-81302 (81302)	gl
6850-00-078-4459	Fluid, Heat Transfer, (Coolant Glycol) 5959151 (18876)	gl
9150-00-252-6383	Fluid, Hydraulic, MIL-H-5606 Type 1 (81349)	qt
9620-00-529-9629	Graphite, Dry Lubricant, MIL-G-6711 (81349)	ea
9150-00-269-8255	Grease, Aircraft MIL-G-4343B (81349)	lb
9150-00-080-9652	Grease, Silicone, MIL-L-15719 (81349)	tu
9150-00-190-0905	Grease, Automotive and Artillery, 6.5 lb cn, MIL-G-10924, (81349)	lb

Expendable Supplies and Materials List - Continued

(1) National stock number	(2) Description	(3) U/M
9150-00-985-7246	Grease, Aircraft and Instrument, 1.75 lb MIL-G-23827 (81349)	cn, lb
9150-01-040-1423	Grease, Molykote, 3 oz tu, FS-34512 (71984)	oz
9150-00-753-4588	Grease, Silicone Insulated Electric Motor, G300 (01139)	oz
9150-00-223-4004	Grease, Molybdenum Disulfide, 6.5 cn, MIL-G-21164 (81349)	lb
6850-00-109-4362	Grease, Silicone, MIL-S-13901 (18876)	Pt
7510-00-145-0063	Ink, Black, Liquid, Opaque, Stencil Marking, 1 oz cn, MIL-I-43553 (81349)	oz
7510-00-224-6732	Ink, White, Stencil Marking, TT-I-1795 (81348)	pt
8040-00-078-5073	Kit, Adhesive, Hysol, 80055MG (73168)	kt
8040-01-048-2193	Kit, Compound Hardener, Hysol Kit 6C (04347)	kt
1430-00-983-3894	Kit, Fluid Press, 5957338 (18876)	kt
1430-00-076-1888	Kit, Fluid Filter Repair, 5959133 (18876)	kt
8010-00-166-3152	Lacquer, White, Lusterless, T-T-L-20 (81348)	qt
9150-00-948-6912	Lubricant, Solid Film, MIL-L-46010 (81349)	gl
8030-00-838-7789	Lubricant, Corrosion Preventive, 1 lb cn, MIL-C-23411 (81349)	lb
9150-01-078-9586	Lubricant, Fluorocarbon, 16 oz cn, MIL-L-60326 (81349)	oz
6810-00-275-6010	Methanol, Technical, 5 gl cn, 0-M-232 (81348)	gl
6810-00-292-9676	Methanol, Technical, 0-M-232 (81348)	qt
6810-00-281-2785	Methyl, Ethyl, Ketone, Technical, 1 gl cn, TTM261 (81348)	gl
6810-00-223-9073	Naphtha, Aromatic, 5 gl cn, TTN97 (81348)	gl

Expendable Supplies and Materials List - Continued

(1) National stock number	(2) Description	(3) U/M
9150-00-223-4116	Oil, Gear Lubrication, Mineral Oil, Mineral Base, Antifoam, 5 gl cn, MIL-L-6086 (81349)	gl
9160-00-943-4691	Oil, Insulating, Electrical, OS59 MIL-C-47220 Type 3 (81349)	gl
9150-00-082-5636	Oil, Lubricating, Hydraulic, MIL-S-81087 (81349)	qt
9150-00-223-4129	Oil, Lubricating Instrument, 1 qt cn (OAI), MIL-L-6085 (81349)	qt
9150-00-189-6727	Oil, Lubricating, MIL-L-2104 (81349)	qt
9150-00-782-2627	Oil, Lubrication, Aircraft Turbine Engine, Synthetic 1 qt cn, MIL-L-7808 (81349)	qt
9150-00-263-3490	Oil, Lubrication, General Purpose, Corrosion and Oxidation Resistant, 1 qt cn, MIL-L-7870 (81349)	qt
9150-00-231-6689	Oil, Lubrication, General Purpose, Corrosion and Oxidation Resistant, 1 qt cn, (pl-Special), VVL800 (81348)	qt
9150-00-082-5636	Oil, Silicone Fluid (F50), MIL-S-81087 (81349)	qt
9160-00-237-4777	Oil, Insulating, Electrical, OS45 MIL-C-47220 Type 2 (81349)	gl
5350-00-161-9044	Paper, Abrasive Backing, Closed Coating, 9XII sh, P-P-121 (81348)	ea
6640-00-240-5851	Paper, Lens Cleaning, NNN-P-40 (81348)	hd
9150-00-250-0926	Petrolatum, Technical, 1.75 lb cn, VV-P-236 (81348)	lb
8030-00-656-1032	Preservative, Coating, Rubber, MIL-P-11520 (81349)	gl
8030-00-664-4968	Putty, Zinc Chromate w/Asb Filler, 10 lb cn, MIL-P-8116 (81349)	lb
7920-00-205-1711	Rag, Wiping, Cotton, 50 lb be, DDD-R-30 (81348)	lb
4020-00-618-0261	Rope, Fibrous, 300 ft per re, 9167894 (18876)	ft
4010-00-956-2871	Rope, Wire MIL-C-5424 Size 1-4 (81349)	ft

Expendable Supplies and Materials List - Continued

(1) National stock number	(2) Description	(3) U/M
8040-00-225-4548	R.T.V. 102, 12 oz cn, MIL-A-46106 Type 1 (81349) Sealing and Coating Compound, Corrosion Inhibitive MIL-S-81733, Type I or Type II	oz
3439-00-555-4629	Solder, Tin Alloy, QQ-S-571 or SN60WRP 0.032 1 (81348)	lb lb
6850-00-597-9765	Solvent, Cleaning Compound, Petroleum Base, 1 qt cn, MIL-C-18718 (81349)	gl
6850-00-664-5685	Solvent, Dry Cleaning, P-D-680 (81348)	qt
5350-00-242-4405	Steel Wool, FF-S-740 (81348)	lb
8510-00-817-0295	Talcum Powder, U-T-30 (81349)	cn
9320-00-065-4326	Tape, Adhesive, Rubber, 0.5 in wide, black, 100 ft roll, 10105495-1 (18876)	ft
9320-00-812-4218	Tape, Adhesive, Rubber, Syn, Black lw, Moisture Proof, 9183590 (18876)	ft
5970-00-076-1885	Tape, Insulating, 10066892 (18876)	ea
5970-00-419-4290	Tape, Insulation, Electrical, MIL-I-24391 (81349)	ft
4020-00-656-1125	Tape, Lacing and Tying, Nylon, Fungus Resistant, 500 yd sl, MIL-T-43435 Type 1 FI (81349)	ro
4020-00-789-0802	Tape, Lacing and Tying, MPD1508 (18876)	yd
4020-00-656-1257	Tape, Lacing and Tying, , Plain Weave, FI Braid 250 yd sl, MIL-T-43435 (81349)	yd
7510-00-721-9756	Tape, Pressure Sensitive, Adhesive, Transparent 1-1/2w, 72 yd roll, 9086466 (18876)	yd
8010-00-160-5787	Thinner, Dope and Lacquer, 1 gl cn, TT-T-266 (81348)	gl
8010-00-242-2089	Thinner, Paint, Petroleum Spirits, 1 gl cn TT-T-291 (81348)	gl
8010-00-558-7026	Thinner, Paint, 340 to 485 Deg F Distillation Range, 5 gl cn, TT-T-291 (81348)	gl

Expendable Supplies and Materials List - Continued

(1) National stock number	(2) Description	(3) U/M
8310-00-559-5212	Thread, Nylon, V-T-295 (81348)	yd
6810-00-281-2002	Toluene, Technical, 1 gl cn, TT-T-548 (81348)	gl
6810-00-664-0387	Trichloroethane 1, 1, 1 Technical, (Inhibited) 1 gl cn,	
	0-T-620 (81348)	gl
8010-00-180-6345	Varnish, Oil, MIL-V-173 (81349)	gl
5970-00-076-8988	Varnish, Insulating, Electrical, 9056163 (18876)	ea
8010-00-221-2809	Varnish, Oil, TT-V-109 (81348)	qt
6810-00-297-9540	Water, Distilled, O-B-41 (81348)	gl
8305-00-267-3009	Webbing, Textile, MIL-W-4088 (81349)	yd
9505-00-555-8648	Wire Safety, MS20995C47 (96906)	sl
6810-00-598-6600	Xylene, Technical, 1 gl cn, TT-X-916 (81348)	gl

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**APPENDIX A
REFERENCES**

Refer to TM 9-1425-525-L for a list of other publications pertinent to this material and associated equipment.

By Order of the Secretary of the Army:

JOHN A. WICKHAM, LR.
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Chief of Staff

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